



ANNUAL REPORT 2018-19



अखिल भारतीय जैविक खेती नेटवर्क कार्यक्रम
All India Network Programme on Organic Farming
ICAR-Indian Institute of Farming Systems Research
Modipuram, Meerut - 250110 (U.P.)



ICAR-IIFSR

ICAR Indian Institute of Farming Systems Research (IIFSR) formerly Project Directorate for Farming Systems Research (PDFSR) was established by Indian Council of Agricultural Research New Delhi in April 1989 at Modipuram Meerut Uttar Pradesh.

Vision

Management of natural source of holistic improvement of small and marginal farmers through Integrated Farming Systems

Mission

Improve food, nutrition, livelihood and financial security of small and marginal households through climate smart Integrated Farming Systems (to make marginal and small households as bountiful)

Mandate

- Research in integrated farming Systems on production technologies for improving productivity and resource use efficiencies
- Develop efficient, economically viable and environmentally sustainable integrated farming system models for different farming situations.
- On-farm testing, verification and refinement of system-based farm production technologies.
- Co-ordinate and monitor integrated farming system research in the country

All India Coordinating Coordinated Research Project on Integrated Farming System (AICRP on IFS) is an integral part of ICAR-IIFSR with 74 centres to undertake on-station main (25 nos.) on-station sub (11 nos.) on-station voluntary (6 no's) and on-farm research (32 nos.) spread across length and breadth of the country. The institute is also leading an All-India Network Programme on Organic Farming (AI-NPOF) with 20 centres

Annual Report

2018-19



ALL INDIA NETWORK PROGRAMME ON ORGANIC FARMING

ICAR-Indian Institute of Farming Systems Research

Modipuram, Meerut – 250 110, India



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Compiled & Edited	: Dr. N. Ravisankar, National PI : Dr. Vipin Kumar, CTO (AI-NPOF) : Dr. Gautam Veer Chauhan, RA (AI-NPOF)
Data processing	: Dr. Vipin Kumar, CTO (AI-NPOF) : Dr. Gautam Veer Chauhan, RA (AI-NPOF)
Hindi translation	: Dr. Vipin Kumar, CTO (AI-NPOF)
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Important Notes:

- This compilation is a joint contribution of all the scientists involved in All India Network Programme on Organic Farming (AI-NPOF) at 20 centres including 7 new centres started from 2015-16 and ICAR-IIFSR, Modipuram (report writing, compilation, editing and printing).
- The Annual Report 2018-19 is based on experimental data generated during *kharif*, *rabi* and summer seasons of 2017-18. The other details are relevant up to 31 March 2018.
- The report includes both processed and semi-processed data, generated in different experiments under All India Network Programme on Organic Farming (AI-NPOF) and as such no material/ data should be reproduced in any form without prior written permission of the Director, ICAR-Indian Institute of Farming Systems Research and due credit to the concerned scientist (s).

ACKNOWLEDGEMENT

All India Network Programme on Organic Farming (AI-NPOF) initiated during 2004 having mandate to develop package of practices and technologies for organic production system is currently operating with 20 co-operating centres covering 16 states by involving 11 State Agricultural Universities, 7 ICAR institutes and 1 deemed (special heritage) university. Results of the study, experiments and demonstrations conducted during 2017-18 at 20 co-operating centres are processed, compiled, and published as Annual Report 2018-19. I take this opportunity to record my sincere thanks to **Dr Trilochan Mohapatra**, Secretary, Department of Agricultural Research and Education and Director General, Indian Council of Agricultural Research, New Delhi for his technical guidance and administrative support in shaping the scheme to serve better and meeting the aspirations of policy makers. I extend my gratitude to **Dr. K. Alagusundaram**, DDG (Agricultural Engineering) and then acting Deputy Director General (Natural Resource Management) for his treasured support extended to the scheme. I am also equally thankful to **Dr. S.K. Chaudhari**, Deputy Director General (Natural Resource Management) for his support and mentoring for the scheme to excel in developing technologies and strategies for promotion of organic farming in India. Practical and methodological inputs received from **Dr S. Bhaskar**, Assistant Director General (Agronomy, Agroforestry and Climate Change) for improving the performance and output of the scheme is duly acknowledged. Scientific inputs received from **Quinquennial Review Team (QRT)**, **Research Advisory Committee (RAC)** and **Institute Management Committee (IMC)** is thankfully acknowledged as the issues raised and inputs shared were of immense value in taking new initiatives for applied research and extension.

I am highly thankful to each one of the scientists and research fellows involved in the scheme at 20 centres for setting the painstaking effort to conduct the field experiments, lab analysis and generating data. The sincere efforts put forth by **Dr. N. Ravisankar**, Principal Scientist and National Principal Investigator for overall coordination of technical, administrative and financials of the scheme and super vision of preparing the report. I extend my gratitude and appreciation to **Dr Vipin Kumar**, Chief Technical Officer and **Dr Gautam Veer Chauhan**, Research Associate for their dedicated efforts in compilation of the data, its statistical analysis, report drafting and proof correction. Administrative assistance to the scheme given by **Mrs. Jailata Sharma**, Personal Assistant, Coordination Unit is also duly acknowledged.

The contributions of all the other scientific, technical, administrative, and skilled supporting staff either directly or indirectly at various levels during preparation of this report are duly acknowledged. Findings from the scheme especially organic management packages including weed management, varieties, integrated organic farming systems, geo-tagged characterization and natural farming will lay the foundation for steppingstone for improving the organic production system in the country and promote eco-friendly management practices in farming.

(A.S. Panwar)
Director

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सारांश

अखिल भारतीय जैविक खेती नेटवर्क कार्यक्रम के अंतर्गत वर्ष 2017-18 के दौरान किए गए मुख्य शोध निष्कर्ष नीचे दिये गये हैं।

1. जैविक, रसायनिक और एकीकृत (जैविक की ओर) उत्पादन प्रणालियों का मूल्यांकन

बाजौरा (हिमाचल प्रदेश) में सब्जी आधारित फसल प्रणालियों का मूल्यांकन किया गया जिसमें फूलगोभी, फ्रेंचबीन, उड़द, समर स्कवॉश, भिंडी, और मटर की उपज एकीकृत पैकेज के अन्तर्गत अधिकतम पायी गयी। ग्रीष्मकालीन टमाटर की अधिकतम उपज 11080 किग्रा./हे. भी जैविक प्रबंधन के अंतर्गत 75 प्रतिशत जैविक उर्वरक और 25 प्रतिशत अभिनव प्रयोग (10 प्रतिशत वर्मीवाश) से प्राप्त हुई थी जबकि खरीफ में उगाये जाने वाले टमाटर की अधिकतम उपज 1650 किग्रा./हे. एकीकृत प्रबंधन (75 प्रतिशत जैविक और 25 प्रतिशत रसायन) के अंतर्गत प्राप्त हुई। उड़द (990 किग्रा./हे.), भिंडी (5580 किग्रा./हे.), फूलगोभी (10680 किग्रा./हे.) और मटर (8640 किग्रा./हे.) की अधिकतम उपज एकीकृत प्रबंधन (50 प्रतिशत प्रत्येक जैविक और रसायन) के अन्तर्गत पायी गयी। हालाँकि फ्रेंचबीन और समर स्कवॉश की अधिकतम उपज (क्रमशः 5550 और 15380 किग्रा./हे.) 75 प्रतिशत जैविक और 25 प्रतिशत अजैविक (एकीकृत प्रबंधन) के साथ दर्ज हुई। प्रणाली समतुल्य उपज के संबंध में उड़द-फूलगोभी-समर स्कवॉश में अधिकतम फूलगोभी समतुल्य उपज (22358 किग्रा./हे.) अन्य सभी फसल प्रणालियों की तुलना में दर्ज की। उड़द-फूलगोभी-समर स्कवॉश प्रणाली ने ही सबसे अधिक शुद्ध आय और प्रति रुपये निवेशित आय जैविक प्रबंधन के तहत 75 प्रतिशत जैविक उर्वरक और 25 प्रतिशत अभिनव प्रयोग (10 प्रतिशत वर्मीवाश) के साथ प्राप्त की जो रासायनिक की तुलना में 3 गुणा अधिक थी।

भोपाल (मध्य प्रदेश) में सोयाबीन आधारित फसल प्रणालियों का मूल्यांकन किया गया जिसमें सोयाबीन, गेहूँ, सरसों, चना और अलसी की अधिकतम उपज जैविक प्रबंधन के अंतर्गत पाई गई। सोयाबीन की अधिकतम औसत उपज जैविक प्रबंधन के साथ 1495 किग्रा./हे. दर्ज की गई जो अजैविक प्रबंधन की तुलना में

17.9 प्रतिशत अधिक थी। 100 प्रतिशत जैविक पोषक तत्वों के प्रबंधन के साथ गेहूँ, सरसों, चना और अलसी की अधिकतम उपज क्रमशः 3853, 1654, 1850 और 1587 किग्रा./हे. दर्ज की गई जो रासायनिक की तुलना में क्रमशः 18.1, 10.8, 12.3, और 15.7 प्रतिशत अधिक थी। सोयाबीन समकक्ष उपज के संदर्भ में, उन फसल क्रम क्रमों में से सोयाबीन-चना फसल क्रम ने सबसे अधिक सोयाबीन समतुल्य उपज (4011 किग्रा./हे.) प्राप्त की उसके बाद सोयाबीन-गेहूँ फसल क्रम से 3637 किग्रा./हे. प्राप्त हुई। जैविक प्रबंधन ने जैविक खाद के माध्यम से 100 प्रतिशत पोषक तत्वों की आपूर्ति या जैविक खाद के माध्यम से 75 प्रतिशत पोषक तत्व और 25 प्रतिशत रासायनिक उर्वरक देने पर अधिकतम शुद्ध आय रुपये क्रमशः रुपये 90,671 और 84,558/हे. और प्रति रुपये निवेशित आय (2.01 एवं 1.89) प्राप्त हुई जो रासायनिक की तुलना में 88.8 और 75.9 प्रतिशत अधिक शुद्ध आय थी।

कालीकट (केरल) में अदरक, हल्दी और कालीमिर्च मसालों फसलों का मूल्यांकन अलग-अलग पोषण प्रबंधन के अंतर्गत किया गया जहाँ अदरक और हल्दी की अधिकतम उपज (29642 एवं 34667 किग्रा./हे.) एकीकृत पैकेज 75 प्रतिशत जैविक + 25 प्रतिशत रासायनिक उर्वरक के साथ दर्ज की गई। कालीमिर्च की अधिकतम उपज जैविक खादों के माध्यम से 100 प्रतिशत जैविक खाद के रूप में प्रयोग करने पर पाई गई। एकीकृत प्रबंधन पैकेज (75 प्रतिशत जैविक + 25 प्रतिशत रासायनिक) और जैविक पैकेज के साथ रासायनिक की तुलना में अदरक और हल्दी ने क्रमशः 108.5 और 18.5 तथा क्रमशः 75.3 और 10.1 प्रतिशत अधिक पैदावार दी। जैविक और अकार्बनिक प्रत्येक पोषक तत्व के साथ एकीकृत उत्पादन प्रणाली (जैविक की ओर) के अन्तर्गत अदरक की फसल के लिए सकल आय 104.7 प्रतिशत अधिक पायी गयी। जबकि हल्दी के लिए सकल लाभ 100 प्रतिशत जैविक पोषक तत्वों के साथ उत्पादन में उच्चतम प्राप्त हुआ

कोयम्बटूर (तमिलनाडु) में विभिन्न प्रबंधन पैकेज के बीच, जैविक और एकीकृत पैकेज प्रबंधन (50 प्रतिशत प्रत्येक पोषक तत्व जैविक और रासायनिक) के प्रयोग से मक्का की उपज 17.3 और 3.4 प्रतिशत तक बढ़ गई, जबकि कपास (1675 किग्रा./हे.), मिर्च (5893 किग्रा./हे.) सूरजमुखी (1655

किग्रा./हे.), और चुकंदर (22800 किग्रा./हे.) की उपज एकीकृत प्रबंधन पैकेज (75 प्रतिशत जैविक+25 प्रतिशत रासायनिक) के साथ उच्चतम दर्ज की गयी। फसल प्रणाली चुकंदर- मक्का-हरी खाद रुपये 2,02,920/हे. लाभ की दृष्टि से अधिक लाभदायक पाई गई और यह मिर्च-सूरजमुखी और कपास-मक्का प्रणाली की तुलना में 125.5 और 128.4 प्रतिशत अधिक है।

धारवाड़ (कर्नाटक) में लोबिया, कुसुम, ज्वार, मूंगफली और मक्का जैसी सभी फसलों ने जैविक प्रबंधन के अर्न्तगत या तो 100 प्रतिशत जैविक पोषण प्रबंधन या 75 प्रतिशत जैविक + 25 प्रतिशत अभिनव प्रयोग के साथ उच्चतम उपज प्राप्त की, जबकि मूंग ने एकीकृत प्रबंधन (प्रत्येक जैविक और अकार्बनिक पोषक तत्वों का 50 प्रतिशत) के साथ उच्चतम उपज दी। लोबिया, कुसुम, ज्वार और मूंगफली के लिए रासायनिक की तुलना में उपज में वृद्धि क्रमशः 35.4, 16.4, 38.1 और 23.2 प्रतिशत जैविक के साथ पाई गई। अरहर और कपास की फसलों ने रासायनिक प्रबंधन के अर्न्तगत बेहतर प्रदर्शन किया। फसल प्रणालियों में मूंगफली+संकर कपास (2:1) और मक्का-चना ने अन्य प्रणालियों की तुलना में अधिकतम कपास समतुल्य उपज (क्रमशः 1748 और 1311 किग्रा./हे.) दर्ज की। अकार्बनिक उर्वरकों की अनुपस्थिति मात्रा के प्रयोग से मक्का-चना प्रणाली में शुद्ध उच्च आय (रुपये 38,277/हे.) और लाभ:लागत अनुपात (2.67) दर्ज किया गया, इसके बाद मूंगफली+संकर कपास द्वारा शुद्ध रिटर्न के रूप में रुपये 35,480/हे. जैविक पैकेज के साथ प्राप्त हुआ।

जबलपुर (मध्य प्रदेश) में गेहूँ (दुरम), चना, मक्का (चारा), बरसीम (चारा और बीज), सब्जी मटर और रबी ज्वार के साथ बासमती चावल आधारित फसल प्रणाली का मूल्यांकन 4 फसल अनुक्रमों में किया गया। विभिन्न पोषक तत्वों के प्रबंधन से प्रभावित बासमती चावल और अन्य फसलों की औसत अनाज उपज रासायनिक उत्पादन प्रणाली के साथ अधिक पायी गयी। जो जैविक और एकीकृत पोषक प्रबंधन के साथ क्रमशः 9.8 और 7.0 प्रतिशत बासमती चावल के लिए घटी। जैविक प्रबंधन पैकेज के साथ गेहूँ, चना, मक्का (चारा), बरसीम बीज, सब्जी मटर और ज्वार (चारा) की उपज अकार्बनिक पोषक तत्व प्रबंधन की तुलना में क्रमशः 11.7, 20.4, 10.6, 22.2, 25.6 और 19.1 प्रतिशत कम हुई। विभिन्न उत्पादन प्रणालियों में, बासमती चावल समतुल्य उत्पादकता 100 प्रतिशत रासायनिक पोषक तत्व प्रबंधन

(5901 किग्रा./हे.) के साथ उच्च दर्ज की गई, इसके बाद एकीकृत (5727 किग्रा./हे.) का स्थान रहा। फसल-क्रमों में, चावल-सब्जी-मटर-चारे द्वारा बासमती चावल समतुल्य उच्चतम पैदावार (5785 किग्रा./हे.) दर्ज की गई। शुद्ध लाभ (रु. 1,15,771/हे.) और लाभ लागत अनुपात (2.46) अकार्बनिक प्रबंधन में अधिक था क्योंकि खेती की लागत 25.8 प्रतिशत कम थी, जिसके परिणामस्वरूप जैविक की तुलना में 30.0 प्रतिशत अधिक शुद्ध लाभ हुआ।

कर्जट (महाराष्ट्र) में धान आधारित फसल प्रणालियों में धान की अधिकतम पैदावार (4752 किग्रा./हे.) एकीकृत प्रबंधन के तहत दर्ज की गई जो जैविक प्रबंधन के बराबर पाई गई। चना और प्याज ने भी एकीकृत पैकेज के साथ अच्छी उपज प्राप्त की जो जैविक और अकार्बनिक की तुलना में क्रमशः 5.8 और 15.8 प्रतिशत और 6.1 और 18.2 प्रतिशत अधिक थी। जैविक पैकेज के साथ फील्ड बीन की उपज अधिक दर्ज की गई। अन्य फसलों जैसे बैंगन की उपज अकार्बनिक पैकेज (50155 किग्रा./हे.) के साथ अधिक रही। फसल प्रणालियों में जैविक पैकेज के साथ उगाई गई धान-बैंगन प्रणाली ने अन्य प्रणाली की तुलना में अधिक धान समतुल्य उपज (62967 किग्रा./हे.) दी। जैविक पैकेज के अर्न्तगत धान-बैंगन और धान-प्याज प्रणाली ने क्रमशः रुपये 6,97,934 और 5,03,240/हे. और लाभ लागत अनुपात (3.17 और 3.21) के साथ अधिकतम शुद्ध आय दी।

लुधियाना (पंजाब) में जैविक प्रबंधन में 75 प्रतिशत जैविक खाद + अभिनव प्रयोग के द्वारा बासमती धान-गेहूँ प्रणाली में धान की अधिकतम उपज (4050 किग्रा./हे.) दर्ज की गई। खरीफ में, सोयाबीन ने भी जैविक पैकेज के अर्न्तगत 1580 किग्रा./हे. की उच्च उपज प्राप्त की तथा यह अकार्बनिक पैकेज की तुलना में 26.4 प्रतिशत अधिक थी। ग्रीष्मकालीन मूंग (1300 किग्रा./हे.) ने ऑर्गेनिक पैकेज के साथ 75 प्रतिशत जैविक+इन्नोवेटिव प्रैक्टिस के साथ बेहतर प्रदर्शन किया और रासायनिक की तुलना में 88.4 प्रतिशत का अधिक उत्पादन किया। हालांकि, गेहूँ ने रासायनिक पैकेज के साथ उच्च उपज (6030 किग्रा./हे.) दर्ज की, और यह जैविक प्रबंधन से लगभग 5.31 प्रतिशत अधिक था। प्रबंधन पैकेज के मध्य प्रणाली उत्पादकता के संदर्भ में, गेहूँ के समतुल्य उपज या तो जैविक (100 प्रतिशत) या 75 प्रतिशत जैविक +इन्नोवेटिव प्रैक्टिस के साथ अधिक हुई। फसल प्रणालियों में, गेहूँ समतुल्य उपज ग्वार-गेहूँ-मूंग के बाद बासमती धान-गेहूँ प्रणाली में अधिक थी। बासमती चावल-गेहूँ-हरी खाद

में सबसे अधिक शुद्ध रिटर्न (रुपये 1,47,270/हे.) जैविक पद्धति के अन्तर्गत दर्ज की गयी, जिसमें 75 प्रतिशत जैविक +इन्नोवेटिव प्रैक्टिस को अपनाया गया, जिसने रासायनिक और एकीकृत पैकेज की तुलना में क्रमशः 15.5 और 17 प्रतिशत अधिक शुद्ध आय दर्ज की।

मोदीपुरम (उत्तर प्रदेश) में चावल और मक्का आधारित फसल प्रणाली जैसे कि रबी में गेहूँ, मूंग, जौ, आलू और सरसों और गर्मियों में भिंडी का मूल्यांकन किया गया। जैविक प्रबन्धन के साथ बासमती धान की अधिकतम उपज (4398 किग्रा./हे.) पाई गई जो क्रमशः 32.9 प्रतिशत रासायनिक पोषक तत्व प्रबन्धन की तुलना में अधिक थी, जबकि धान, मक्का (पॉपकॉर्न), जौ, आलू और मूंग में क्रमशः 13.5, 16.9, 13.6, 25 और 27.1 प्रतिशत की कमी जैविक के साथ एकीकृत पैकेज की तुलना में देखी गई। विभिन्न प्रणालियों की उत्पादकता में, मक्का-आलू-भिंडी-हरी खाद ने आलू की अधिकतम उपज और अच्छी कीमत के परिणाम स्वरूप 32499 किग्रा./हे. की धान समतुल्य उपज दर्ज की। फसल प्रणाली में, मक्का (स्वीट कॉर्न)-सरसों-हरी खाद ने एकीकृत पैकेज के साथ अधिकतम आय (रु. 1,35,472/हे.) दर्ज की और यह फसल क्रम सबसे अधिक लाभदायक पाया गया।

पंतनगर (उत्तराखंड) में विभिन्न पोषक तत्व के अन्तर्गत बासमती धान आधारित फसल प्रणालियों का मूल्यांकन किया गया। 100 प्रतिशत जैविक पैकेज के साथ बासमती धान की अधिकतम उपज (4976 किग्रा./हे.) पायी गयी जो क्रमशः 18.1 प्रतिशत रासायनिक प्रबंधन पैकेज की तुलना में अधिक थी। रबी में गेहूँ की अधिकतम उपज (4852 किग्रा./हे.) एकीकृत पोषण प्रबंधन (50 प्रतिशत जैविक और अजैविक) में पायी गयी जो लगभग रासायनिक (4735 किग्रा./हे.) के बराबर थी। धनिया को अन्य फसल जैसे चना एवं मटर के साथ 4:2 के अनुपात में उगाया गया। धनिया की उपज को समतुल्य उपज में परिवर्तित किया गया है जिसके अन्तर्गत चना और मटर समतुल्य उपज क्रमशः 2586 और 9491 किग्रा./हे. जैविक प्रबंधन (100 प्रतिशत जैविक खाद) में अधिकतम पायी गयी जो 9.5 और 16.7 प्रतिशत अजैविक की तुलना में अधिक थी। जैविक प्रबंधन के तहत आलू कंद उपज में उल्लेखनीय अंतर देखा गया और अकार्बनिक की तुलना में उपज में 19.6 प्रतिशत की वृद्धि पाई गई। जैविक प्रबंधन के साथ बासमती चावल समतुल्य उपज (11505 किग्रा./हे.) प्रणाली उत्पादकता के रूप में अधिकतम पाई गई। सभी फसल प्रणालियों में, बासमती चावल- चना +

धनिया-सेसबनिया ने उच्च समकक्ष उपज (13398 किग्रा./हे.) और रुपये 2,25,097/हे. की शुद्ध आय और लाभ लागत अनुपात 3.44 दर्ज की। प्रबंधन पैकेजों में, जैविक खाद के उपयोग द्वारा अधिकतम शुद्ध आय रुपये 2,07,634/हे. प्राप्त हुई। जैविक पैकेज को अपनाने से शुद्ध लाभ रासायनिक और एकीकृत प्रबंधन की तुलना में 55.4 और 44.4 प्रतिशत तक बढ़ गया।

रायपुर (छत्तीसगढ़) में सोयाबीन आधारित फसल प्रणालियों में मक्का, मटर, मिर्च और प्याज का मूल्यांकन किया गया। सोयाबीन की अधिकतम उपज (1790 और 1935 किग्रा./हे.) जैविक प्रबंधन के अन्तर्गत क्रमशः या तो 100 प्रतिशत जैविक खाद या 75 प्रतिशत जैविक + 25 प्रतिशत इन्नोवेटिव प्रैक्टिस (10 प्रतिशत वर्मीवॉस का स्प्रे 20 दिनों के अन्तराल पर) के साथ दर्ज की गई। अजैविक की तुलना में सोयाबीन की उपज में अन्तर क्रमशः 16.3 और 15.9 प्रतिशत जैविक एवं एकीकृत के साथ अधिक पाया गया। अन्य फसले जैसे मक्का (मीठी मक्का), मटर और मिर्च की अधिकतम उपज (14217, 7343 एवं 8613 किग्रा./हे.) भी जैविक प्रबंधन के अन्तर्गत 75 प्रतिशत जैविक+25 प्रतिशत इन्नोवेटिव प्रैक्टिस (10 प्रतिशत वर्मीवॉस का स्प्रे 20 दिनों के अन्तराल पर) जबकि प्याज कंद की अधिकतम उपज (15896 किग्रा./हे.) राज्य सिफारिश उर्वरक प्रबंधन के साथ पाई गई। सोयाबीन के समतुल्य उपज के संदर्भ में फसल प्रणाली की उत्पादकता 75 प्रतिशत जैविक पोषक तत्व इन्नोवेटिव प्रैक्टिस (7201 किग्रा./हे.) के साथ जैविक प्रबंधन के तहत उच्चतम दर्ज की गई और यह रासायनिक की तुलना में 14.9 प्रतिशत अधिक थी। सोयाबीन-मक्का फसल प्रणाली ने उच्च सोयाबीन समकक्ष उपज (7485 किग्रा./हे.) और रु. 2,74,503/हे. की आय भी इसी उत्पादन पैकेज (75 प्रतिशत जैविक+25 प्रतिशत अभिनव प्रयोग वर्मिन-वॉश 10 प्रतिशत का फोलियर स्प्रे) को अपनाने के साथ दर्ज की। इसी प्रकार, उच्चतम लाभ:लागत अनुपात (4.0) भी 75 प्रतिशत ऑर्गेनिक इन्नोवेटिव प्रैक्टिस वर्मीवाष का पर्ण स्प्रे (10 प्रतिशत) और उसके बाद गोमूत्र 10 प्रतिशत, 20 दिनों के अंतराल पर 30 और 50 दिन रोपाई के बाद सोयाबीन-मक्का के साथ में प्राप्त किया गया था।

रांची (झारखंड) में गेहूँ, आलू, अलसी, और मसूर जैसी विभिन्न फसलों के साथ चावल आधारित फसल प्रणालियों का मूल्यांकन किया गया था जिसमें धान की अधिकतम उपज क्रमशः 3359 और 3518 किग्रा./हे. 75 प्रतिशत जैविक+25

प्रतिशत अभिनव प्रयोग (अजोला के साथ वर्मीवाष स्त्रे) के साथ दर्ज की गई थी। आलू और अलसी की फसल ने जैविक पैकेज के साथ अच्छा प्रदर्शन किया जबकि मसूर की उच्च उपज एकीकृत प्रबन्धन के साथ प्राप्त हुई। गेहूँ की अधिकतम उपज 2678 किग्रा./हे. रासायनिक पैकेज के साथ दर्ज की गई थी जो 100 प्रतिशत जैविक और एकीकृत प्रबन्धन के साथ रासायनिक की तुलना में 9.3 और 6.7 प्रतिशत कम थी। फसल प्रणालियों में, धान-आलू ने उच्चतम प्रणाली समतुल्य उपज (8508 किग्रा./हे.) दर्ज की, जबकि धान-अलसी ने सबसे कम 4145 किग्रा./हे. दर्ज की। 75 प्रतिशत जैविक पोषक तत्व+इन्नोवेटिव प्रैक्टिस के साथ रुपये 71,471/हे./वर्ष का शुद्ध आय दर्ज की। फसल प्रणालियों में, धान-आलू ने लाभ:लागत अनुपात (1.87) के साथ अधिकतम शुद्ध लाभ (रु. 57,907/हे.) दिया।

उमियम (मेघालय) में सब्जी आधारित फसल प्रणालियों को उच्चिकृत क्यारी में और चावल की किस्मों को नीची जलमग्न क्यारी (संकन बेड़) में मूल्यांकन किया गया। इसमें ब्रोकली की अधिकतम उपज (15310 किग्रा./हे.) ऊँची क्यारी तकनीक में ब्रोकली-फ्रेंचबीन प्रणाली के साथ दर्ज की गई। उच्चिकृत क्यारी पर रासायनिक की तुलना में ब्रोकली की उपज 13.7 प्रतिशत अधिक दर्ज हुई। उच्चिकृत क्यारी पर अन्य सब्जियों की फसलें, गाजर, आलू, फ्रेंच बीन और टमाटर ने क्रमशः 16210, 16150, 9070 और 18390 किग्रा./हे. की अधिकतम उपज जैविक प्रबन्धन के अन्तर्गत प्राप्त की गई। ब्रोकली- सब्जी आधारित फसल प्रणालियों में से धान समतुल्य उपज (39440 किग्रा./हे.) 100 प्रतिशत जैविक के साथ अधिकतम दर्ज की गई, इसके बाद एकीकृत पैकेज के साथ उपज 38620 किग्रा./हे. थी। नीची जलमग्न क्यारियों में, धान-टमाटर प्रणाली ने 39270 किग्रा./हे. में धान समतुल्य उपज की अधिकतम पैदावार हुई। जबकि धान-गाजर प्रणाली दूसरी सबसे अच्छी प्रणाली रही। अधिकतम शुद्ध लाभ ब्रोकली-टमाटर के बाद ब्रोकली-गाजर में दर्ज किया गया, जैविक के तहत जैविक खाद के माध्यम से 100 प्रतिशत पोषक तत्वों की आपूर्ति या 75 प्रतिशत जैविक+ 25 प्रतिशत इन्नोवेटिव प्रैक्टिस ने अकार्बनिक पर क्रमशः 30.4 और 14.3 प्रतिशत अधिक प्रतिफल दिया। ब्रोकली-फ्रेंचबीन (1.77) फसल प्रणाली में निवेश किए गए प्रति रुपये शुद्ध प्रतिफल के बाद ब्रोकली-गाजर (1.63) का स्थान आता है। नीची जलमग्न क्यारियों में से, 50 प्रतिशत कार्बनिक+50 प्रतिशत अकार्बनिक पोषक तत्वों वाले एकीकृत पैकेज के साथ उच्चतम धान की

उपज (4630 किग्रा./हे.) दर्ज की गई। चावल की किस्मों में, शाहपरंग -1 ने अधिकतम अनाज उपज (4620 किग्रा./हे.) का उत्पादन किया, उसके बाद लम्पना (4440 किग्रा./हे.), मेघा एरोमैटिक 2 (4250 किग्रा./हे.) और नगोबा (4130 किग्रा./हे.) ने उत्पादन किया।

अजमेर (राजस्थान) में मूंग और ग्वारफली के साथ बीज मसालों जैसे धनिया और सौंफ का समावेश कर उसका मूल्यांकन किया गया। एकीकृत पैकेज के तहत 75 प्रतिशत कार्बनिक+25 प्रतिशत अकार्बनिक उर्वरक के एकीकरण के साथ मूंग, ग्वारफली, धनिया और सौंफ का उत्पादन जैविक की दिशा में बेहतर पाया गया। पोषक तत्व प्रबंधन में से, अकार्बनिक की तुलना में मूंग, ग्वारफली, धनिया और सौंफ की उपज क्रमशः 19.3, 19.5, 17.4 और 19.4 प्रतिशत अधिक थी। रुपये 1,56,333 और 1,63,924/हे. का शुद्ध प्रतिफल 100 प्रतिशत अकार्बनिक या राज्य सिफारिश पैकेज के साथ दर्ज किया गया। धनिया और सौंफ के साथ मूंग, उगाना लाभ लागत अनुपात (3.63 और 3.09) की दृष्टि से अधिक लाभदायक पाया गया।

अल्मोड़ा (उत्तराखंड) में बारानी प्रणाली के तहत बाजरा+काली सोयाबीन (2:1 अनुपात-पंक्ति का प्रतिस्थापन)-गेहूँ+तोरिया (2:1 अनुपात) और चौलाई-गेहूँ+मसूर (2:1 अनुपात) के लिए विभिन्न पोषक स्रोतों का मूल्यांकन किया गया। फसल प्रबंधन प्रणालियों में, जैविक खाद के माध्यम से फसल की 100 प्रतिशत नत्रजन की आपूर्ति से गेहूँ समतुल्य उपज क्रमशः 3535 और 8306 किग्रा./हे. बाजरा+काली सोयाबीन-गेहूँ+तोरिया और चौलाई-गेहूँ+मसूर में अधिकतम पाई गई। दोनों प्रणालियों में रासायनिक की तुलना में जैविक के साथ क्रमशः 68.0 और 100.7 प्रतिशत ज्यादा गेहूँ समतुल्य अनाज की उपज प्राप्त हुई।

गंगटोक (सिक्किम) में मक्का और अंतर फसल जैसे अदरक, हल्दी, सोयाबीन और अरहर ने जैविक प्रबंधन पैकेज के अंतर्गत अधिकतम पैदावार दी इसी तरह फ्रेंच-बीन कुटू और राजमा ने भी जैविक पैकेज के तहत 100 प्रतिशत नत्रजन जैविक स्रोतों से देने पर जिसमें 25% खाद+25% केंचुए की खाद+25% नीम केक+25% सरसों की खली है उल्लेखनीय रूप से उच्च उपज दर्ज की। सोयाबीन की मक्का समतुल्य उपज, मक्का+अदरक (1:1)-फ्रेंच बीन (15000 किग्रा./हे.) के बाद मक्का+हल्दी (1:1)-राजमा (10700 किग्रा./हे.) ने जैविक उत्पादन पैकेज के साथ 100% नत्रजन जैविक

स्रोत्रो के साथ अधिकतम शुद्ध प्रतिफल ($\text{₹ } 266.7 \times 10^3 / \text{हे.}$) और लाभ लागत अनुपात (3.69) के रूप में मिला। फसल प्रणालियों में, मक्का+अदरक (1:1)–फ्रेंच बीन ($275.5 \times 10^3 / \text{हे.}$) ने उच्चतम शुद्ध प्रतिफल दिया।

नरेन्द्रपुर (पश्चिम बंगाल) में बासमती धान और मोटा धान ने जैविक पोषक तत्व प्रबंधन के अर्न्तगत अधिकतम उपज (क्रमशः 2719 और 6021 किग्रा./हे.) दर्ज की। अकार्बनिक पोषक पैकेज की तुलना में बासमती धान और मोटा धान की उपज में अंतर 17.1 और 10.6 प्रतिशत पाया गया। रबी के दौरान अन्य फसलों जैसे ब्रोकोली, सरसों, शिमला मिर्च और फ्रेंचबीन की पैदावार रासायनिक की तुलना में जैविक के साथ क्रमशः 21.7, 14.5, 26.5 और 8.0 प्रतिशत अधिक रही। इसी तरह, तिल और हरे चने ने भी जैविक में अधिकतम उपज दर्ज की और क्रमशः 8.0 और 10.9 प्रतिशत अधिक उपज दी। फसल प्रणाली धान–फ्रेंचबीन–तिल ने अन्य फसल प्रणालियों की तुलना में 2 गुना अधिक पैदावार दी।

सरदार कुशीनगर (गुजरात) में गेहूँ और सौंफ ने विभिन्न पोषक तत्व प्रबंधन पैकेज के बीच में राज्य संस्तुति पैकेज के अर्न्तगत क्रमशः 4765 और 1828 किग्रा./हे. की उच्च उपज दर्ज की। जबकि मूंगफली, मूंग और लोबिया की अधिकतम उपज क्रमशः 1944, 718 और 5833 किग्रा./हे. एकीकृत पैकेज (50 प्रतिशत जैविक + 50 प्रतिशत रासायनिक) द्वारा दर्ज की गई। मूंगफली के समतुल्य उपज एकीकृत पैकेज में (50 प्रतिशत प्रत्येक कार्बनिक+अकार्बनिक आगत) में अधिकतम पायी गई। फसल प्रणालियों में, मूंग–जीरा–सब्जी लोबिया ने उच्चतम मूंगफली समकक्ष उपज (15283 किलो/हे.), शुद्ध प्रतिफल रुपये 1,43,418/हे. और निवेशित प्रति रुपये शुद्ध लाभ (1.46) दर्ज की।

तिरुवनंतपुरम (केरल) में दो कन्द फसलों जैसे कसावा और अरबी के साथ लोबिया, मूंगफली, उड़द और मूंग का फसल प्रणाली के रूप मूल्यांकन किया गया। कसावा के कंद की उपज 100 प्रतिशत रासायनिक में अधिक थी, उसके बाद एकीकृत में पाई गई। जबकि अरबी की उपज 100 प्रतिशत जैविक के साथ अधिक थी। कसावा की उपज में भिन्नता रासायनिक से जैविक में 24.9 प्रतिशत रही। हालांकि, अरबी में यह रासायनिक की तुलना में जैविक के साथ 367 प्रतिशत अधिक थी। लोबिया और मूंग की उपज 1540 और 453 किग्रा./हे. जैविक में अधिक थी, जबकि एकीकृत पैकेज में मूंगफली और उड़द की पैदावार 1091 और 710 किग्रा./

हे. अधिकतम पाई गई। कसावा–मूंगफली फसल प्रणाली ने रु. 5,71,362/हे. और निवेशित प्रति रुपये शुद्ध लाभ (3.52) रासायनिक पैकेज के अर्न्तगत अधिकतम दिया।

उदयपुर (राजस्थान) में मक्का और उसमें अन्तः फसल उड़द की अधिकतम उपज (3121 किग्रा./हे.मक्का समतुल्य उपज) एकीकृत पैकेज (75 प्रतिशत जैविक+25 प्रतिशत रासायनिक) में पायी गयी। जबकि मीठी मक्का और अन्त फसल उड़द में अधिकतम उपज (8671 किग्रा./हे.मक्का समतुल्य उपज) रासायनिक प्रबंधन के साथ दर्ज की गई। अकेले उड़द की अधिकतम उपज (421 किग्रा./हे.), सोयाबीन (642 किग्रा./हे.) और गेहूँ (ड्यूम 4286 किग्रा./हे. एस्टीवम 3714 किग्रा./हे.) या तो रासायनिक अथवा या राज्य संस्तुति पैकेज में अधिकतम दर्ज की गई। सोयाबीन (27.3 प्रतिशत), उड़द (18.8 प्रतिशत), गेहूँ (30.0 और 21.1 ड्यूम और एस्टीवम) और चना (30.6 प्रतिशत) की पैदावार रासायनिक के साथ जैविक की तुलना में अधिक पाई गई। रासायनिक की तुलना में सौंफ ने लगभग 4 प्रतिशत अधिक पैदावार जैविक पैकेज दी। मक्का+उड़द (2:2)–गेहूँ (ड्यूम)–सेसबनिया (जीएम) फसल प्रणाली ने अधिकतम मक्का समकक्ष उपज 79583 किग्रा./हे. दी। परन्तु इस प्रणाली द्वारा अधिकतम शुद्ध आय रुपये 1,73,359/हे. राज्य संस्तुति पैकेज के साथ दी। इसके बाद 100 प्रतिशत रासायनिक पैकेज ने रुपये 1,73,236/हे. की शुद्ध आय दी।

2. जैविक खेती के लिए प्रमुख फसलों की विभिन्न किस्मों का मूल्यांकन

बजौरा (हिमाचल प्रदेश) में भिड़ी की विभिन्न किस्मों का मूल्यांकन किया गया उनमें से भिड़ी की किस्म चमेली–015 ने उल्लेखनीय रूप से उच्च उपज 5620 किग्रा./हे., शुद्ध प्रतिफल रुपये 61,097 और लाभ लागत अनुपात 0.77 दर्ज किया इसके बाद इन्द्रानिल की पैदावार रही। मटर की किस्म टेनप्लस और निराली ने सबसे ज्यादा पैदावार क्रमशः 9810 और 9120 किग्रा./हे., शुद्ध प्रतिफल रुपये 1,72,271 और 1,55,047 दर्ज की। फूलगोभी की विभिन्न किस्मों में से यूएस –178 और चंद्रमुखी ने क्रमशः 11830 और 11360 किग्रा./हे. की उपज के साथ शुद्ध प्रतिफल रुपये 1,94,910 और 1,79,819 तथा लाभ लागत अनुपात क्रमशः 1.736 दर्ज किया। गर्मियों के दौरान टमाटर की किस्मों में उल्लेखनीय रूप से क्रमशः अधिकतम फल आकार (30.1 वर्गसेमी), फलों की संख्या/पौधा (42.6 वर्गसेमी) और उपज 13,350 किग्रा./

हे. किस्म आरके-123 ने दर्ज की जबकि मारग्लोब ने सबसे कम उपज 3350 किग्रा./हे. की पैदावार दी।

भोपाल (मध्य प्रदेश) में सोयाबीन-गेहूं और मक्का-चना प्रणाली में फसलों की विभिन्न किस्मों का मूल्यांकन किया गया यद्यपि सोयाबीन की किस्म जेएस-97-52 सबसे लम्बी (54.3 सेंटीमीटर) थी, लेकिन आरवीएस-2002-4 के साथ जेएस-97-52 ने सबसे अधिक फली/पौधे (49.9, 49.3) और बीजों की संख्या/फली (3.3) के कारण अधिकतम पैदावार 1890 एवम 1777 किग्रा./हे. दी। सोयाबीन की किस्म NRC-37 में सबसे कम उपज (1320 किग्रा./हे.) दर्ज की गई। मक्का की किस्मों में, कंचन और प्रोएग्रो 4212 ने 3920 एवम 3880 किग्रा./हे.) उपज के साथ सबसे अच्छा प्रदर्शन किया। गेहूं की किस्मों में, GW-366 ने स्पाइक्स/मीटर/पंक्ति लंबाई (101.0), बीज/स्पाइक (77.4) की संख्या के साथ-साथ उच्चतम अनाज, जैविक उपज 4167 और 8847 किग्रा./हे.) और फसल सूचकांक (47.0) की उसके बाद HI-8498 का स्थान रहा। काबुली चने की किस्म, जेजी 130 में उल्लेखनीय रूप से अधिक बीज/फली (2.0) और फली/पौधे (99.1) के अनुरूप सबसे अधिक उपज (1962 किग्रा./हे.) दर्ज की गई, इसके बाद जेजी-63 का का स्थान रहा जिसने 1880 किग्रा./हे. की पैदावार दर्ज की।

कालीकट (केरल) में जैविक और अजैविक स्थिति में अदरक और हल्दी की किस्मों का मूल्यांकन किया गया। अदरक की किस्म राजेथा ने अधिकतम प्रकंद उपज (26200 किग्रा./हे.) दर्ज की, जो महिमा से केवल 200 किग्रा. और वर्दा से 600 किग्रा. अधिक थी। हल्दी की किस्मों में, प्रगति (48600 किग्रा./हे.) द्वारा अधिकतम उपज दर्ज की गई, इसके बाद सुदर्शन (44000 किग्रा./हे.) का स्थान रहा। हल्दी की गुणवत्ता के संदर्भ में, प्रभा ने हल्दी की किस्मों में से अधिकतम ओलिओरेसिन और करक्यूमिन सामग्री 17.1 और 6.46: दर्ज की।

कोयम्बटूर (तमिलनाडु) में जीरागा सांबा में सबसे कम प्रति हजार दानों का वजन (12.4 ग्राम) देखा गया, जबकि सबसे अधिक वजन (21.1 ग्राम) मापिल्लई सांबा द्वारा उत्पादन किया गया। सभी किस्मों के बीच से अनाज की उपज में अंतर 2660 से 5770 किग्रा./हे. के बीच रहा और किस्म मपिल्लई सांबा ने सबसे कम अनाज उपज (2660 किग्रा./हे.) जबकि सीओ (आर) 48 में अधिकतम अनाज उपज (5770 किग्रा./हे.) दर्ज की।

धारवाड़ (कर्नाटक) में चने की किस्मों में, ए1 ने अधिकतम 2857 किग्रा./हे. की उपज दर्ज की, इसके बाद जाकी 9218 पैदावार (2843 किग्रा./हे.) रही। गेहूं की किस्मों में से बीजागा पीली सबसे लम्बी (49.4 सेमी) किस्म पाई गई। 1000-दानों दानों का वजन (44.0 ग्राम) डीडब्ल्यूआर 2006 में पाया गया, हालांकि, गेहूं की उच्चतम अनाज उपज (1945 किग्रा./हे.) किस्म यूएसएस 347 (बीडब्ल्यू) के साथ दर्ज की गयी, जो सबसे कम उपज देने वाली किस्म एनआईएडब्ल्यू 1415 (1215 किग्रा./हे.) की तुलना में 60.1: अधिक उपज थी।

जबलपुर (मध्य प्रदेश) में मूल्यांकन की गई सभी किस्मों में से पीएस-3 और आईआर-36 अग्रणी किस्म रही। अधिकतम पौधे की लम्बाई (75.1 सेमी), किल्ले/गुछा (13.2 संख्या), बाली की लंबाई (26.1 सेमी), दाने/बाली (68.7) अधिक होने के कारण पीएस-3 धान की किस्म में उच्चतम अनाज उपज (4277 किग्रा./हे.) दी। आईआर -36 की उपज 4040 किग्रा./हे. के साथ दूसरा स्थान रही। गेहूं की किस्मों में, HI-1500 ने 3885 किग्रा./हे. अधिकतम उपज दर्ज की जो सांख्यिकीय रूप से HI-1418 (3689 किग्रा./हे.) और सी-306 (3554 किग्रा./हे.) के बराबर पायी गयी। धान समतुल्य उपज, शुद्ध प्रतिफल (रु./हे./वर्ष) और लाभ लागत अनुपात क्रमशः 8404 किग्रा./हे., रु. 1,04,083/हे. और 1.98 धान (पीएस-3)-गेहूं (एचआई-1500) के साथ अधिकतम पाया गया। दूसरे स्थान धान (आईआर-36)-गेहूं (सी-306) प्रणाली का रहा जिसने 8060 किग्रा./हे. की पैदावार दी और रु 95,479/हे./वर्ष का शुद्ध प्रतिफल और 1.90 का लाभ लागत अनुपात दिया।

कर्जत (महाराष्ट्र) में चावल की किस्मों को चार श्रेणियों में बांटा गया है, चावल की किस्म सह्याद्री-4 (जल्दी परिपक्व होने वाली), सह्याद्री-3 (मध्य-देर से पकने वाली), सह्याद्री-5 (देर से पकने वाली) और जया जो किसानों के बीच लोकप्रिय है, ने क्रमशः 6522, 6711, 6766 और 6039 किग्रा./हे. अधिकतम उपज दर्ज की। लेकिन ये बाकी किस्मों की तुलना में सांख्यिकीय रूप से एक दूसरे के बराबर हैं। कर्जत-4 ने चावल की किस्मों में सबसे कम उपज (3938 किग्रा./हे.) दर्ज की। मूंगफली की किस्मों में टीजी-26 के बाद कोंकण गौरव ने अधिकतम उपज 3247 और 3095 किग्रा./हे. दर्ज की।

लुधियाना (पंजाब) में बासमती धान की विभिन्न किस्मों में, पंजाब बासमती-4 ने सबसे अधिक अनाज की उपज (5130 किग्रा./हे.) की उसके बाद आरवाईटी-3677 (5090 किग्रा./

हे.) की पैदावार रही। गेहूं की किस्मों में, PBW-1-Zn में गेहूं की सबसे अधिक अनाज उपज (5920 किग्रा./हे.) देखी गई। उन्नत पीबीडब्ल्यू-550, 5550 किग्रा./हे. की उपज के साथ दूसरी गेहूं की सबसे अच्छी किस्म रही।

मोदीपुरम (उत्तर प्रदेश) में मक्का की विभिन्न किस्मों के बीच में विवेक क्यूपीएम-9 में मक्का की उपज (15000 किग्रा./हे.) सबसे अधिक थी, उसके बाद पीएमएच-1 की उपज (14000 किग्रा./हे.) रही। विवेक क्यूपीएम-9 ने अधिकतम सकल आय, शुद्ध आय और लाभ लागत अनुपात क्रमशः रुपये 1,50,000, 1,08,575/हे. और 2.62 प्राप्त किया। इसके बाद, पीएमएच-1 रही जिसने रुपये 98575/हे. का शुद्ध रिटर्न और लाभ लागत अनुपात 2.38 दिया। सरसों की किस्मों में, आरजीएन-48 ने उल्लेखनीय रूप से 1775 किलो/हे. की उच्चतम बीज उपज दर्ज की थी और यह सांख्यिकीय रूप से उर्वर्षी (1773 किलो/हे.) के बराबर थी। अधिकतम सकल आय, शुद्ध आय और लाभ:लागत अनुपात भी आरजीएन-48 में क्रमशः रुपये 71,000, 52,124/हे. और 2.76 दर्ज किया गया। इसके बाद उर्वर्षी ने रुपये 52,057 का शुद्ध रिटर्न और 2.76 लाभ:लागत अनुपात दर्ज किया।

पंतनगर (उत्तराखंड) में खरीफ के दौरान धान की किस्मों में से किस्म पंत सुगंध धान-17 में उल्लेखनीय रूप से सबसे अधिक उपज (4141 किग्रा./हे.) देखी गई, इसके बाद पंत बासमती-1 4136 किग्रा./हे., पंत सुगंधा-27 एवं 21 के उपज क्रमशः 4115 एवं 4108 किग्रा./हे. रही। गेहूं की विभिन्न किस्मों में अनाज उपज 3358 से लेकर 4040 किग्रा./हे. तक दर्ज की गई। उच्चतम अनाज उपज किस्म एचडी-2967 (4040 किग्रा./हे.) में देखी गई, जिसके बाद यूपी-2565 और यूपी-2684 (किग्रा./हे. 3990 और 3964 किग्रा./हे.) का स्थान रहा।

रायपुर (छत्तीसगढ़) में धान की अन्य सभी किस्मों के मुकाबले सुगंधित धान की उच्चतम अनाज उपज सीआर सुगंधा धान-907 (4603 किग्रा./हे.) में दर्ज की गई, इसके बाद सी. जी. सुगंध भोग (4389 किग्रा./हे.) पाई गई जो बाकी किस्मों की तुलना में काफी बेहतर थी। ये दो किस्में कद में छोटी हैं। लंबे कद वाली छोटे अनाज की सुगंधित किस्मों के से, विष्णुभोगेमस - 01 ने उच्चतम उपज (4080 किग्रा./हे.) दी, उसके बाद गोपाल भोग (4023 किग्रा./हे.) रही परंतु ये दोनों किस्में सांख्यिकीय रूप से सुगंधमती (3983 किग्रा./हे.) के बराबर थीं। चने की किस्मों में से उच्च उपज जेजी-130 (1711 किग्रा./हे.) से प्राप्त की गई, जो सांख्यिकीय रूप

से वैभव और आरजी 2009-16 (क्रमशः 1689 और 1622 किग्रा./हे.) के बराबर थी। फसल सूचकांक सबसे अधिक जेजी-14 (46.95) में रहा, इसके बाद वैभव (46.58) थी। चने की किस्म जेजी-130 में की शुद्ध आय और लाभ लागत अनुपात (रु.71,111/हे. 2.83) अधिकतम पाया गया, इसके बाद वैभव (रु 69,733/हे. और 2.78) और आरजी 2009-16 (66,222/हे. और 2.64) का स्थान रहा।

रांची (झारखंड) में धान और गेहूं की 12 किस्मों का मूल्यांकन एक समान पोषक तत्वों के स्रोतों के साथ में जैविक खेती में उनकी उपयुक्तता के लिए किया गया था। धान की किस्मों में एम.टी.यू-1010 (4022 किग्रा./हे.) ने सबसे अधिक उपज दी जबकि उपज के मामले में लालत और बासमती (क्रमशः 3884 और 3644 किग्रा./हे.) एमटीयू-1010 के बराबर पायी गयी। गेहूं की किस्मों में, K-0307 ने किल्ले प्रति वर्ग मी (336.7), बाली की लंबाई (9.2 सेमी), दाने/बाली (34.6) और अनाज उपज 3158 किग्रा./हे. अधिकतम दर्ज की, जो राज 4229 (3022 किग्रा./हे.), डीबीडब्ल्यू 39 (2889 किग्रा./हे.) के सांख्यिकीय रूप से बराबर थी। गेहूं की किस्मों में, अन्य किस्मों की तुलना में K-0307 ने अधिकतम शुद्ध आय (रुपये 23035 किग्रा./हे.) और लाभरु लागत अनुपात (0.58) प्राप्त किया, लेकिन किस्म राज-4229 (रुपये 22246/हे.), और GW-366 (रुपये 19826/हे.) भी लगभग बराबर रही। चावल-गेहूं फसल अनुक्रम के संदर्भ में, धान (एमटीयू 1010) और गेहूं (डब्ल्यूआर-544) ने उच्चतम शुद्ध आय (रुपये 68317/हे.) और लाभ लागत अनुपात (0.88) दिया।

उमियम (मेघालय) में तीन प्रमुख फसलें मक्का फ्रेंचबीन और टमाटर की विभिन्न किस्मों का मूल्यांकन किया गया। विभिन्न किस्मों के बीच में अधिकतम भुट्टे की लंबाई, भुट्टे का वजन, हरे भुट्टे की उपज और दानों की पैदावार क्रमशः 14.7 सेंटीमीटर, 231.5 ग्राम, 6200 और 3700 किग्रा./हे. डीए-16ए में पाई गई जो आरसीएम-75 (14.4 सेंटीमीटर, 226.9 ग्राम, 5900 और 3700 किग्रा./हे.) और आरसीएम-13 (13.1 सेंटीमीटर, 216.6 ग्राम, 5800 और 3600 किग्रा./हे.) के सांख्यिकीय रूप से बराबर थी। टमाटर की किस्म एमटी-2 ने 20500 किग्रा./हे. की दर से सबसे अधिक उपज दर्ज की इसके बाद किस्म ओ-17 एवं एमटी-11गएमटी-2 (20330 और 18770 किग्रा./हे.) की उपज रही। किस्म एमटी-2 में सबसे कम फल बेधक सक्रमण 7.1 प्रतिशत पाया गया। मूल्यांकन की गई फ्रेंचबीन की किस्मों में, नागा लोकल ने हरी फली और बीज उपज (क्रमशः 9000 और 4400 किग्रा./

हे.) के साथ जैविक उत्पादन की उपयुक्तता के लिए सर्वोत्तम किस्म का प्रदर्शन किया, उसके बाद आरसीएम-एफबी-18 ने हरी फली और बीज उपज (क्रमशः 8300 और 3900 किग्रा/हे.) दर्ज की।

अजमेर (राजस्थान) में मूंग और ग्वारफली की अलग-अलग किस्मों का बीज मसाले वाली फसलों धनिया और सौंफ सहित मूल्यांकन किया गया। मूंग की किस्म मम-2 ने पौधे की ऊँचाई (60.3 सेमी), प्राथमिक शाखाओं की संख्या (4.53), गांठ प्रति पौधा (28.7), बीज की संख्या/फली (11.2) और बीज उपज (983.5) ने सबसे अच्छा प्रदर्शन किया। इसके बाद आरएमजी-975 की उपज 937 किलो/हे. रही। ग्वारफली की किस्म आरजीसी-1038 ने प्राथमिक शाखाएं (7.7), फली/पौधे (64), बीजों की संख्या/फली (8.67) और अधिकतम बीज उपज (1250 किग्रा./हे.) दर्ज की इसके बाद आरजीसी-1055 की पैदावार 1063 किलो/हे. पायी गई। धनिया कि किस्मों में से आजाद धनिया-1 ने बेहतर प्रदर्शन किया तथा प्राथमिक और माध्यमिक शाखाओं (7.3 और 25.3), पुष्पछत्र/पौधा (43.2), छत्रक की संख्या (6.1) और बीज की उपज (1653 किग्रा./हे.) पाई गई के बाद एसीआर-1 में उपज 1619 किलो/हे. दर्ज की। सौंफ की किस्मों में से, प्राथमिक शाखाएं (12.7), द्वितीयशाखाएं/पौधे (22.5), पुष्पछत्र की संख्या/पौधा (42.1), छत्रक की संख्या/पौधा (26.8) और बीज की उपज (6500 किग्रा/हे) किस्म जीएफ-2 में अधिकतम पाई गई, उसके बाद एएफ-1, आरएफ-125 ने क्रमशः 3218 और 3190 किलो/हे. की पैदावार दी।

गैगाटक (सिक्किम) में मक्का की किस्म विवेक संकुल-35 ने अनाज की अधिकतम उपज (2890 किग्रा/हे.), शुद्ध आय (रु. 72900/हे.) और निवेशित प्रति रुपये आय (2.71) के साथ बेहतर प्रदर्शन किया, जो आरसीएम-75 और विवेक संकुल-31 के बराबर सांख्यिकीय रूप से बराबर रही। कुट्ट की किस्मों में, आईसी 109433 सबसे अधिक उपज वाली किस्म (2610 किग्रा/हे.) रही, इसके बाद लोकल मीथे और आईसी 109729 में 2500 और 2390 किग्रा/हे. की उपज रही। सकल प्रतिफल, शुद्ध प्रतिफल और निवेशित प्रति रुपये प्रतिफल, उत्पादन क्षमता, लाभप्रदता और भूमि उपयोग दक्षता भी आईसी 109433 में अधिक थी।

सरदार क्रुशीनगर (गुजरात) में शाखाओं/पौधों, उपज (2052 किग्रा/हे.), शुद्ध आय (रुपये 75,048/हे.) और लाभ लागत अनुपात (2.02) मूंगफली की किस्म जीजी -20 (एसएस) के

साथ अधिकतम रही, इसके बाद जीआईजे -17 (एस) रही परन्तु ये दोनों सांख्यिकीय रूप से एक दूसरे के बराबर पाई गई। गेहूँ की अधिकतम उपज (4015 किग्रा/हे.) किस्म GW-451 में पाई गई, जो अन्य किस्मों की तुलना में काफी अधिक है, लेकिन GW-496, GW-273 और GDW-1255 सांख्यिकीय रूप से बराबर रही। उच्चतम शुद्ध प्रतिफल और लाभ लागत अनुपात भी जीडब्ल्यू 451 (रु. 30744/हे. और 0.47) में अधिकतम पाया गया। मूंग की किस्म जीएम 4 ने उल्लेखनीय रूप अधिकतम उपज (687 किग्रा/हे.), शुद्ध आय (रुपये 25,158/हे.) और लाभ लागत अनुपात (0.87) दर्ज किया। मूंगफली की किस्म जीजी 20 (एसएस) के साथ गेहूँ की किस्म जीडब्ल्यू-366 और मूंग जीजेजी-17 को फसल क्रम के रूप में उगाने पर मूंगफली समतुल्य उपज, उच्चतम सकल आय और शुद्ध आय क्रमशः 4973 किग्रा/हे., रुपये 2,52,809 और 1,21,040/हे. प्राप्त किया गया। अन्य फसल क्रम GJG-HPS-1(S)-GW 451-GG- 20 (SS) 4919 किग्रा/हे., रुपये 2,48,769 और 1,17,000/हे. के साथ दुसरे स्थान पर रही। फसल क्रमशः GG-7 (B) -GW 322-GW496 ने सबसे अधिक प्रति रुपये निवेशित लाभ (2.50) दिया।

तिरुवनंतपुरम (केरल) में 12 किस्मों में से, एच-226 और श्री पवित्रा ने आकार में अधिकतम कंद लंबाई (34.7 और 34.4 सेमी) दर्ज की, जबकि एच-165 और एच-226 ने अधिकतम कंद परिधि प्राप्त की। हालांकि, श्री पवित्रा ने उच्चतम औसत कंद वजन/पौधे (602.3 ग्राम) दर्ज किया, लेकिन सीआर-24-4 (40.7 टन/हे.) और श्री पवित्रा (29.5 टन/हे.) सबसे अधिक उपज देने वाली किस्में रही। जैविक उत्पादन के अर्न्तगत किस्म एच-226 और सीआर-24-4 की खेती लाभदायक थी क्योंकि इन किस्मों ने उच्च लाभ (क्रमशः रुपये 5,32,229 और 5,18,855/हे.) और लाभ लागत अनुपात (क्रमशः 4.16 और 4.08) प्राप्त किया।

उदयपुर (राजस्थान) में विभिन्न मक्का किस्मों में, प्रताप संकर मक्का-3 अनाज के लिए, शूगर-75 स्वीटकोर्न के लिए, पीएम-5 बेबीकोर्न के लिए, वीएल-अम्बर पॉपकोर्न के लिए और स्थानीय किसानों के बीच लोकप्रिय नवजोत ने अधिकतम उपज (क्रमशः 6389, 6390, 1167, 4222 और 4537 किग्रा/हे.) और शुद्ध आय क्रमशः रुपये 80,102, 1,56,763, 23,520 और 1,53,912/हे. दर्ज की। अन्य किस्मों की तुलना में निवेशित प्रति रुपये शुद्ध आय भी प्रताप हाइब्रिड मक्का-3, शूगर-75, वीएल एम्बर और नवजोत के लिए 2.43, 2.99, 2.80, और 1.79 सबसे अधिक दर्ज की गई। ऐस्टीवम गेहूँ की किस्मों में

एमपी-3288 और एचआई-1531 में क्रमशः 4626 और 4504 किलो/हे. की अधिकतम अनाज उपज पैदा की। ड्यूरम गेहूं की किस्मों में, एचआई-8713 और एचआई-8663 में क्रमशः 5424 और 5024 किलो/हे. की अधिकतम पैदावार दी। गेहूं की किस्मों में शुद्ध आय क्रमशः MP-3288, HI-1531, HI-8713 और HI-8663 में रु 1,30,065, 1,24,981, 1,54,307 और 1,40,772/हे. द्वारा प्राप्त की।

3. जैव-गहन पूरक फसल प्रणालियों का जैविक उत्पादन के अंतर्गत मूल्यांकन

धारवाड़ (कर्नाटक): विभिन्न कृषि संरक्षण तकनीक में, परम्परागत समतल बुआई विधि के अलावा फसल अवशेषों के पुनर्चक्रण से चौड़ी क्यारी और कूड़ विधि की तुलना में सोयाबीन, मूंगफली, हरा चना और अरहर क्रमशः (1345, 1192, 126 और 841 किग्रा/हे.) की अधिक उपज का उत्पादन हुआ। चौड़ी क्यारी और कूड़ बुआई विधि द्वारा उपरोक्त फसलों को उगाने पर क्रमशः 30.0, 24.2, 14.3 और 16.2 प्रतिशत की उपज में कमी आयी। विभिन्न प्रणालियों में फसल अवशेषों के पुनर्चक्रण के अलावा परम्परागत समतल बुआई विधि के साथ सबसे अधिक समतुल्य उत्पादकता दर्ज की गई। फसल अवशेष समावेशन के साथ परम्परागत बुआई विधि ने शुद्ध आय और लाभ लागत अनुपात (रु.31,722 और 2.25) प्राप्त की। फसल प्रणालियों में, सोयाबीन-गेहूं प्रणाली में अधिकतम शुद्ध आय और लाभ लागत अनुपात क्रमशः रु. 31,722/हे. और 2.25 पाया गया।

पंतनगर (उत्तराखंड) में बासमती धान-गेहूं-ढेंचा प्रणाली ने अन्य सभी संसाधन संरक्षण तकनीकों की तुलना में अधिकतम बासमती धान की उपज (4133 किग्रा/हे.) दर्ज की, जबकि उच्च फसल सूचकांक (0.477) धान की सीधी बुआई (डीएसआर)-चना-मूंग के साथ उच्चकृत क्यारी और कूड़ तकनीक द्वारा (संसाधन संरक्षण) प्राप्त किया गया। गेहूं की अधिकतम अनाज उपज (3643 किग्रा/हे.) बासमती धान-गेहूं-ढेंचा प्रणाली में ही दर्ज की गई, जबकि सबसे कम अनाज उपज (3135 किग्रा/हे.) धान की सीधी बुआई (डीएसआर)-गेहूं- (शून्य कृषण)-ढेंचा में देखी गई। सब्जी मटर की हरी फली की उपज उच्चकृत क्यारी और कूड़ तकनीक पर धान की सीधी बुआई (डीएसआर)-गेहूं-(शून्यकृषण)-ढेंचा में 7424 किलो/हे.उसके बाद धान (डीएसआर)-मटर-लोबिया प्रणाली में पाई गई। इसी तरह चने की अधिकतम उपज धान (डीएसआर)-मटर-लोबिया-चना और मूंग भी 1821 की पैदावार के साथ उच्चकृत क्यारी और कूड़ तकनीक पर प्राप्त हुई।

उमियम (मेघालय) में नीची जलमग्न हुई क्यारियों में चावल आधारित फसल प्रणालियों में से धान-मसूर और धान-मटर फसल प्रणाली द्वारा धान की उपज क्रमशः 4010 और 3940 किलो./ हे. उच्चतम दर्ज की गई। चावल की किस्मों में से शाहसरंग-1 ने 4470 किलो./हे. की पैदावार धान-मसूर फसल क्रम में पाई। रबी के दौरान मसूर की उच्चतम उपज क्रमशः 1380 और 1200 किलो./हे. पूर्ववर्ती फसल धान की किस्म शाहसरंग-1 और विवेक धान-82 के साथ दर्ज की जबकि मटर की उच्चतम उपज 4680 किलो./हे. धान-मटर प्रणाली में धान की किस्म विवेक धान-82 साथ भी अधिक थी। धान समतुल्य उपज (13210 किलो./हे.) धान वीडो-82-मटर के साथ रही इसके बाद फसल क्रम धान (लम्पना)-मटर 13200 किलो./हे. का स्थान रहा। पूर्व-खरीफ सब्जी फसलों जैसे आलू, फ्रेंचबीन और गाजर ने क्रमशः 18400, 12200 और 22800 किलो./हे. उच्चकृत क्यारी पर अधिकतम उपज दर्ज की। खरीफ मौसम के दौरान भिंडी की अधिकतम उपज 9500 किलो./हे. पूर्ववर्ती फसल फ्रेंचबीन के साथ अधिक थी, जबकि धान समतुल्य उपज 32000 किलो./हे. गाजर-भिंडी फसल प्रणाली के साथ अधिक रही।

4. समेकित जैविक कृषि प्रणाली (IOFS) मॉडल का विकास

कालीकट (केरल) में मसालों, चारों और सब्जियों के समायोजन के साथ एक समेकित जैविक कृषि प्रणाली मॉडल का विकास किया गया। फसलों में मिर्च, हल्दी, चारा घास (कांगो सिग्नल घास, सीओ-3 और 4), टैपिओका, केला, लोबीया और अनानास लगाए गए। भारतीय मसाला अनुसंधान संस्थान, चेलावूर के फार्म पर चार गायों और उनके बछड़ों को रखा गया है। केला 80 किलो, टैपिओका 70 किलो और लोबिया 12 किलो प्राप्त हुआ। फार्म में रखी गई गायों को चारा घास खिलाया गया। एक एकड़ के एकीकृत जैविक कृषि प्रणाली मॉडल से रुपये 1 लाख 8 हजार का लाभ प्राप्त हुआ।

कोयम्बटूर (तमिलनाडु) में हरी खाद (ढेंचा) + मक्का प्रणाली के साथ उगाई गई भिंडी से अधिकतम उपज 14,345 किग्रा./हे. प्राप्त हुई। प्रति हेक्टेयर भिंडी उगाने की लागत रुपये 61,750 हुई और भिंडी की फसल से प्राप्त सकल आय रुपये 1,43,450/हे. रहा। 2.32 के लाभ लागत अनुपात के साथ शुद्ध प्रतिफल रुपये 81,700/हे. पाया गया। मक्का की किस्म सीओएच (एम) 8 ने 4931 किग्रा./हे. की पैदावार दर्ज करायी। मक्का से रुपये 73,695/हे. की सकल आय प्राप्त हुई। 1.94 लाभ लागत अनुपात के साथ मक्का ने 41,730/हे. की शुद्ध आय दी कपास की फसल से 1396 किग्रा./हे.

की पैदावार के साथ का कुल सकल आय रुपये 62,680 / हे. और शुद्ध प्रतिफल रुपये 27,050 किलो / हे. प्राप्त हुआ। अरहर ने 1317 किलो / हे. और रुपये 30,629 का शुद्ध प्रतिफल दिया। समेकित जैविक कृषि प्रणाली मॉडल द्वारा एक वर्ष में रुपये 3,17,923 / वर्ष प्राप्त हुए। कुल शुद्ध लाभ में सबसे अधिक योगदान फसल घटक (कुल आय का रुपये 1,76,355 का 56 प्रतिशत) का था, इसके बाद डेयरी का योगदान था जिसने दूध और खाद के माध्यम से कुल आय का 32 प्रतिशत (रुपये 1,01,068) का योगदान दिया। अन्य संबद्ध घटकों ने कुल आय का 13 प्रतिशत (रुपये 40,500) हिस्सा रखा, जबकि आईओएफएस मॉडल से वर्ष के भीतर 453 मानव-दिवस रोजगार भी सृजित किये।

सरदार क्रुशीनगर (गुजरात) में विभिन्न घटकों अर्थात फसलों (0.24 हेक्टेयर), हरे चारे की फसलों (0.15 हेक्टेयर), सीमा वृक्षारोपण, डेयरी और वर्मी-कम्पोस्ट (0.01 हेक्टेयर) से युक्त एक समेकित जैविक कृषि प्रणाली मॉडल विकसित किया गया। सीमा और बांधों के आसपास अरदुसा, नेपियर घास और लेमन ग्रास लगाए गए हैं। 0.24 हेक्टेयर में फसल घटक से रु. 28,211 का शुद्ध लाभ प्राप्त किया गया और जबकि चारा इकाई (0.15 हेक्टेयर) द्वारा रु. 19,737 प्राप्त हुए। वर्ष 2017-18 के दौरान 0.4 हेक्टेयर क्षेत्र के मॉडल के सभी घटकों से कुल शुद्ध लाभ रु. 47,948 प्राप्त हुआ।

तिरुवनंतपुरम (केरल) में एक एकीकृत जैविक खेती प्रणाली मॉडल विकसित किया जा रहा है जिसमें खाद्य फसल, कसावा, अरबी, सब्जी लोबिया, मक्का और चारा घास शामिल हैं। फसल कसावा और अरबी की उपज क्रमशः 40,121 और 10,565 किग्रा / हे. दर्ज की गई, जिससे शुद्ध आय क्रमशः 4,33,490 और 1,29,680 प्राप्त हुई।

उदयपुर (राजस्थान) में 0.25 हे. में खरीफ के दौरान फसल (स्वीट कॉर्न+उड़द) और रबी के दौरान गेहूँ 0.05 हे. में चारा फसले (चारा मक्का + लोबिया खरीफ में और बरसीम रबी में) 0.10 हेक्टेयर में सब्जिया (टमाटर और लोबिया), 0.04 हेक्टेयर में फलों की फसल और 0.01 हे. में कम्पोस्ट का वर्ष 2016-17 के दौरान मूल्यांकन किया गया। इस जैविक कृषि प्रणाली मॉडल से कुल मक्का समतुल्य उपज 5120 किग्रा. / हे. और शुद्ध आय रु. 63,086 / हे. प्राप्त की गई।

उमियाम (मेघालय) में 0.43 हे. के समेकित जैविक कृषि प्रणाली मॉडल से रुपये 56,835 / वर्ष का खर्च होना पाया गया। इस मॉडल से रुपये 73,903 / वर्ष प्राप्त किया गये जो कि क्षेत्र के किसान द्वारा अपनायी गई धान की मोनो-क्रॉपिंग या धान-सब्जियों की फसल प्रणाली की तुलना में बेहतर रही।

मॉडल के फसल घटक ने 66.4 प्रतिशत इसके बाद डेयरी ने 23.95 प्रतिशत और मात्स्यिकी घटक ने 15.29 प्रतिशत का योगदान दिया। मछली का उत्पादन 140 किलोग्राम हुआ।

5. बासमती धान-गेहूँ प्रणाली में प्राकृतिक खेती में प्रयोग होने वाले जैविक मिश्रणों का मूल्यांकन

लुधियाना में प्राकृतिक कृषि पद्धतियों के विभिन्न मिश्रण में से एकीकृत पोषक प्रबंधन और कीटनाशक मुक्त उपचार के साथ प्रभावी टिलर / वर्गमी. (379.2), बाली की लंबाई (9.7 सेमी), अनाज / बाली (46.8), 1000-दान-भार (43.6 ग्राम) और गेहूँ की उपज (5270 किग्रा / हे.) प्राप्त हुई। गुरुकुल और एनपीओएफ पैकेज के बीच पैदावार में 3.22 प्रतिशत उपज अंतर देखा गया।

मोदीपुरम में कल्ले / वर्गमी., बाली की लंबाई और दाने / बाली एकीकृत फसल प्रबंधन (50 प्रतिशत जैविक+50 प्रतिशत रासायनिक) के अर्न्तगत बेहतर रहे। इसी प्रकार, एकीकृत फसल प्रबंधन के अर्न्तगत उच्चतम अनाज की पैदावार 5408 किग्रा / हे. और जैविक उपज 13600 किग्रा / हे. दर्ज की गई। मिट्टी के जैविक गुणों में भी विभिन्न प्राकृतिक खेती में प्रयोग होने वाले जैविक मिश्रणों द्वारा भिन्नता देखी गई। एआई-एनपीओएफ पैकेज में मिट्टी में पाये जाने वाले जीवाणु (2.36×10^7 सीएफयू ग्रा / मिट्टी) और कवक (7.2×10^4 सीएफयू ग्रा / मिट्टी) उच्चतम पाये गये।

पंतनगर में एकीकृत फसल प्रबंधन में पौधे की ऊंचाई (99.3 सेमी) और बालियां / वर्गमी. अधिकतम दर्ज की गई हालांकि, 1000-दानों का अधिकतम वजन (43.3 ग्राम) नियंत्रण उपचार (प्राकृतिक खेती के किसी भी जैविक मिश्रण का इस्तेमाल नहीं किया) के साथ देखा गया। एकीकृत फसल प्रबंधन के अर्न्तगत प्राकृतिक कृषि पद्धतियों के विभिन्न मिश्रणों में, अधिकतम अनाज की पैदावार और पुआल उपज (क्रमशः 3250 और 6292 किग्रा / हे.) दर्ज की गई। परिणामस्वरूप गुरुकुल पैकेज की तुलना में एआई-एनपीओएफ पैकेज में 24.5 प्रतिशत अधिक उपज प्राप्त हुई।

कुरुक्षेत्र में कल्ले / मीटर पंक्ति लंबाई (74) और 1000-दानों का वजन (49.8 ग्राम) जैसे उपज विशेषता वर्ण एआई-एनपीओएफ पैकेज के साथ अधिक पाये गये। मूल्यांकित जैविक मिश्रणों में, एकीकृत फसल प्रबंधन (50 प्रतिशत जैविक+50 प्रतिशत रासायनिक) में अधिकतम अनाज और पुआल की पैदावार क्रमशः 3785 और 5148 किग्रा / हे. दर्ज की गई। एकीकृत फसल प्रबंधन ने उन्नत गुरुकुल पैकेज में की तुलना बेहतर प्रदर्शन किया जिसमें 49.2 प्रतिशत अधिक पैदावार हुई। जबकि एआईएनपीओएफ में गेहूँ की पैदावार गुरुकुल पैकेज के बराबर रही।

ABSTRACT

The salient research findings made during 2017-18 under All India Network Programme on Organic Farming is given below.

1. Evaluation of organic, inorganic and integrated production systems

Bajaura: Crops evaluated under vegetable-based cropping systems, the general performance of tomato, cauliflower frenchbean, blackgram, summer squash, lady finger and pea were found to be better under integrated (towards organic) followed by organic production systems. During summer, higher tomato fruit yield (11080 kg/ha) was observed with organic package (75% organic +innovative organic practices i.e. 10% vermiwash) whereas, during *kharif* yield of tomato found to be higher with integrated with 75% organic +25% inorganic (1650 kg/ha). The yield of blackgram (990 kg/ha), lady finger (5580 kg/ha), cauliflower (10680 kg/ha), pea (8640 kg/ha) observed maximum with 50% organic+50% inorganic however, frenchbean (5050 kg/ha) and summer squash (15380 kg/ha) was highest in term of yield with 75% organic+25% inorganic under integrated production system. In terms of system equivalent yield (cauliflower equivalent), blackgram-cauliflower-summer squash resulted in higher cauliflower equivalent yield (22358 kg/ha) among the cropping systems. However blackgram-cauliflower-summer squash gave the highest net return and returns per rupee invested under organic package with 75% nutrient through manure + innovative organic practice. It was higher by more than 3 times for net return and NRPRI.

Bhopal: All the crops in the systems such as soybean, wheat, mustard, chickpea and linseed recorded higher yield under organic management. Higher mean yield of soybean (1495 kg/ha) was recorded under 100% organic practice which

was 17.9% higher than inorganic. The yield of durum wheat, mustard, chickpea and linseed was recorded maximum in 100% organic management of 3853, 1654, 1850 and 1587 kg/ha respectively. The yield difference between organic and inorganic management was 18.1, 10.8, 12.3, and 15.7% for durum wheat, mustard, chickpea and linseed respectively. Among the cropping systems, soybean-chickpea recorded higher soybean equivalent yield (4011 kg/ha) followed by soybean-wheat (3637 kg/ha). Organic production package either by 100% organic nutrient input through manure or 75% nutrient through manure + innovative organic practice recorded maximum net returns (Rs.90,671 & 84,458) and return per rupee investment (2.01 & 1.89) as compared to inorganic management and it increased 88.8 and 75.9% in respect of net return than the inorganic management, respectively.

Calicut: Spices crops such as ginger, turmeric and black pepper were evaluated under different management packages. Among the different management packages, integrated package consisting of 75% nutrient supply through organic manure +25% inorganic recorded higher yield of ginger and turmeric (29642 and 34667 kg/ha respectively). In case of black pepper, yield was higher under organic (100% organic manure) management. In comparison to inorganic, the yield of ginger and turmeric was increased to the tune of 108.5 & 18.5% and 75.3 & 10.1% with integrated (75% nutrient organic manure +25% inorganic) and 100% organic management, respectively. Gross return for ginger crop found to be significantly higher by 104.7% towards organic approach under integrated production system with 50% each nutrient through organic and inorganic input. In case of turmeric, gross return was highest with organic consisting of 100% organic nutrient

Coimbatore: Among the management practices, maize yield was increased to the tune of 17.3 and 3.4% with integrated package of 50% each nutrient



over organic and inorganic management whereas the yield of cotton (1675 kg/ha), chilli (5893 kg/ha) sunflower (1655 kg/ha), and beetroot (22800 kg/ha) was recorded higher with 75% nutrient through organic+25% inorganic under integrated management package. Cropping system beetroot-maize-green manure found more profitable in term of net return for Rs.2,02,920/ha and it is higher by 125.5 and 128.4% than chili-sunflower and cotton-maize system.

Dharwad

All the crops such as cowpea, safflower, sorghum, groundnut and maize recorded higher yield under organic management either in 100% organic nutrients or 75% organic+ innovative practice whereas, green gram recorded higher with integrated (50% each organic and inorganic nutrients application). The yield increase over inorganic was found to be 35.4, 16.4, 38.1, and 23.2%, for cowpea, safflower, sorghum and groundnut respectively. Pigeon pea and cotton crops performed better under inorganic management practice. Among the cropping systems, groundnut + hybrid cotton (2:1) and maize-chickpea registered higher cotton equivalent yield (1748 and 1311 kg/ha respectively) than other systems. Production practices involving recommended dose of inorganic fertilizers recorded higher net return and B:C ratio (38,277/ha and 2.67, respectively) in maize- chickpea system followed by groundnut + hybrid cotton which obtained of Rs 35,480/ha as net return with organic package.

Jabalpur: Basmati rice-based cropping systems with wheat (*duram*), chickpea, maize (fodder), berseem (fodder and seed), vegetable pea and *rabi* sorghum was evaluated in 4 cropping sequences. Mean grain yield of basmati rice and other crops as influenced by different nutrient management was higher with inorganic production system. The yield reduction in basmati rice with organic and towards organic was found to be 9.8 and 7.0% respectively. The reduction in the yield of wheat, chickpea, maize (fodder), berseem seed, vegetable pea and sorghum

(fodder) with 100% organic management package was 11.7, 20.4, 10.6, 22.2, 25.6 and 19.1% respectively over inorganic nutrients management. Among the different production systems, total productivity of cropping system in terms of basmati rice equivalent was recorded higher with 100% inorganic nutrient management (5901 kg/ha) followed by integrated (5727 kg/ha). Among the crop-sequences, rice-vegetable pea- sorghum fodder led to record highest basmati rice equivalent yields (5785 kg/ha). Net return (Rs.1,15,771/ha) and benefit cost ratio (2.46) was higher in inorganic management owing to 25.8% lesser cost of cultivation resulted in 30.0% higher net returns compare to organic.

Karjat: Higher mean yield of rice (4752 kg/ha) was recorded with application of 50% organic+50% inorganic nutrient in integrated package but on par with organic. Chickpea and onion also resulted good yield with integrated package and found to be higher by 5.8 & 15.8% and 6.1 & 18.2% over organic and inorganic, respectively. Field bean yield recorded higher with organic package. Other crops such as brinjal resulted in higher with inorganic package (50155 kg/ha). Rice-brinjal system grown with organic package produced maximum rice equivalent yield (62967 kg/ha) compared to other system. Among the cropping systems, higher net returns of Rs 6,97,934 and 5,03,240/ ha and B:C ratio (3.17 and 3.21) were observed in rice-brinjal and rice-onion system respectively under organic package.

Ludhiana: Maximum yield of basmati rice (4050 kg/ha) was recorded in organic management with through application of 75% organic manure + innovative practice. In *kharif*, soybean was also obtained higher yield (1580 kg/ha) under organic package (100% organic) and it was 26.4% higher compare to inorganic packages. Summer moong (1300 kg/ha) performed better with 75% organic + innovative practice under organic package and produced significantly 88.4% more yield compared to inorganic practices. However, wheat recorded higher yield (6030 kg/ha) under inorganic package,



and it was about 5.31% higher over 100% organic management. In term of system productivity among the management practices, wheat equivalent yield resulted in higher either in organic (100%) or with 75% organic + innovative practice. Among the cropping systems, it was higher in cluster bean-wheat-summer moong followed by basmati rice-wheat system. Net return was recorded maximum in basmati rice-wheat-green manure under organic practice (Rs 1,47,270/ha) by adoption of 75% organic input +innovative organic practice which gave 15.5 and 17% higher net return/ha compared to inorganic and integrated package respectively.

Modipuram: Basmati rice recorded higher yield (4398 kg/ha) under organic production package, while rice (coarse grain), maize (popcorn), barley, potato, okra and green gram recorded higher yield towards organic under integrated system. In case of basmati rice yield, it was 32.9% higher under organic compared to inorganic package, whereas the reduction in yield was noticed with organic by 13.5, 16.9, 13.6, 25 and 27.1% in rice, maize (popcorn), barley, potato and green gram, over integrated package, respectively. Productivity among the various systems, maize-potato-okra-sesbania recorded higher rice equivalent yield of 32499 kg/ha because of higher yield of potato and good premium price followed by maize (sweet corn)-mustard-sesbania (GM). Organic management package with 100% organic application through manure recorded higher net return but being on par to all other production systems. Among the cropping system, maize (sweet corn) - mustard- sesbania green manure recorded maximum return (1,35,472/ha) with integrated package and found more profitable.

Pantnagar: Higher yield of basmati rice during *kharif* was recorded with organic package (4976 kg/ha). The yield increase under organic was 18.1% over inorganic package. *Rabi* crop, wheat recorded higher yield under integrated package (4852 kg/ha) but, the same was at par with inorganic (4735 kg/ha). Coriander was raised as intercrop with chickpea and vegetable pea in the manner of 4:2 ratio. Chickpea

and vegetable equivalent yield recorded highest (2586 and 9491 kg/ha) in organic (100% nutrient application through organic sources). Organic management package was increased for chickpea and vegetable pea equivalent to the tune of 9.5 and 16.7% over inorganic practice. A remarkable difference in tuber yield of potato was observed under organic management and increase in yield was found to be 19.6% over inorganic. System productivity in terms of basmati rice equivalent yield found to be higher with organic management (11505 kg/ha). Among all the cropping systems, basmati rice-chickpea+coriander-sesbania system recorded higher equivalent yield (13398 kg/ha) and net return of Rs. 2,25,097/ha and B:C ratio 3.44. Among the management packages, application of organic input recorded maximum net return (Rs.2,07,634). Adoption of organic package, net return increased up to the 55.4 & 44.4% than inorganic and integrated management.

Raipur: Soybean based cropping systems were evaluated with maize, pea, chilli and onion under different mode of management. Organic production system either by 100% organic manure or 75% organic + innovative practice resulted in higher soybean yield (1790 and 1935 kg/ha respectively). Other crops such as maize (sweet corn), pea, and chilli (14217, 7347 and 8613 kg/ha respectively) also resulted higher yield with 75% organic manures+ innovative practices under organic while, onion bulb yield recorded higher with state recommendation (15896 kg/ha). The productivity of cropping system in term of soybean equivalent yield recorded higher under organic management with 75% organic nutrient + innovative practices (7201 kg/ha) and it was increased by 14.9% over inorganic. Soybean-maize cropping system registered higher soybean equivalent yield (7485 kg/ha) and net return of Rs 2,74,503/ha with adoption of 75% organic + innovative organic practice (foliar spray of vermin-wash 10%). Similarly, highest B:C ratio (4.0) was also obtained with 75% organic + Innovative practice (foliar spray of vermiwash (10%) followed by cow urine (10%) at 20 days interval at 30 DAT and 50 DAT) in soybean-maize.



Ranchi: In rice, organic management practice (100% and 75% organic manure + innovative practice “Azolla along with vermiwash spray”) resulted in higher mean yield (3359 and 3518 kg/ha respectively). Other crops like potato and linseed recorded higher with organic package whereas, lentil perform better with integrated. Wheat recorded highest yield (2678 kg/ha) under inorganic package. The yield was decrease with 100% organic and towards organic (75% organic + 25% inorganic) by 9.3 and 6.7% respectively. Among the cropping systems, rice-potato recorded highest system equivalent yield (8508 kg/ha) while rice-linseed recorded lower equivalent yield (4145 kg/ha). Organic package with application of 75% organic manure + innovative practices recorded net return of Rs 71,471/ha/year followed by 100% organic practice of Rs. 65,186/ha. Among cropping systems, rice-potato recorded maximum net return (Rs. 57,907/ha) along with benefit cost ratio of 1.87.

Umiam: Broccoli was grown with carrot, potato, french bean and tomato on raised beds and four rice varieties in sunken beds were evaluated under raised and sunken bed system. The higher broccoli yield was recorded with broccoli-french bean (15310 kg/ha) under organic management. The yield of broccoli was enhanced on raised bed by 13.7 and 5.4% over inorganic and towards organic (integrated). Other vegetable crops viz. carrot, potato, french bean and tomato recorded maximum yield under 100% organic with 16210, 16150, 9070 and 18390 kg/ha respectively. Rice equivalent yield of broccoli-vegetables cropping system were recorded maximum with 100% organic (39440 kg/ha) followed by integrated treatment (38620 kg/ha). In sunken beds, rice equivalent yield recorded higher in rice-tomato systems (39270 kg/ha) while rice-carrot system was the second-best system. Maximum net return was recorded in broccoli- tomato followed by broccoli-carrot, under organic practices by 100% nutrient supply through organic manure or by application 75% organic + 25% innovative practices which gave 30.4 and 14.3% more return over inorganic, respectively. Net return per rupee invested being higher in broccoli -frenchbean

(1.77) cropping system followed by broccoli-carrot (1.63). Among the management practices on sunken beds, the higher rice yield (4630 kg/ha) was recorded with integrated package having 50% organic + 50% inorganic nutrients. Among the rice varieties, Shahsharang-1 produced maximum grain yield (4620 kg/ha) followed by Lampnah (4440 kg/ha), Megha Aromatic 2 (4250 kg/ha) and Ngoba (4130 kg/ha).

Ajmer: Seed spices coriander and fennel was evaluated with green gram and cluster bean in system mode. The performance of green gram, cluster bean, coriander and fennel were found to be better towards organic practice with integration of 75% organic + 25% inorganic input under integrated package. Among nutrient management practice, seed yield of green gram, clusterbean, coriander and fennel were higher by 19.3, 19.5, 17.4 and 19.4% respectively over inorganic. Net returns of Rs 1,56,333 and 1,63,924 /ha was recorded with 100% inorganic or by state recommendation practice. Green gram grown with fennel and found to be more profitable in term of benefit cost ratio (3.63 and 3.09).

Almora: Different nutrient sources were evaluated for finger millet + black soybean (2:1 ratio - substitution of row) - wheat + toria (2:1 ratio) and grain amaranth - wheat + lentil (2:1 ratio) under rainfed system. Among crop management systems, application of 100% N requirement of crop through organic manure produced highest wheat equivalent grain yield of 3535 and 8306 kg/ha for finger millet + black soybean-wheat + toria and grain amaranth-wheat + lentil, respectively. The highest yielding treatment recorded 68 and 107% higher wheat equivalent grain yield of finger millet + black soybean-wheat + toria and grain amaranth-wheat + lentil, respectively than 100% inorganic package, respectively.

Gangtok: Yield of maize with intercrops ginger, turmeric, soybean and pigeon pea during *khari* remarkably higher with organic package. Similarly, frenchbean, buckwheat and rajmash also recorded higher yield with organic (100% N equivalent though

organics (25% FYM+25% VC+25% NK+25% MC). In terms of maize grain equivalent yield of system, significantly higher maize grain equivalent yield (MEY) was recorded with maize + ginger (1:1)- french bean (15000 kg/ha) followed by maize + turmeric (1:1)- rajmash (10700 t/ha). Production package organic with 100% N equivalent though organics gave the maximum net return (266.7×10^3 ₹/ha) with B:C ratio (3.69). Among the cropping systems, maize + ginger (1:1)-french bean (275.5×10^3 ₹/ha) recorded highest net return.

Narendrapur: Basmati rice and rice recorded maximum yield (2719 and 6021 kg/ha respectively) under organic nutrient management followed by integrated. The differences in yield of basmati rice and rice were found to be 17.1 and 10.6% compared to inorganic nutrient package. Other crops in the systems such as broccoli, mustard, capsicum and frenchbean during *rabi* resulted higher yield by 21.7, 14.5, 26.5 and 8.0% with organic compared to inorganic, respectively. Similarly, sesame and green gram during summer also recorded maximum yield in organic and being higher by 8.0 and 10.9% respectively. Cropping systems rice-frenchbean-sesame resulted more than 2 times higher than three other cropping systems.

Sardarkrushinagar: Wheat and fennel recorded higher yield (4765 and 1828 kg/ha) under state recommendation whereas, groundnut, green gram, vegetable cowpea resulted in higher yield (1944, 718 and 5833 kg/ha respectively) in integrated nutrient management with 50% organic +50% inorganic input. In term of groundnut equivalent yield, response of different production system was found to be higher in integrated package (50% each organic + inorganic input). Among the cropping systems, greengram- cumin- vegetable cowpea system recorded highest groundnut equivalent yield (15283 kg/ha). Net return of Rs.1,04,246 was obtained highest under 100% inorganic but being at par with integrated (Rs 1,10,101/ha). Among the cropping systems, greengram- cumin- vegetable cowpea system recorded higher net return of Rs. 1,43,418/h

and Net return per rupee invested (1.46).

Thiruvananthapuram: Tuber yield of cassava was higher in 100% inorganic followed by integrated while comel yield of taro was higher with 100% organic. Variation in yield for cassava was 24.9% from inorganic to organic however, in taro it was 367% higher with organic over inorganic. Vegetable cowpea and green gram yield (1540 and 453 kg/ha) was higher in organic while, groundnut and blackgram was higher in integrated package (1091 and 710 kg/ha). Cassava-groundnut resulted in higher net returns of Rs. 5,71,362/ha and net return per rupees invested (3.52) under organic condition followed by inorganic practices.

Udaipur: During *kharif*, maize+blackgram recorded higher yield (3121 kg/ha MEY) towards organic with integrated packages (75% organic +25% inorganic) whereas maximum yield of maize (sweetcorn)+black gram (8671 kg/ha MEY) was higher under 100% inorganic nutrient management. Sole black gram (421 kg/ha), soybean (642 kg/ha) and wheat *durum* & *aestivum* (4286 & 3714kg/ha) yield recorded maximum either in inorganic or in state recommendation practice. Reduction in yield of soybean (27.3%), blackgram (18.8%), wheat (30.0 & 21.1 *durum* and *aestivum*) and chickpea (30.6%) were found with organic over inorganic. About 4% higher yield was observed in fenugreek with organic compared to inorganic practice. Cropping systems, maize + blackgram (2:2)-wheat (*durum*)-*sesbania* (GM) cropping system gave maximum maize equivalent yield of 79583 kg/ha. Maize + black gram-*durum* wheat cropping system recorded highest net return (Rs1,73,359/ha) under state recommendation practice followed by 100% inorganic practices (Rs1,73,236/ha). However, reverse was found in NRPRI which maximum in inorganic followed by state recommendation.

2. Evaluation of response of different varieties of major crops for Organic Farming

Bajaura: Best performing variety of okra (Chameli-015) recorded significantly higher fruit



yield (5620 kg/ha), net returns (Rs. 61097/ha) and B:C ratio (0.77) followed by Indranil. Pea variety Ten plus gave the highest pod yield (9810 kg/ha) and maximum net return (Rs. 1,72,271/ha) followed by Nirali yield (9120 kg/ha) and net return (Rs. 1,55,047/ha). Among the cauliflower varieties, significantly higher curd weight (635 g), marketable curd (82.8%), curd yield (11830 kg/ha) resulted with higher net return of Rs. 1,94,910/ha and B:C ratio (1.736) in US-178 followed by Chandramukhi, curd yield (11360 kg/ha), net return (Rs. 1,79,819/ha) and B:C ratio (1.736). Among the tomato varieties, Mar Globe showed lowest yield (3350 kg/ha) while R K-123 had highest fruit size (30.1 cm²), number of fruits/plant (42.6) and fruit yield (13350 kg/ha) during summer.

Bhopal: Soybean variety JS-97-52 was tallest (54.3 cm) but RVS-2002-4 resulted in significantly higher seed yield (1890 kg/ha) owing to higher pods/plant (49.9) and numbers of seeds/pod (3.3). NRC-37 recorded lower soybean yield (1320 kg/ha). Among the maize varieties, Kanchan outperformed better in yield (3920 kg/ha) followed by Proagro 4212. Among the wheat varieties, GW-366 significantly performed superior in number of spikes/meter row length (101.0), seeds/spike (77.4) resulted in higher grain and biomass yield (4167 and 8847 kg/ha) and harvest index (47.0%) followed by HI-8498. Chickpea variety, JG 130 recorded significantly higher seed yield (1962 kg/ha), correspondingly higher biomass yield of 5493 kg/ha, seeds/pod (2.0) and pod/plant (99.1) followed by JG-63 (1880 kg/ha).

Calicut: Ginger variety Rajetha recorded maximum rhizome yield (26200 kg/ha) which only 200 kg higher to Mahima and 600 kg more to Varda. Among turmeric varieties, maximum yield was recorded by Pragati (48600 kg/ha) followed by Sudarshana (44000 kg/ha). In term of quality of turmeric, Prabha recorded maximum oleoresin and curcumin content of 17.1 and 6.46% among the turmeric varieties.

Coimbatore: Least thousand grains weight (12.4 g) was observed in Jeeraga Samba while heaviest grains (21.1 g) was produced by Mapillai Samba. Difference

in grain yield among the varieties ranged from 2660 to 5770 kg/ha. Mappillai samba showed lowest grain yield (2660 kg/ha) while CO (R) 48 had highest grain yield (5770 kg/ha).

Dharwad: Among the chickpea varieties, A1 recorded maximum yield of 2857 kg/ha which on par with JAKI 9218 (2843 kg/ha). Wheat variety Bijaga yellow recorded tallest variety (49.4 cm). 1000-grains weight (44.0g) was recorded in DWR 2006 (DW) however, higher grain yield of wheat (1945 kg/ha) was recorded with UAS 347 (BW) produced 60.1% higher yield over least yielded cultivars NIAW 1415 (BW) (1215 kg/ha).

Jabalpur: PS-3 and IR-36 was the leading varieties in all the traits. Maximum Plant height (75.1 cm), effective tillers/hill (13.2 nos.), panicle length (26.1 cm), grains/panicle (68.7 nos.) resulted in highest grain yield (4277 kg/ha) in PS-3 rice variety followed by IR-36 in term of yield (4040 kg/ha). Among the wheat varieties, significantly higher wheat yield was recorded with HI 1500 (3885 kg/ha) and found to be on par with HI 1418 (3689 kg/ha) and C 306 (3554 kg/ha). The system productivity in term of rice equivalent yield (REY), net return (Rs/ha/year) and B:C ratio of rice-wheat cropping systems under organic management recorded maximum with rice (PS-3) - wheat (HI-1418) system of 8404 kg/ha (REY), Rs. 1,04,083/ha (NR), and 1.98 (B:C ratio) followed by rice (IR-36) - wheat (C-306) system of 8060 kg/ha (REY), Rs. 95,479/ha/year (NR) and 1.90 (B:C ratio).

Karjat: Among the rice varieties grouped in four categories, rice variety Sahyadri-4 (early maturing), Sahyadri-3 (mid-late maturing), Sahyadri-5 (late maturing) and Jaya which is popular among farmers recorded significantly higher grain yield (6522, 6711, 6766 and 6039 kg/ha respectively) over rest of varieties but these are statistically on par to each other. Karjat 4 recorded lowest yielded (3938 kg/ha) among the rice varieties. Ground nut varieties TG-26 followed by Konkan Gaurav recorded significantly higher pods yield (3247 and 3095 kg/ha) but these are statistically on par to TAG 24 and Phule-6021.



Ludhiana: Among the basmati rice varieties, Pb basmati-4 gave and the highest grain yield (5130 kg/ha) followed by RYT 3677 (5090 kg/ha). Among wheat varieties, significantly higher grain yield of wheat (5920 kg/ha) was observed in PBW 1 Zn. Unnat PBW 550, being the second-best performing variety (5550 kg/ha) of wheat.

Modipuram: Grain yield of maize was significantly higher in Vivek QPM-9 (15000 kg/ha) followed by PMH-1 (14000 kg/ha). Vivek QPM -9 gave maximum gross return, net returns and benefit cost ratio of Rs. 1,50,000, Rs.1,08,575 ha⁻¹ and 2.62 respectively followed by PMH-1 which gave net return of Rs. 98575/ha and B:C ratio 2.38. Among the mustard varieties, significantly higher seed yield was recorded with RGN-48 (1775 kg/ha) and it was statistically at par with Urvashi (1773 kg/ha). Maximum gross return, net return and benefit cost ratio was recorded also with RGN-48 (Rs. 71,000, 52,124/ha and 2.76 respectively) followed by Urvashi with Rs 52,057 as net return and 2.76 of BC ratio.

Pantnagar: Significantly higher grain yield of rice was observed in Pant Sugandha Dhan-17 (4141 kg/ha) which was at par with Pant basmati-1 (4136 kg/ha), Pant Sugandha-27 & 21 (4115 & 4108 kg/ha, respectively). Grain yield of different wheat varieties recorded in range from 3358 to 4040 kg/ha. Highest grain yield was noticed in HD-2967 (4040 kg/ha) which was closely followed by UP-2565 and UP-2684 (3990 and 3964 kg/ha).

Raipur: The highest grain yield of scented rice was recorded in CR Sugandha Dhan-907 (4603 kg/ha) followed by C.G. Sugandhitbhog (4389 kg/ha) which were significantly superior over rest of the varieties. In case of tall traditional short grain aromatic rice varieties, Vishnubhog sel-01 gave the highest yield (4080 kg/ha) followed by Gopalbbhog (4023 kg/ha) and these varieties were statistically on par with Sugandhmati (3983 kg/ha). Higher seed yield of chickpea was obtained from JG-130 (1711 kg/ha) which was statistically on par with Vabhav

and RG2009-16 (1689 and 1622 kg/ha respectively). The harvest index was maximum in JG-14 (46.95) followed by Vaibhav (46.58). Net return and B:C ratio was maximum in JG-130 (Rs 71111/ha & 2.83) followed by Vaibhav (Rs 69733/ha & 2.78) and RG 2009-16 (Rs 66222/ha & 2.64).

Ranchi: Among the rice varieties, significantly higher yield was obtained in MTU-1010 (4022 kg/ha). Lalat and Birsamati was the successor of MTU-1010 in case of yield (3884 and 3644 kg/ha respectively) and found on par to each. Among the wheat varieties, K-0307 recorded significantly higher number of tiller m⁻² (336.7), spike length (9.2 cm), number of grains/spike (34.6) and grain yield of 3158 kg/ha which was statistically at par with Raj 4229 (3022 kg/ha), DBW 39 (2889 kg/ha). Among wheat variety, K-0307 registered significantly higher net returns (Rs.23035/ha) and benefit: cost ratio (0.58) than rest of the varieties but remains statistically at par with Raj-4229 (Rs.22246/ha), GW-366 (Rs.19826/ha). In terms of system economics of rice-wheat cropping sequence, rice (MTU1010) and wheat (WR-544) gave highest system net returns (Rs.68317/ha) and system B:C ratio (0.88).

Umiam: Maximum cob length, cob weight, green cob yield and kernel yield were recorded with variety DA 61-A (14.7 cm 231.5 g, 6200 kg/ha and 3700 kg/ha respectively) and found to be on par with RCM-75 (14.4 cm, 226.9 g, 5900 and 3700 kg/ha respectively) and RCM-1-3 (13.1 cm 216.6 g, 5800 kg/ha and 3600 kg/ha respectively). Tomato cultivars MT-2 produce higher fruit yield (20500 kg/ha) compared to other cultivars and being at par with 0-17 and MT11XMT2 (20330 and 18770 kg/ha). Less fruit borer infection (7.1%) was observed in MT-2 compared to the other cultivars. Other less infested cultivars were 0-17 (7.2%) and MT 1 X MT 2 (10.2%). Among the French bean varieties, Naga Local performed best variety evaluated for their suitability with green pod and seed yield (9000 and 4400 kg/ha) after that RCM-FB-18 green pod and seed yield (8300 and 3900 kg/ha respectively).



Ajmer: Seed spice crops coriander and fennel including different varieties in *rabi* and green gram and cluster bean in *kharif* were evaluated/screened for organic farming. Green gram variety Mum-2 performed significantly better in term of plant height (60.3 cm), number of primary branches (4.53), number of nodes/plant (28.7), number of seeds/pod (11.2), also for seed yield (983.2 kg/ha) closely followed by RMG-975 (937 kg/ha). Among the cluster bean varieties' variety RGC-1038 performed better with highest nos. of primary branch/plant (7.07), pods/plant (64), seeds/pod (8.67) and seed yield (1250 kg/ha) followed by RGC-1055 for yield (1063 kg/ha).

Among the coriander varieties, Azad Dhan-1 found superior in case of primary and secondary branches/plant (7.3 & 25.3), days to 50% flowering (77.7 days) number of umbels/plant (43.2), number of umbellets/umbel (6.1) and seed yield (1653 kg/ha) followed by ACR-1 for seed yield (1619 kg/ha). Among fennel varieties, GF-12 performed superior with number of primary and secondary branches (12.7 & 22.5), umbels per plant (42.1), umbellets per umbel (26.8) and seed yield per hectare (6500 kg) followed by AF-1, RF-125 with yield of 3218 and 3190 kg/ha.

Gangtok: Maize variety Vivek sankul -35 performed better in term of grain yield (2890 kg/ha), net return (Rs. 72,900/ha) and return per rupee invested (2.71) which were on par with RCM -75 and Vivek sankul-31. Among the buckwheat varieties, IC 109433 was the highest yielded variety (2610 kg/ha) followed by local Meethay and IC 109729 with yield of 2500 and 2390 kg/ha. In terms of economics, gross return, net return and return per rupees invested, production efficiency, profitability and land use efficiency was also higher in IC 109433 followed by Local Meethay and IC 109729.

Sardarkrushinagar: Number of branches/plants, pod yield (2052 kg/ha), net return (Rs. 75,048/ha) and BC ratio (2.02) was higher with GG-20(SS) followed by GIJ-17(s), both were found on par to each other statistically.

Maximum yield of wheat was found in variety GW-

451 (4015 kg/ha) which is significantly higher than other varieties but was on par with GW 496, GW-273 and GDW-1255. Highest net return and B:C ratio was also obtained in GW 451 (Rs. 30744/ha and 0.47). Green gram variety GM 4 recorded significantly higher seed yield (687 kg/ha), net return (Rs. 25158/ha) and B:C ratio (0.87) but been at par to GM-5 and Meha. Highest groundnut equivalent yield, gross return, and net return ratio was obtained in GG 20 (SS) - GW 366 - GJG-17 (S) cropping system of 4973 kg/ha, Rs. 2,52,809/ha and Rs. 1,21,040 respectively which is closely followed by GJG-HPS-1(S)-GW 451-GG-20 (SS) (4919 kg/ha, Rs. 2,48,769/ha and 1,17,000/ha respectively) whereas highest B:C ratio was obtained in GG-7 (B) -GW 322-GW496 (2.50) but it gave minimum equivalent yield, gross and net return.

Thiruvananthapuram: Among the 12 varieties, H-226 and Sree Pavithra recorded maximum tuber length in size (34.7 and 34.4 cm) while H-165 and H-226 attained the maximum tuber girth. Although, Sree Pavithra recorded highest average tuber weight/plant (602.3 g), but CR-24-4 (40.7 t/ha) and Sree Pavithra (29.5 t/ha) was the highest yielded varieties. Cultivar of H-226 and CR-24-4 under organic practice was profitable as these varieties generated higher profit (Rs. 5,32,229 ha⁻¹ and Rs. 5,18,855 ha⁻¹ respectively) and B: C ratio (4.16 and 4.08).

Udaipur: Among the different maize varieties, Pratap hybrid maize-3 for grain, Sugar -75 for sweetcorn, PM-5 for baby corn, VL amber for popcorn and Navjot popular among local farmers recorded significantly higher yield (6389, 6390, 1167, 4222 and 4537 kg/ha respectively) and net return of Rs. 80,102, 1,56,763, 23,520 and 1,53,912/ha respectively as compared to other varieties. Net return per rupee invested was also observed the same trends as it gave 2.43, 2.99, 2.80, and 1.79 NRPR for Pratap hybrid maize-3, Sugar -75, VL amber and Navjot. Among *aestivum* wheat varieties, MP-3288 and HI-1531 recorded maximum grain yield of 4626 and 4504 kg/ha respectively and among *durum*, significantly higher grain yield of 5424 and 5024 kg/ha was

recorded in HI-8713 and HI-8663 respectively. Net return of Rs. 1,30,065, 1,24,981, 1,54,307 and 1,40,772/ha as obtained in MP-3288, HI-1531, HI-8713 and HI-8663 respectively.

3. Evaluation of bio-intensive complimentary cropping systems under organic production systems

Dharwad: Conventional flatbed (FB) method of planting in addition to recycling of crop residues produced higher yield of soybean, groundnut, greengram and pigeonpea (1345, 1192, 126 and 841 kg/ha respectively) compared to broad bed and furrow planting method. The reduction with broad bed and furrow method of planting are observed as 32.04, 24.2, 14.3 and 16.2% than conventional flat bed with residue. Equivalent yield of different systems also recorded higher with conventional flatbed method of planting in addition to recycling of crop residue. Conventional flatbed method of planting with crop residue produced higher gross return, net monetary returns and benefit cost ratio across to cropping systems. Among the cropping systems, soybean-wheat system recorded maximum net return and B:C ratio of Rs. 31,722/ha and 2.25 respectively.

Pantnagar: Basmati rice-wheat-*sesbania* system recorded significantly higher basmati rice grain yield (4133 kg/ha) over all other resource conservation techniques, while higher harvest index (0.477) was obtained with DSR-chickpea-moong on broad bed furrow resource conservation technique. Grain yield of wheat (3643 kg/ha) was also recorded in basmati rice-wheat- *sesbania* system while lowest grain yield (3135 kg/ha) was observed in rice (DSR)-wheat-(ZT)-*sesbania*. Green pod yield of vegetable pea was found higher (7424 kg/ha) in rice (DSR) +soybean-vegetable pea + mustard on raised bed & furrow system (FIRB), as compared to 7197 kg/ha in rice (DSR)-vegetable pea-cowpea on broad bed and furrow system (BB&F) chickpea yield under rice (DSR)-chickpea-moong system on broad-bed and furrow was 1821 kg/ha.

Umiam: In rice-based cropping systems on sunken

beds, the rice yield in sunken beds productivity of 4010 kg/ha and 3940 kg/ha was recorded highest under rice-lentil and rice-pea cropping system, respectively. Among the rice varieties, Shahsarang-1 recorded the highest grain yield (4470 kg/ha) under rice-lentil cropping sequence. During *rabi*, the highest lentil yield (1380 kg/ha) was recorded with preceeding crop rice variety Shahsarang-1 and Vivek dhan-82 of 1200 kg/ha whereas, pea yield (4680 kg/ha) was also higher with rice (Vivek dhan-82) in rice-pea system. The highest rice equivalent yield was recorded under rice (VD-82)-pea (13210 kg/ha) followed by rice (Lampnah)-pea 13200 kg/ha. Pre-*kharif* vegetable crops, potato, frenchbean and carrot recorded yield on raised bed of 18400, 12200 and 22800 kg/ha respectively. The yield of okra during *kharif* season was higher with frenchbean (9500 kg/ha) in the system whereas, rice equivalent yield was recorded higher under carrot-okra cropping system of 32000 kg/ha.

4. Development of Integrated Organic Farming System Models (Area: 0.4 ha)

Calicut: The plot with spices, fodder and vegetables combination was established at ICAR-IISR main campus, Chelavoor. The crops are pepper, turmeric, fodder grasses (congo signal grass, CO-3, CO-4), tapioca, banana, cowpea and pineapple were planted as inter-crop in an established coconut garden. Four cows and their calves are also maintained. Banana 80 kg, tapioca 70 kg and vegetable cowpea 12 kg were harvested. Fodder grass fed to the cows that are maintained at IISR farm. A profit of Rs 1.08 lakhs was received from one acre.

Coimbatore: The fruit yield of bhendi was 14345 kg/ha whereas, the cost of cultivation incurred per hectare was Rs.61750 and the gross return obtained from bhendicrop was of Rs.143450/ha. The net return was found to be of Rs.81700/ha with benefit cost ratio of as 2.32. Maize variety COH (M) 6 was sown in the system gave 4931 kg/ha of grain yield. Gross return of Rs. 73965/ha was recorded from maize plot. Maize recorded the net income of Rs. 41,370/ha with 1.94



B:C ratio under integrated organic farming model. Cotton recorded 1396 kg/ha of seed cotton yield with the gross and net return of Rs. 62,820 and Rs. 27,050/ha respectively. Redgram yield (1317 kg/ha) was also obtained with net return of Rs. 30,629/ha. A total net return of Rs. 3,17,923/- per year was achieved from the IOFS model. The highest contribution towards the total net return was contributed by crop component (56% of the total income Rs.176355) followed by dairy which contributed 32% share of the total income through milk and manure (Rs. 101068). Other allied components shared 13% of the total income (Rs. 40500) whereas 453 man-days were generated as employment within the year from IOFS model

Sardarkrushinagar: IOFS model is comprised of different components viz., Crops (0.24 ha), green fodder crops (0.15 ha), dairy & vermi-compost (0.01 ha) and boundary plantation. Total net profit of Rs 28,211 was received by crop component from 0.24 ha and net profit of Rs 19,737 was received by green fodder unit (0.15 ha.). Ardusa, Napier grass and lemon grass have been planted around the border and bunds. Total net profit from all the components of IOFS Model during 2017-18 was Rs 47,948 from 0.4 ha area.

Thiruvananthapuram: An Integrated Organic Farming System model is being develop at research farm of ICAR-CTCRI, Thiruvananthapuram consisting of food crop components, cassava, taro, vegetable cowpea, maize and fodder grass. Crop cassava and taro were taken during 2017-18. The yield of cassava and taro was recorded 40121 and 10565 kg/ha with net return of Rs. 4,33,490 and 1,29,680 respectively from the model.

Udaipur: An integrated organic farming system model for 0.45 ha consisting of field crops in 0.25 ha (sweet corn + blackgram during *kharif* and wheat during *rabi*), fodder crops in 0.05 ha (fodder maize + cowpea during *kharif* and berseem in *rabi* and *sesbania* green manuring during *zaid*), vegetables in 0.10 ha (tomato and cowpea), fruit crop in 0.04 ha

(guava) and compost unit in 0.01 ha were evaluated during 2017-18. The total maize equivalent yield of 5120 kg/ha and a net return of Rs. 63068 /ha was obtained from the farming system model.

Umiam: The total cost of cultivation was recorded at Rs. 56,835/- per year under the IOFS model with an area of 0.43 ha. A total net return of Rs. 73,903/- per year was achieved under the IOFS model which is much higher than the region's farmer common practices of rice mono-cropping or improved practice of rice-vegetables cropping system. The highest contribution towards the total net return was contributed by crop component of the model (66.44%) followed by dairy (23.95%) and fishery component (15.29%). The fish production was 140 kg. The net return from dairy component was calculated only in terms of milk production since the cow dung produced was recycled back into the model which was used as manure for crop production.

5. Evaluation of concoctions of Natural Farming in Basmati Rice - Wheat system

Ludhiana: Among different concoctions of natural farming practices, integrated nutrient management & pesticide free treatment followed by integrated crop management perform better in term of effective tillers/m² (379.2 & 378.3), ear length (9.7 & 9.8 cm), grains/ear (46.8), 1000-grans-weight (43.6 & 43.0 g) and grain yield (5270 & 5200 kg/ha) of wheat. 3.22% yield difference was observed between Gurukul and NPOF package.

Modipuram: Yield attributing characters such as effective tillers/m², spike length and no. of grains/spike were recorded better under integrated crop management. Similarly, highest grain (5408 kg/ha) and biological yield (13600 kg/ha) was also recorded under integrated crop management. Biological properties of soil were significantly influenced by different treatments. Highest bacterial (2.36×10^7 CFU/g soil) and fungal population (7.2×10^4 CFU/g) in soil was found under AI-NPOF package.

Pantnagar: Highest plant height (99.3 cm) and spikes/m² were recorded in integrated crop

management. However, test weight (1000-grains) 43.3g was observed maximum with control. Among different concoctions of natural farming practices, maximum grain yield (3250 kg/ha) and straw yield (6292 kg/ha) was also recorded under integrated crop management. AI-NPOF package resulted in 24.5% higher yield than Gurukul package.

Kurukshetra: Yield attribute characters such as effective tiller/meter row length (74 nos.) and

1000-grans weight (49.8g) resulted higher with AI-NPOF package. Among evaluated practices, maximum grain yield (3785 kg/ha) and straw yield (5148 kg/ha) was recorded under integrated crop management. Improved Gurukul package outperformed after integrated crop management. ICM package resulted in 49.2% higher yield than Gurukul package whereas AINPOF been on par with Gurukul.

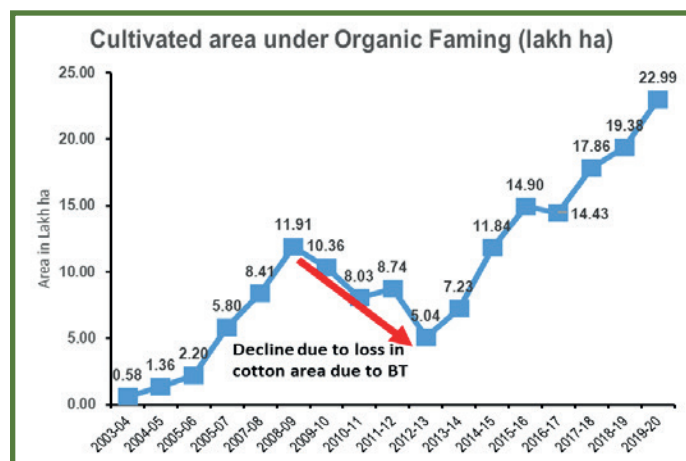


1

INTRODUCTION

India is celebrating the 150th Birth Anniversary of Mahatma Gandhiji during 2020 and in Gandhian way, agrarian economies are classified to three categories such as Subsistence, commercial and marketized. Subsistence farming (farmers grow enough for themselves without a marketable surplus) otherwise known as low external input based farming and commercial farming (farmers produce certain crops for the market but keep their own food system intact by growing their own inputs) are highly relevant to concepts of organic farming. Mahatma Gandhi ji principles does not support marketized farming (buy every input from the seeds to water, tractor, fertilizers – all of which are cash-based). Organic farming principles and practices also discourages the use of market inputs for several reasons such as cost, quality, timely availability etc. In the subsistence and commercial model of farming, the payout for purchasing of inputs are either nil or minimal.

Growing demand for organic food nationally and internationally with the increased awareness for safe and healthy food attracted policy makers to look for alternative environment friendly production systems. Organic farming has been identified as one of the viable alternatives especially in niche areas and crops for improving the production besides making availability of safe food. Institutional development such as National Programme for Organic production (NPOP) launched during 2001, followed by setting up of National Centre of Organic Farming (NCOF) under Ministry of Agriculture and Farmers Welfare and initiation of research through All India Network Programme on Organic Farming (AI-NPOF) under ICAR-Indian Institute of Farming Systems Research by ICAR during 2004 laid the foundation for systematic development of technologies for organic farming in the country. Started with just 58,300 ha



Growth of cultivated area under organic certification in India

during 2003-04 (the year of launch of AI-NPOF by ICAR), the area under organic farming has grown almost 33-fold, reaching to 1.938 million ha by March 2019.

India is ninth largest in terms of total arable land under organic farming and largest in terms of total number of organic producers in the world. Conducive policy, technological advancements, demonstrations, and farmer led innovations have contributed for phenomenal increase in area besides the market. Launch of All India Network Programme on Organic Farming helped significantly for promotion of organic farming practices in India supporting Gandhian principles. 'Towards organic' (integrated crop management) approach for input-intensive areas (food hubs) and 'certified organic' approach by integrating tradition, innovation and science in the de-facto organic areas (hill and rainfed/dryland regions) are found to be the better option for national food security, higher household income and climate resilience which will further enhance the safe food production and meet the social values of Mahatma Gandhi ji.

Considering the consumer awareness and global scenario of organic agriculture, Government of India has set target to bring 4% of net cultivated area under organic farming by 2025. Technology generation and its scaling is essential to achieve the target. Effective management of nutrient, weeds, insect-pest, and disease is the major challenge for successful organic farming. Integrated management comprising cultural, mechanical, and biological practices are warranted for managing nutrient, weeds, pest and diseases in an eco- friendly way in organic farms. To develop package of practices for organic farming in a system perspective, a Network Project on Organic Farming (NPOF) was initiated during 2004-05 by Indian Council of Agricultural Research (ICAR), New Delhi with ICAR-Indian Institute of Farming Systems Research (IIFSR) as lead centre. Initially, the project was operating with 13 centres covering 12 states.

During XII plan, the numbers of centres of have been increased to 20 covering 16 states. Results of multi-location study and experiments conducted under the scheme including geo-tagged characterization of organic farmers, demonstration of organic farming packages, development of integrated organic farming systems and pilot evaluation of natural farming are presented in the report besides other aspects such as publications, human resource development *etc.* Integrated Organic Farming Systems (IOFS) concepts developed and promoted under All India Network Programme on Organic farming involving crops for household consumption, cash crops for income and livestock relies mostly on the on-farm inputs rather than market inputs such as seeds, fertilizers, pesticides *etc.* *thus fulfilling the dream of Mahatma Gandhi ji.*



2

OBJECTIVES AND METHODOLOGY

Scheme Objectives

- To study productivity, profitability, sustainability, quality and input-use-efficiencies of different crops and cropping systems under organic farming in different agro-ecological regions
- To develop efficient crop and soil management options for organic farming
- To develop need-based cost-effective new techniques for farm-waste recycling

Methodology

The experiments in the project have been designed mainly to evaluate the relative performance of location-specific, important cropping systems under organic and conventional (chemical) farming, and assess agronomic efficiency of different production systems. Cropping systems, which are under evaluation, involve cereal crops (mainly basmati rice, coarse rice, durum and *aestivum* wheats, sorghum, barley and maize), pulses and oilseeds (blackgram, cowpea, pigeonpea, chickpea, lentil, linseed, green gram, soybean, mustard, sunflower, safflower and groundnut), spices (black pepper, ginger, turmeric, chillies, onion, and garlic), vegetables (potato, okra, baby corn, cowpea, pea, tomato, frenchbean, summer squash, beetroot, carrot, Broccoli, coriander and cauliflower), cotton and fodder crops (sorghum, maize, cow pea and berseem) in location-specific cropping systems. During 2017-18, following twelve experiments/study were undertaken at different centers:

1. Geo-referenced characterization of organic farmers
2. Evaluation of organic, inorganic and integrated production systems for crops and cropping systems
3. Evaluation of response of different varieties of major crops for organic farming
4. Evaluation of bio-intensive complimentary cropping

systems under organic production systems

5. Development of Integrated Organic Farming System models
6. Evaluation of Farm waste recycling techniques for organic farming
7. Documentation & validation of organic ITKs
8. Evaluation of organic management practices for insect pest in various crops
9. Evaluation of organic management practice for diseases in crops
10. Development of scientific organic package for large cardamom
11. Biochemical characterization & molecular identification of microbial population of different organic manures
12. Evaluation of weed management practices under organic production system
13. Evaluation of concoctions of Natural Farming in Basmati rice-wheat system
14. Cluster based demonstration of Organic Farming Package under TSP

The objectives, locations and treatment details of each experiment at various locations are presented in chapter 7 and at respective tables. General guidelines and standards for the production of organic production, as suggested under National Standards for Organic Production (NSOP), forms the basis for raising the experimental crops in the project. A compact block of land has been earmarked at each of the cooperating centres for experimental purposes, as far as possible. The plot identified was in general, free from hazards of erosion, sediments, chemical pollutants and contaminants. Shelterbelts have been developed by planting multi-purpose trees/shrubs etc. such as *Subabul*, *Sesbania* spp. etc. around the field. The individual centre has been advised to select organic sources of nutrients depending upon the local availability and also in suitable combination(s)

to fulfill the entire requirement of nitrogen and 80-90% requirement of phosphorus and potassium for each cropping system. Cooperating centers have also been advised that each centre should select only those crops for organic farming research in which effective organic (non-chemical) measures are available for plant protection to avoid failure of crops at later stages. Bulky manures were prepared

within the premises of cooperating centres under the project itself or under any other project going on at university/institute/ centre in order to ensure proper quality of inputs. Inputs related to plant protection, bio-fertilizers etc are procured from reliable sources only. Adequate care has also been taken by the centres that seeds purchased from outside are not treated with any chemical seed dresser.



AI-NPOF



+ AI-NPOF (20)

3

LOCATION

Multi-location experiments were conducted during 2017-18 at 20 research centers of SAUs/ ICAR Institutes in 16 states. Statewise details of centres are given below in the order of results presented in the chapter 7.

Sl. No.	Location of centre	State	Address of SAU/ICAR institute
Centres functioning from 2004-05			
1	Bajaura	Himachal Pradesh	CSK HPKV Hill Agri. Res. & Extn. Centre, Bajaura-175 125
2	Bhopal	Madhya Pradesh	ICAR-Indian Institute of Soil Science, Nabi Bagh, Berasia Road, Bhopal - 462 038
3	Calicut	Kerala	ICAR-Indian Institute of Spices Research, P.B. No. 1701, Mari-kunnu PO, Calicut - 673 012
4	Coimbatore	Tamil Nadu	Tamil Nadu Agricultural University, Coimbatore - 641 003
5	Dharwad	Karnataka	University of Agricultural Sciences, Yettinagudda Campus, Krishinagar, Dharwad-580 005
6	Jabalpur	Madhya Pradesh	Jawaharlal Nehru Krishi Viswa Vidyalaya, Jabalpur-482 004
7	Karjat	Maharashtra	Dr. Balasaheb Sawant Konkan Krishi Vidypeeth, RARS, Karjat, Dist. Raigad - 410 201
8	Ludhiana	Punjab	Punjab Agricultural University, Ludhiana-141 004
9	Modipuram	Uttar Pradesh	ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut -250 110
10	Pantnagar	Uttarakhand	G.B.Pant University of Agriculture Sciences and Technology, Pantnagar, Udham Singh Nagar - 263 145
11	Raipur	Chhattisgarh	Indira Gandhi Krishi Vishwavidyalaya, Raipur-492 012
12	Ranchi	Jharkand	Birsa Agricultural University, Kanke, Ranchi - 834 006
13	Umiam	Meghalaya	ICAR Research Complex for NEH Region, Umiam - 737 102
Centres functioning from 2015-16			
14	Ajmer	Rajasthan	ICAR-National Research Centre on Seed Spices, Tabiji, Ajmer-305 206,
15	Almora	Uttarakhand	ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora-263 601
16	Gangtok	Sikkim	ICAR Research Complex for NEH Region, Sikkim Centre, Tadong, Gangtok
17	Narendrapur	West Bengal	School of Agriculture & Rural Development, Ramakrishna Mission Vivekananda University, PO Belur Math, Howrah-711 202,
18	Sardar Krushinagar	Gujarat	Sardar Krushinagar-Dantiwada Agricultural University, Sardar Krushinagar, Banaskantha -385 506
19	Thiruvananthapuram	Kerala	ICAR-Central Tuber Crops Research Institute, Sreekariyam, Thiruvananthapuram - 695 017
20	Udaipur	Rajasthan	Agricultural Research Station, Maharana Prataprana University of Agriculture and Technology, Udaipur

4

MANPOWER

No regular posts, in any category, have been provided and the responsibility was assigned to a scientist, nominated as Principal Investigator of AI-NPOF, by the parent institute/ university (Names and contact addresses of PI's are given in Annexure10). The

scientists of related disciplines were also involved in the research programme by the respective institution. In addition, two senior research fellows (as contractual staff) have been provided at each centre.



5

SOIL AND CLIMATE

Soil type, weather parameters and initial values of soil physico-chemical properties at various locations are presented below.

Soil type, weather, latitude and longitude of the various centres

Sl. No.	Name of centre	Soil Type	Weather				Latitude (N)	Longitude (E)
			Rainfall (mm)	Temperature (°C)		R.H (%)		
				Max.	Mini.			
Centres functioning from 2004-05								
1	Bajura	Silty loam	499.7	21.8	5.3	88.6	-	-
2	Bhopal	Vertisols, Clay Montmorillonite/ smectite type	906.2	32.67	20.91	58.8	23°18'	77°24'
3	Calicut	Clay loam, ustic Humitropept	4121	31.8	22.0	68	11°34'	75°48'
4	Coimbatore	Sandy, Clay, Loam soil	967	29.8	21.3	86	11°	77°0'
5	Dharwad	Clay loam	582.8	31.2	18.8	76.9	15°26'	75°07'
6	Jabalpur	Vertisols, Chromusterts	1096.10	32.4	17.7	78.2	23°90'	79°90'
7	Karjat	Red and medium black	3457	42.9	11.6	-	18°92'	77°33'
8	Ludhiana	Ustochrepts-Ustic pramments association, alluvial, sandy & sandy loam	73.7	33.52	17.02	76.22	24°35'	74°42'
9	Modipuram	Alluvium soils Typic ustochrept	747.0	43.5	2.5	72.7	29°4'	77°46'

Sl. No.	Name of centre	Soil Type	Weather				Latitude (N)	Longitude (E)
			Rainfall (mm)	Temperature (°C)		R.H (%)		
				Max.	Mini.			
10	Pantnagar	Hapludolls, very deep alluvium coarse loomy soils	1191.5	30.1	17.7	84.2	29°N	79°30'
11	Raipur	Ochraquals association, deep black soil	830	33.4	20.8	79.6	21°16'	81°36'
12	Ranchi	Ultic PalesustalFs, very deep soils	1611.2	30.2	15.7	85.1	-	-
13	Umiam	Clay loam	2631.9	26.2	15.3	63.6	24°44'	76°48'
Newl Centres functioning from 2015-16								
14	Ajmer	-	450	-	-	-	36°01'	22°31'
15	Almora	-	-	-	-	-	-	-
16	Gangtok	-	2853.3	29.69	7.20	90.42	27°32'	88°60'
17	Narendrapur	-	-	-	-	-	-	-
18	Sardar Krushinagar	-	931.2	34.31	20.32	61.33	24°-19'	72°-19'
19	Thiruvananthapuram	-	1297.7	32.29	24.23	91.54	-	-
20	Udaipur	Clay loam	813.2	32.15	17.08	71.00	24°35'	74°42'

Initial nutrient status of soil (2017-18)

Centre	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)	S (ppm)	Fe (ppm)	Zn (ppm)	pH	EC (ds/m)
Centres functioning from 2004-05									
Bajaura	-	-	-	-	-	-	-	-	-
Bhopal	0.53	154.2	12.8	530	4.92	5.52	0.74	7.85	0.50
Calicut	1.8	196	6.6	146	-	32	0.10	4.96	.30
Coimbatore	0.66	247	17.5	495	-	30.40	4.10	8.3	0.06
Dharwad	5.87	273.9	28.40	359	13.06	9.50	1.46	7.5	0.13
Jabalpur	0.68	263	12.6	296	9.6	2.39	0.35	7.2	0.39
Karjat	1.14	230	20.0	327	-	-	1.72	7.02	0.28
Ludhiana	0.56	278	36.3	134	-	-	-	8.1	0.50
Modipuram	0.59	-	-	-	-	-	-	-	-
Pantnagar	1.04	350	35.8	235	30.8	30.24	0.84	6.8	0.29
Raipur	0.64	237	13.0	274	-	-	-	7.67	0.28
Ranchi	0.38	-	-	-	-	-	-	-	-
Umiam	1.32	-	-	-	-	-	-	-	-
Centres functioning from 2015-16									
Ajmer	0.28	124.60	11.91	336.22	-	-	-	7.13	0.13
Almora	-	-	-	-	-	-	-	-	-



Centre	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)	S (ppm)	Fe (ppm)	Zn (ppm)	pH	EC (ds/m)
Gangtok	0.88	237.6	14.07	273.6	23.78	-	2.18	5.57	-
Narendrapur	0.89	-	72.03	254.8	-	-	-	6.07	0.19
Sardar Krushinagar	0.33	-	18.60	172.0	8.20	8.40	0.68	7.65	0.13
Thiruvananthapuram	-	-	-	-	-	-	-	-	-
Udaipur	0.56	155.76	2.87	250.13	-	-	-	8.1	0.50



6

BUDGET

A total budget of Rs. 175.0 lakhs were released to 20 centers during 2017-18. The centre wise allocations of funds are given below.

Sl. No.	Name of University/ Institutes	Grant-in-Aid, Other than NEH & TSP				TSP component	Grant-in-Aid, under NEH Component				Grand Total
		Sub-heads			Total other than TSP & NEH	Research Expenses	Sub-heads				
		Domestic T.A.	Research Expenses	Operational charges			Domestic T.A.	Research Expenses	Operational charges	Total NEH	
1.	HAREC, Bajaura	0.26	1.50	2.62	4.38	0.00	0.00	0.00	0.00	0.00	4.38
2.	ICAR-IISS, Bhopal	0.56	2.20	3.45	6.21	0.00	0.00	0.00	0.00	0.00	6.21
3.	ICAR-IISR, Calicut	0.60	3.34	3.63	7.57	0.00	0.00	0.00	0.00	0.00	7.57
4.	TNAU, Coimbatore	1.26	5.05	4.72	11.03	2.50	0.00	0.00	0.00	0.00	11.03
5.	UAS, Dharwad	0.41	3.50	3.25	7.25	0.00	0.00	0.00	0.00	0.00	7.25
6.	JNKVV, Jabalpur	0.26	2.00	2.75	5.01	0.00	0.00	0.00	0.00	0.00	5.01
7.	DBSKKV, ARS, Karjat	0.50	1.95	2.25	4.61	0.00	0.00	0.00	0.00	0.00	4.61
8.	PAU, Ludhiana	0.26	1.50	2.25	4.01	0.00	0.00	0.00	0.00	0.00	4.01
9.	ICAR-IIFSR, Modipuram	0.26	6.90	3.42	10.58	0.00	0.00	0.00	0.00	0.00	10.58
10.	National PI, ICAR-IIFSR, Modipuram	0.06	1.92	2.82	4.80	0.00	0.00	0.00	0.00	0.00	4.80
11.	GBPUA&T, Pantnagar	0.35	5.95	3.25	9.55	0.00	0.00	0.00	0.00	0.00	9.55
12.	IGKV, Raipur	0.26	2.00	3.62	5.88	2.50	0.00	0.00	0.00	0.00	5.88
13.	BAU, Ranchi	0.23	1.08	2.62	3.93	0.00	0.00	0.00	0.00	0.00	3.93
14.	ICAR-RC-NEH, Umiam	0.00	1.25	0.00	1.25	15.00	0.75	1.25	4.25	6.25	22.50
15.	ICAR-NRCSS, Ajmer	0.56	1.75	3.53	5.84	0.00	0.00	0.00	0.00	0.00	5.84
16.	ICAR-VPKAS, Almora	0.35	3.41	2.75	6.51	0.00	0.00	0.00	0.00	0.00	6.51
17.	ICAR-NOFRI, Gangtok	0.00	0.00	0.00	0.00	0.00	0.75	11.25	6.75	18.75	18.75
18.	RMVU, Narendrapur	0.34	2.50	3.80	6.64	0.00	0.00	0.00	0.00	0.00	6.64



Sl. No.	Name of University/ Institutes	Grant-in-Aid, Other than NEH & TSP				TSP component	Grant-in-Aid, under NEH Component				Grand Total
		Sub-heads			Total other than TSP & NEH	Research Expenses	Sub-heads				
		Domestic T.A.	Re-search Expenses	Oper-ayional charges			Domestic T.A.	Re-search Expenses	Oper-ayional charges	Total NEH	
19.	SDAU, Sardarkrushinagar	0.26	2.00	3.62	5.88	0.00	0.00	0.00	0.00	0.00	5.88
20.	ICAR-CTCRI, Thiruvananthapuram	0.82	2.50	5.96	9.28	0.00	0.00	0.00	0.00	0.00	9.28
21.	MPUA&T, Udaipur	0.35	5.19	4.25	9.79	0.00	0.00	0.00	0.00	0.00	9.79
	Total	7.95	57.49	64.56		20.00	1.50	12.50	11.00	25.00	175.00

(Rs. in lakhs)



7

RESEARCH RESULTS

7.1 Geo-referenced characterization of organic farmers

In order to understand the successful practices and constraints of organic farmers, a study on geo-referenced characterization of organic farmers was initiated during 2017-18. A minimum of 30 farms household was fixed as target for collection of information. However, some centers have collected information from less or more number of farmers depending on the resources. The objective of the study was

- To understand and characterize the practice and constraints of organic farmers
- To access the technological gaps of organic farmers

Centre wise results for each centre are presented below.

Ajmer

Total 35 farmers from Ajmer district of Rajasthan were characterized during 2017-18.

- Soil type in surveyed village found to be sandy loam in nature and 65% farmers are having organically converted land holding less than 0.5 and remaining 35% are having between 0.5-1.0 ha.
- Farmers (100%) are using only FYM as nutrient source for crop production.
- Major crops of *kharif* are cluster bean, bajra, green gram, sorghum and maize whereas in *rabi* chickpea, barley, wheat, fenugreek, cumin, fennel occupies the major area of land holding.
- All the farmers are following hand weeding for controlling weeds and most of them are using neem oil and neem leaf extract as insecticide.
- Farmers (100%) are selling their produce in local market and not getting any premium price.

- Average yield of wheat is 1800 kg/ha, fenugreek is 1200 kg/ha, chickpea 2200 kg/ha, cumin 120 kg/ha and barley 2000 kg/ha.
- All the surveyed farmers adopted organic farming due to harmful effect of chemicals in human health.

Bajaura

Geo-referenced characterization survey in organic clusters involving uncertified 30 households in different villages namely Chkurtha, Kharal, Ghurali, Targali Bagaan, Khabal and Kalbari of Banjar block in district Kullu was carried out.

- The survey revealed that villages had a total of 93.4-hectare area, out of which area under Subhash Palekar Natural Farming (SPNF) was 17.66 hectares and rest of the remaining area (75.74) was under conventional farming. This indicated that out of total surveyed farmers, 93% were marginal and 7% farmers were small.
- In the survey village, 3% of farmers had power tiller, 33% of farmers had hand power weeder. All the farmers had sprayer/duster.
- Among the surveyed famers of the village, 100% of the farmers had cows and 36% had calves whereas, approximately 23% farmers also rear sheep/goats.
- In the surveyed village, the gross area under vegetable, cereal, spice, pulse and fruit crops was 9.68 ha, 3.88 ha, 0.32 ha, 1.04 ha and 2.50 ha with average production of 8046 kg, 5009 kg, 9125 kg, 819 kg and 192 kg/hectare, respectively
- Cauliflower crop had maximum area (2.36 ha) and total production (21600 kg) in *kharif* season followed by maize (2.08 ha and 14290 kg). A large proportion of the vegetable and fruit produce are sold in the market, however maize, blackgram

and kulthi consumed by the farmers.

- During *rabi* season, the pea crop had maximum area (3.04 ha.) as well as total production (23050 kg) followed by wheat (area 1.80 ha & production 5145 kg) and onion (area 0.32 ha) with a total production of 2920 kg. The vegetables are marketed but wheat and onion were kept for their own consumption.
- During summer season farmers grow vegetables like french bean and tomato only. Tomato had maximum area (3.42ha.) than frenchbean (1.10 ha.) with production of 28585 kg/ha and 6585 kg/ha, respectively. Only a small quantity of their produce is kept for self-consumption and rest is sold in the market.
- The farmers in the surveyed village obtained gross return of Rs.4,62,209/ha in respect to vegetables and Rs.11,520/ha in case of fruits. The farmers were financially assisted by ATMA Project, Department of Agriculture, Kullu and Himachal Pradesh.
- The computation of yield gap for major crops between on-station experiment and at farmers field revealed that all the crops had higher yield under on-station experiment than farmers field. The blackgram crop showed maximum yield increases (13.89%) followed by maize with an increase of 7.66%.

Bhopal

Geo-referenced organic cluster survey was carried out at Perwalia Sadak, Mugaliya hat, Tara Sevaniya and Raati Bar villages of Tehsil- Huzur, District-Bhopal, Madhya Pradesh.

- Among the respondents in the villages, total maximum land holding was around 18 ha while minimum was 1.0 ha. Out of which the maximum area under organic farming was 8 ha and minimum was 1 ha. The area spared for cereal crop has been diverted to vegetable production and other cash crops like groundnut and cut flowers.
- Among the on-farm resources, farmyard

manure (FYM) is still the most predominant source of organic manures being used by the farmers followed by vermin-compost. Besides this, the farmers are now switching over to poultry manure in nearby area Bhopal city for nutrient management. Crop residue recycling and composting of crop residue with cattle dung is also being practiced by farmers.

- Madhya Pradesh is the soybean state, all the farmers grow soybean including 10% area under vegetables during *kharif* and depending on the water availability either wheat or chickpea is grown during *rabi*. Farmers have started planting orchard plants like guava, pomegranate and custard apple.
- Neem oil, mattha and cow urine spray are the major organic pesticides for the management of insect, pest and diseases in organic crops. Trichoderma is most commonly used bio-control agent under organic farming. Most of the farmers under organic farming practicing manual weeding whereas, summer ploughing and crop rotation were the other practices for the management of weeds.
- Only 10-20% of organic produces is reserved for household consumption and the rest sold out in either krishi mandi or local market.
- Minimum requirement of off-farm inputs, demonstration, awareness created by ICAR-IISS for soil health and encouragement from state govt. agency was the major reason behind the adoption of organic farming. Knowledge about access to market, certification agency and price for organic produce has increased amongst organic farmers.

Calicut

Geo-referenced characterization of organic cluster at Irulam, district wayanad, kerala was carried out. Total 30 farmers of Irulam, in wayanad district were characterized in which 98% of land was found under organic farming.

- Total 30 farmers were surveyed, and 98% land



found to be under organic farming. The major crops were pepper, coffee, coconut, arecanut, ginger, turmeric and banana. These farmers were characterized under Large-0, Medium-1 and Small-29. Farmers having farm animals – 23 and farm machineries – 13.

- Crop residue availability within the farm for recycling - 4 t /ha/year , vermi-compost /biogas unit – 8 from which mean production from vermi-compost unit is 0.45t/year. Hand weeding used for weed control.
- Indocert, Alwaye, Kerala was the certification Agency, Organic Wayanad is the market mode. Major reason for adoption of organic farming- for healthy and safe food. Major constraints for adoption of organic farming is low price, diseases, lack of sufficient govt support and labour

Characterization of organic cluster at Irulam

Crops	Number of Farmers	Land under organic cultivation (ha)	Profit/ha (Rs)
Pepper	30	12.135	461269
Coffee	30	8.93	10571
Coconut	24	7.88	135025
Areca nut	14	2.80	172714
Cardamom	10	1.055	121421
Ginger	5	0.345	171014
Banana	6	0.638	127351
Cocoa	1	0.10	250000

Coimbatore

Geo-referenced characterization survey was carried out for 30 households in organic clusters in different villages of Thondamuthur block, Coimbatore District, Tamil Nadu.

- The mean holding size is 2.5 ha out of which 80% area maintained under organic farming consisting 4 dairy animals per household. Major crops under organic farming are tomato, brinjal, bhindi, onion, coconut, areca-nut and turmeric.

Yield gap between on-station and farmers field were 11,13,14,13,13,11 and 10% respectively. Major constraints for yield gap were labour intensive and time involvement for organic inputs preparation, inadequate availability of organic inputs in time, lengthy process for getting organic certification, inadequate market facilities, lack of premium price for organic products, inadequate scientific research on organic farming.

- Thondamuthur block selected under PKVY scheme. The cluster formed PGS as in the name of Kovai Thendral Organic Group consisting of 20 members from different villages within the geo-organic cluster. The PGS groups cultivating the high value crops such as turmeric, areca nut, coconut, onion, bhendi, tomato and brinjal. Individual member of the groups are involved in entrepreneurial activities such as panchagavya, ghana jeevamruth, fermented fruits extract, sale of mullu seethaa jam, organic ghee, desi poultry birds and eggs. All the members are maintaining 80% of their land under organic, 15 % for animal husbandry and 5 % for fodder cultivation. Prompting and adoption of organic farming, effective use of farm wastes and sharing experiences among the groups and themselves. Received best stall award 2018 through participation in the KISAN SAMRDDHI MELA 2018 held at CODISSIA Trade Fair complex, Coimbatore during August 2018.

Gangtok

Timpyem village is situated in East district of Sikkim lying 27°33.94'N lat and 88°60.32'E long and 1330 m altitude. East Sikkim has been selected for geo-referenced characterization; data of organic farming was collected.

- Total 13 nos. of farm families reside in the villages and base line survey has been completed. Baseline survey has been completed during July 2017, mostly there are small and marginal farmers (90.4%) in the village. The cropping intensity of the village is hardly 125 per cent



approx. Crop production with low organic input is practiced by the farmers resulting in very low yield of the crops. During winter season no and very scanty rainfall observed in the village for the last few years.

- Farmers was encouraged to grow crops such as, maize, rice, vegetable pea and winter vegetables like squash (*Sechium edule*), yam etc. as food for consumption purpose and as feed for livestock.
- As pig farming is mostly followed by the farmers, improved piggery (Hampshire x local) was promoted. Some farmers practice dairying and poultry, backyard poultry farming system with vanaraja variety. The cow dung is used for vermicomposting, FYM preparation etc.
- All the wastage, crop residues, weed biomass etc. from the farmer's field is collected and stored near the compost unit. Water harvesting structures such as jalkunds, farm ponds etc. would be developed to provide necessary additional water during off season or lifesaving irrigation for rabi and pre-kharif crops. Unused land in village

is used for community fodder cultivation (e.g., Broom grass, napier etc) to supply green fodder to the dairy unit.

- Farmers of the village managed to sell the birds at the rate of Rs. 300/- per kg and Rs. 12/- per egg and therefore, backyard poultry farming supplemented income generation for livelihood improvement. Total earning from vanaraja backyard poultry was in the range of Rs. 85,200 to 95,500/- in the village. The performance of backyard poultry (5.24 q/ha), dairy cattle (8665 lit.), piggery (13.68 q/ha) were recorded before the intervention of technologies and after technological interventions; the performance increased to 11.2%, 11.1%, 13.4% incremental changes.
- Interventions raised the productivity of maize and rice to 3420 kg/ha and rice 2240 kg/ha as compared to 2150 kg/ha and 1890 kg/ha, respectively. Similarly, total rice production increased 22.80 tonnes from 6.2 ha of land during 2016-17 as compared to pre-intervention of 12.65 tonnes.

Table 7.1.1. Area, production and productivity of crops in East Sikkim:-

Crop	Location I (Timpyem)				Location II (Thanka)			
	Yield at farmers Field (kg/ha)	Yield at Research Field (kg/ha)	Yield Gap (q/ha)	Yield Gap (%)	Yield at farmers Field (q/ha)	Yield at Research Field (q/ha)	Yield Gap (q/ha)	Yield Gap (%)
Rice	18.90	34.90	16.00	45.85	19.88	34.90	15.02	43.04
Maize	21.50	32.60	11.10	34.05	22.42	32.60	10.18	31.23
Soybean	7.80	11.26	3.46	30.73	8.02	11.26	3.24	28.77
Buckwheat	6.80	10.20	3.40	33.33	6.2	10.20	4.00	39.22
Mustard	6.20	8.90	2.70	30.34	5.8	8.90	3.10	34.83
Pea	31.20	42.50	11.30	26.59	32.8	42.50	9.70	22.82
Ginger	20.64	40.35	19.71	48.85	22.8	40.35	17.55	43.49
Beans	3.52	8.48	4.96	58.49	4.87	8.48	3.61	42.57

Karjat

Geo-referenced characterization of organic cluster at karjat in district Raigad, Maharashtra was surveyed namely mhasala, mangaon and mahad.

- Total 30 farmers were characterized in which 9.02 ha. (26.35%) of land was found under organic

farming with latitude-180.05.5995 to 180.32.2683 longitude- 73⁰.07.8476 to 73⁰.42.7094 out of 34.23 ha total land holding having red and medium black soil type

- Cropping systems rice-vegetables was followed including, rice crop in *kharif* whereas in *rabi*,



brinjal, okra, tomato, cucumber, snake gourd, ridge gourd, bottle gourd, bitter gourd, dolichos bean, chilli and onion were the major crops. Fruit crops (mango, cashew, jackfruit and coconut) were adopting the farmers.

- Farmers possessing farm animals - 86, buffalo-11 Nos., cow-25 Nos., bullock-50 nos. and poultry birds-1590 nos. Crop residue availability within the farm for recycling shed waste-69.94%, straw-29.98% and poultry wast-0.08%.
- Plant protection measures for controlling the weeds through hand weeding in seasonal crops and animal grazing in rainfed fruit crops. Major organic inputs FYM, compost and vermin-compost. Farmers using cow urine and Dashparni Aark for Insect & pest management:
- Scarcity of laborer's and high wage rates due to urbanization and industrialization, lack of information about organic inputs, non-availability of labours at the time of transplanting and harvesting, fluctuation in market prices and

lack of co-operative marketing are the major constraint

Pantnagar

Geo-referenced characterization of organic farmers was carried out in the villages namely, Dakshni Patkot, Bhalon and Patkot of under Ramnagar Taluk in Nainital district of Uttarakhand. Total 40 nos. of organic farmers surveyed. Among the 40 farmers surveyed, the land holding size of the organic farmers found to be in ranged from 0.4 ha to 1.6 ha, out of which, the 41.6% farmers grow basmati rice. Yield gap of basmati rice between on-station and farmers field was recorded 11.1%

Thiruvananthapuram

Geo-referenced survey of 30 farmers practicing organic farming in Malappuram district of Kerala was conducted. The survey was carried out in Ponnani, Kuttippuram and Mankada blocks, Malappuram, Kerala (Figs. 1, 2 & 3).

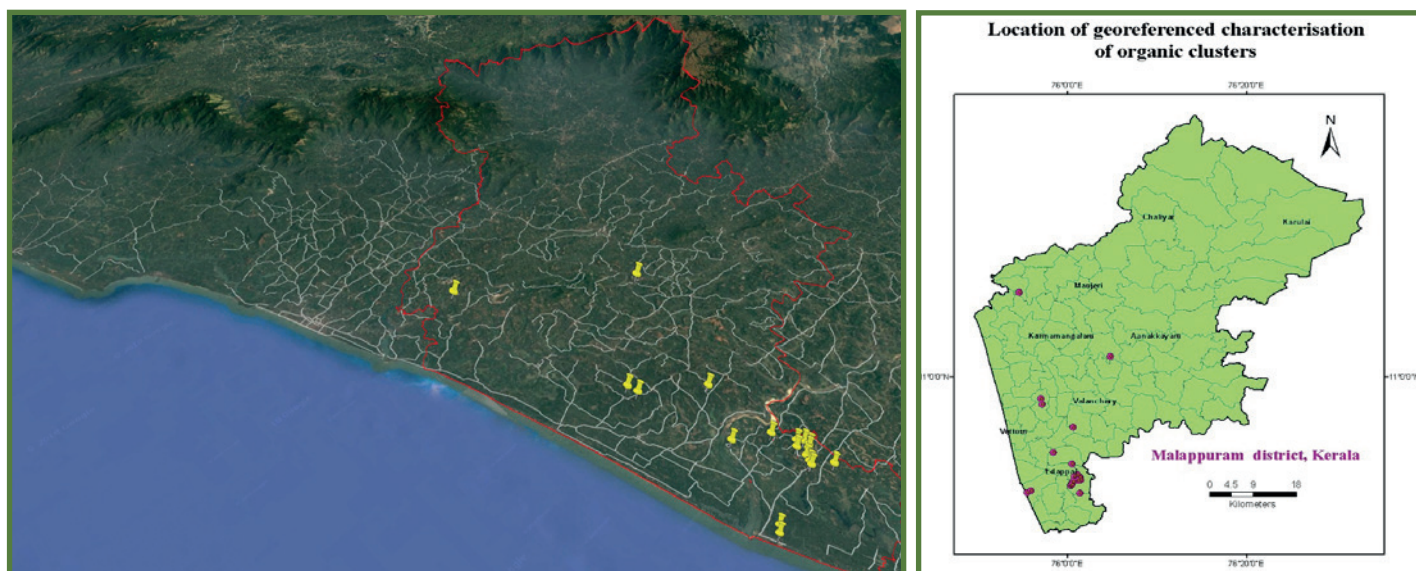


Fig. 1. Location maps of georeferenced characterization of organic clusters in Malappuram district of Kerala

- Sixty per cent of the farmers belonged to the small and marginal group with a land holding size <2 ha. Average land holding size was 1.85 ha. Most of the farming situation surveyed was rainfed (60%), remaining were irrigated. The soil type was laterite (100%)
- Being health conscious and aware of the quality of the organic produce, all the farmers used the organic produce for their house-hold consumption (100%), and the surplus was sold to the market by 93.33% of the farmers.

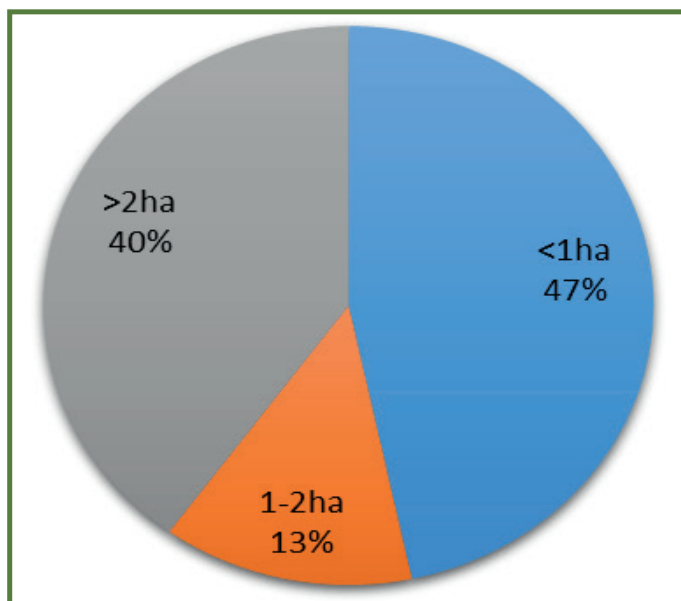


Fig. 2. No. of farmers based on land holding size

- Rice, fruit crops (banana); vegetables (okra, brinjal, bitter gourd, snake gourd, bottle gourd, ridge gourd, ash gourd, pumpkin, cucumber, chillies, amaranth, vegetable cowpea); root and tuber crops (cassava, yams, elephant foot yam, taro, arrowroot, sweet potato); spices (ginger, turmeric) and plantation crops (coconut, arecanut, pepper) are the major crops in the area (Fig.3).

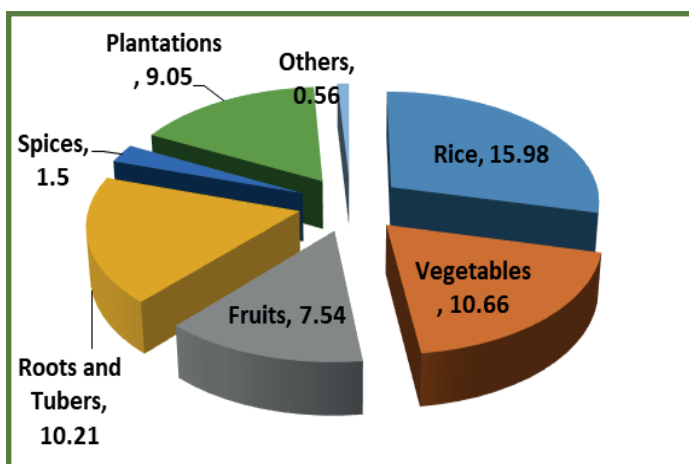


Fig. 3. Area occupied by crops

- About 56.66% of the surveyed farmers owned cow, 16.67% had goat, 53.33% had poultry (hen and turkey) as an integral part of organic farming (Fig. 3).

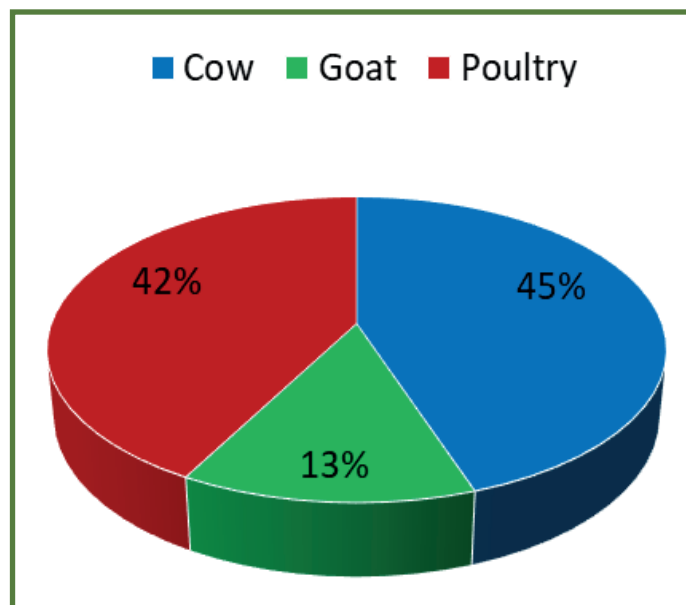


Fig. 4. Relative share of animals

- Cow dung slurry/FYM (100%), poultry manure (60%), vermicompost (23.33%), biogas slurry (16.67%), neem cake (63.33%), ground nut cake (20%), coir pith compost (3.33%), bio-formulations like *Panchagavya* (10%), *Jeevamrutham* (16.67%), and green manuring (10%) are the nutrient sources for organic farming. Some were using ash (40%) and bone meal (33.33%) also. Majority of farmers conducted soil testing before raising the crop. Animal wastes were converted to excellent manures using biogas (in 30% cases) and vermi compost units (50% farms) with an average capacity to produce nearly 200 kg compost/ annum.
- Application of neem oil-garlic emulsion (43.33%), neem oil (16.67%), fish amino acid (46.67%), egg amino acid (23.33%), *Kanthari* emulsion (16.67%), neem soap (16.67%), *Beauveria* (56.67%), *Trichoderma* (73.33%), *Pseudomonas* (66.67%), pheromone trap (20%) as insect pest management. Also practicing cultural methods, intercropping, trap crops on field bunds and some indigenous practices.
- Mostly uncertified (96.67%) organic farmers were at surveyed village, whereas few certified farmers (3.33%) were there. High input cost, non-



availability of quality organic manures, labour shortage, small and fragmented land holdings,

low price of the produce, damage due to pig attack was the constraints of organic farming.



Glimpses of the survey at Thiruvananthapuram

Udaipur

Total 50 households selected from 4 tehsils i.e. Birothi, Basiwada, Judli and Dabla of Udaipur District were surveyed during 2017-18. The highlights of the Geo-referenced on-farm characterization of organic growers of Rajasthan are given below.

- Average land holding size is 1.2 ha whereas, average land holding size under organic farming is 0.75 ha.
- Average number of animals per household is 5.57

whereas, average number of animals per ha is 4.5.

- Average vermicomposting production is 2.25 tonnes year⁻¹. Crop residues available for recycling is 2.0 ton/household.
- Majority of farmers grow maize in *kharif* and wheat in *rabi*. Average yield of maize is 1500 kg/ha and average yield of wheat is 2400 kg/ha. On average, 5.5-ton FYM/ha in maize during *Kharif* and 1.5 tonne FYM/ha in wheat during *Rabi* was used. Fruit and vegetables were grown

- organically for home consumption.
- Use of neem leaves and Go-mutra based indigenous botanical concoctions were used for plant protection in crops, fruit and vegetables. On average, 6.57 kg neem leaves were used as insecticide during *kharif* & *rabi*.
- For weed management only hand weeding practice was using by the farmers. On average 40 man-days during *kharif* and 25 man-days during *rabi* were used in weeding.

- Labour intensive and costly weed management, low productivity of crops, lack of availability of large quantity of organic inputs from small land holding and no assured market with premium price for organic product are major constraints faced by organic farmers.
- Farmers are associated with NGOs and SHGs. Farmers get training from NGOs/SHGs & also sale the produce to these organizations as well as nearby market at Udaipur.



Survey at village Basiwada



Survey at village Birothi



Survey at village Judli



Survey at village Dabla



Survey at village Basiwada



Survey at village Birothi

Geo-referenced on – farm characterization of organic growers of Rajasthan



7.2 Evaluation of organic, inorganic and integrated production packages for crops and cropping systems

Title of the experiment: Evaluation of management packages for crops and cropping systems and its influence on crop productivity and soil health.

Objectives

The experiment was conducted at all the 20 locations with the following objectives.

- To study the impact of organic, conventional and integrated management practices on crop productivity and soil health
- To study the impact of various management practices on microbial population of soil and economics

Year of start: The experiment was originally planned

during 2004-05. However, the year of start varied with the centres depending upon the establishment of infrastructure for conducting the experiments. All the centres started the experiment during 2004-05 except Modipuram and Umiam where it was started during 2005-06. From 2015-16, 7 new centres were included and start the experiment namely Ajmer, Almora, Narendrapur, Sardarkrushinagar, Gangtok, Thiruvananthapuram and Udaipur.

Treatments: The experiment was conducted in strip plot design as un-replicated trial. However, Karjat and Umiam centre have conducted the experiment with three replications in split plot design. The experiment stands modified by dividing the organic, inorganic and integrated plots divided into two for each cropping systems.

The treatments imposed in main plots are given below.

Main Plot	Organic management (Organic)	Supply of 100% nutrients through organic sources and complete organic management
		Supply of only 75% nutrients through organic sources + innovative inputs (any two of cow urine @10%, Panchagavya, PGPR and vermiwash @10%) and complete organic management
	Inorganic management (Chemical)	100% inorganic nutrients and management
		Either state recommendation or farmers package (Choice to centres)
	Integrated management (Towards organic)	50% organic + 50% inorganic source of nutrients and management
		75% organic +25% inorganic source of nutrients and management
Sub Plots	Cropping Systems	Location specific cropping system 1
		Location specific cropping system 2
		Location specific cropping system 3
		Location specific cropping system 4

The cropping system was selected, as per suitability for the location and was assigned into the sub plots. The number of cropping systems ranged from 3 (Calicut and Coimbatore) to as high as 5 (Dharwad) in various centres. The details of cropping systems are given in Tables along with experimental results. Nutrient package for the organic and integrated

management packages were formulated based on recommended nitrogen dose of each system.

Locations: The experiment was conducted in five eco-systems as mentioned below. These locations represent the different ecological regions of Agro-ecological zone.



Eco-system	Locations (State)
Arid	Ajmer (Rajasthan)
	Dharwad (Karnataka)
	Sardar Krushinagar (Gujrat)
Semi-arid	Bhopal (Madhya Pradesh)
	Coimbatore (Tamil Nadu)
	Ludhiana (Punjab)
	Modipuram (Uttar Pradesh)
	Udaipur (Rajasthan)
Sub-humid	Almora (Uttarakhand)
	Gangtok (Sikkim)
	Jabalpur (Madhya Pradesh)
	Raipur (Chhattisgarh)
	Ranchi (Jharkhand)
Humid	Bajaura (Himachal Pradesh)
	Pantnagar (Uttarakhand)
	Narendrapur (west Bengal)
	Umiam (Meghalaya)
Coastal	Calicut (Kerala)
	Karjat (Maharashtra)
	Thiruvananthapuram (Kerala)

The details of inputs used for organic nutrient management and their nutrient content at various locations are given below.

Source of nutrient inputs and their NPK content at various locations

Centre	Nutrient Sources	NPK contents on dry weight basis (%)		
		N	P	K
Bajaura	Vermi-compost	0.90	0.20	0.75
	FYM	0.98	0.25	0.90
	Urea	46.0	-	-
	SSP	-	16.0	-
	MOP	-	-	58.0
	Rock phosphate	-	34.0	-
Bhopal	Vermi-compost	1.14	0.72	0.68
	Neem cake	1.50	0.92	1.04
	Sesbaniastrata	2.90	0.7	1.54
Calicut	Farm Yard Manure	0.75	1.0	0.55
	Neem cake	1.50	0.36	1.51
	Ash	-	0.20	6.3
	Vermi-compost	0.76	0.88	0.65



Centre	Nutrient Sources	NPK contents on dry weight basis (%)		
		N	P	K
	Green leaf manure	2.02	0.16	1.10
	Rajphos	-	18.5	-
	Urea	46	-	-
	MOP	-	-	58
Dharwad	Enriched compost	0.70	0.40	0.80
	Vermi-compost	1.00	0.86	0.98
	Farm yard manure	0.50	.025	0.49
	Glyricidia(Green leaf manure	0.50	0.32	1.15
Jabalpur	Green manure (Sun hemp)	0.66	0.13	0.50
	FYM	0.54	0.20	0.26
	Vermi-compost	1.6	0.75	1.00
	Neem Oil Cake	5.2	1.10	1.50
	Urea	46	-	-
	SSP	-	16	-
	MOP	-	-	60
Karjat	F.Y.M.	0.50	0.25	0.50
	Neem cake	5.20	1.00	1.40
	Vermi-compost	1.50	1.00	1.50
	Glyricidia green leaves	2.74	0.50	1.15
	Paddy straw	0.61	0.16	1.14
Ludhiana	Urea	46.0	-	-
	DAP	18.0	46.0	-
	MOP	-	-	60.0
Modipuram	FYM	0.51	0.30	0.65
	VC	1.28	0.47	1.39
	Sesbania	2.25	0.41	3.01
	Urea	46.0	-	-
	DAP	18.0	46.0	-
	MOP	-	-	60.0
Raipur	Enriched compost	0.40	0.36	0.56
	Cow dung manure	0.57	0.39	0.72
	NEOC-Non edible oil cake	3.2	0.72	1.59
	Rock phosphate		22	
Ranchi	FYM	0.50	0.30	0.50
	Vermi compost	1.2	0.45	1.4
	Karanj cake	4.0	1.0	1.0
	Urea	46.0		
	SSP		16.0	

Centre	Nutrient Sources	NPK contents on dry weight basis (%)		
		N	P	K
Umiam	MOP			60.0
	F.Y.M.	0.72	0.29	0.61
	Vermicompost	1.50	0.62	1.00
	Rock phosphate	-	18.00	-
	Tephrosiaspp	3.31	0.44	1.46
Narendrapur	Vermicompost	1.5	1.0	0.5
	Sashyagavya	1.0	0.015	0.125
	Panchagavya	1.8	0.23	0.44
	Kunapajala	2.34	1.23	1.12
Thiruvananthapuram	Green manure cowpea	2.80	0.52	2.02
	FYM	1.28	0.50	0.28
	Neem cake	0.95	0.29	0.59
	Vermi compost	0.97	0.42	0.45
	Ash	1.40	0.29	4.65
	Panchagavya	0.22	0.061	0.40
	Vermi wash	0.02	0.004	0.20
Udaipur	Vermicompost	1.114	0.278	0.317
	Neem Cake	5.091	1.135	1.397
	NADEP Compost	1.04	0.382	1.071
	Enriched Compost	1.361	0.472	0.973
	FYM	0.502	0.248	0.507

Results

The parameter wise result of 2017-18 for each centre are presented and discussed.

Studies on comparative efficiency of organic, inorganic and integrated management practices on crop productivity system equivalent yield of different cropping systems (Table 1-3)

Bajaura

Among the crops, evaluated under vegetable-based cropping systems, the general performance of tomato, cauliflower frenchbean, blackgram, summer squash, lady finger and pea were found to be better

under integrated (towards organic) followed by organic production systems. During *summer*, higher tomato fruit yield (11080 kg/ha) was observed with organic package (75% organic +innovative organic practices i.e. 10% vermiwash) whereas, during *kharif* yield of tomato found to be higher with integrated with 75% organic +25% inorganic (1650 kg/ha). The yield of blackgram (990 kg/ha), lady finger (5580 kg/ha) during *kharif*, cauliflower (10680 kg/ha), pea (8640 kg/ha) during *rabi* observed maximum with 50% organic+50% inorganic however, frenchbean (5050 kg/ha) and summer squash (15380 kg/ha) during summer season was highest in term of yield



with 75% organic+25% inorganic under integrated production system. Under integrated production system, yield increase over inorganic production system was observed to the tune of 54.1, 13.5, 30.3, 108.4, 93.1 and 33.1% cauliflower, frenchbean, blackgram, summer squash, lady finger and pea respectively while in tomato, it was increase 37.5% with organic than inorganic. In terms of system equivalent yield (cauliflower equivalent), blackgram-cauliflower-summer squash resulted in higher cauliflower equivalent yield (22358 kg/ha) among

the cropping systems. Among different management practices, integrated management with 50% organic+50% inorganic dose of nutrients resulted in higher equivalent yield (19384 kg/ha) followed by application of 75% nutrients only through organic manures+ 25% nutrient supply through inorganic sources (18530 kg/ha). cauliflower equivalent yield was increased to the tune of 56 and 15.7% with integrated nutrient (50% each organic and inorganic) over inorganic and organic nutrient management.



Best performing production system at Bajaura

Bhopal

All the crops in the systems such as soybean, wheat, mustard, chickpea and linseed recorded higher yield under organic management followed by integrated with 75% organic+25% inorganic nutrients. Higher mean yield of soybean (1495 kg/ha) was recorded under 100% organic management practice followed by management practices either with 75% nutrients application through organic manures+ innovative practices (1412 kg/ha) or under integrated (1432 kg/ha). The yield of soybean was found to be higher by 17.9 and 12.9% with organic and integrated (75% organic+25% inorganic) compared to inorganic production system respectively. The yield of durum wheat, mustard, chickpea and linseed was recorded maximum in 100% organic management of 3853, 1654, 1850 and 1587 kg/ha respectively. The yield difference between organic and inorganic

management was 18.1, 10.8, 12.3, and 15.7% for durum wheat, mustard, chickpea and linseed respectively. Straw yield of crops also followed the similar trend. In terms of system equivalent yield (soybean equivalent), organic management registered higher equivalent yield (3816 kg/ha) with 100% nutrients through organic manures followed by integrated with 75% nutrients application through organic manures + 25% inorganic (3804 kg/ha) than inorganic management packages. The soybean equivalent yield was increased with organic management of 12.3% over inorganic however, 75% nutrient supply was made through organic manure +25% inorganic under integrated management recorded higher to the tune of 11.9%. Among the cropping systems, soybean-chickpea recorded higher soybean equivalent yield (4011 kg/ha) followed by soybean-wheat (3637 kg/ha).



Soybean, wheat, mustard and linseed crops under organic management practice at Bhopal

Calicut

Spices crops such as ginger, turmeric and black pepper were evaluated under different management packages. Among the different management packages, integrated package consisting of 75% nutrient supply through organic manure +25% inorganic recorded higher yield of ginger and turmeric (29642 and 34667 kg/ha respectively) followed by 100% application of nutrients through organic manures. In case of black pepper, yield was higher under organic (100% organic manure) management followed by integrated than inorganic. In comparison to inorganic, the yield of ginger and turmeric was increased to the tune of 108.5 & 18.5% and 75.3 & 10.1% with integrated (75% nutrient organic manure +25% inorganic) and 100% organic management respectively.

Coimbatore

Among the management practices, all the crops registered higher yield towards organic either with 75% nutrients through organic manures +25% through inorganic source under integrated management compared to 100% nutrients supply through organic sources and inorganic management. Maize yield was increased to the tune of 17.3 and 3.4% with integrated package of 50% each nutrient over organic and inorganic management whereas the yield of cotton (1675 kg/ha), chilli (5893 kg/ha) sunflower (1655 kg/ha), and beetroot (22800 kg/ha) was recorded higher with 75% nutrient through organic+25% inorganic under integrated management package. The yield was increased by 15.3, 8.4, 18.7 and 31.0% over inorganic management respectively.



Best performing cropping system maize-beetroot and chilli-sunflower at Coimbatore

Dharwad

All the crops such as; cowpea, safflower, sorghum, groundnut and maize recorded higher yield under organic management either in 100% organic nutrients or 75% organic + innovative practice whereas, green gram recorded higher with integrated (50% each organic and inorganic nutrients application). The yield increase over inorganic was found to be 35.4, 16.4, 38.1, and 23.2%, for cowpea, safflower, sorghum and groundnut respectively. Pigeon pea and cotton crops performed better under inorganic management practice. Reduction in yield was found to be 2.4 and 23.1% in pigeon pea and cotton respectively with organic production package over inorganic. System equivalent yield as influenced by production management found to be on par however, state production package recorded maximum cotton equivalent yield. Among the cropping systems,

groundnut + hybrid cotton (2:1) and maize-chickpea registered higher cotton equivalent yield (1748 and 1311 kg/ha respectively) than other systems.

Jabalpur

Basmati rice-based cropping systems with wheat (*durum*), chickpea, maize (fodder), berseem (fodder and seed), vegetable pea and *rabi* sorghum was grown in 4 cropping sequences. Mean grain yield of basmati rice and other crops as influenced by different nutrient management was higher with inorganic production system. The yield reduction in basmati rice with organic and towards organic was found to be 9.8 and 7.0% respectively. The reduction in the yield of wheat, chickpea, maize (fodder), berseem seed, vegetable pea and sorghum (fodder) with 100% organic management package was much higher (11.7, 20.4, 10.6, 22.2, 25.6 and 19.1% respectively over inorganic nutrients management. Among the

different production systems, total productivity of cropping system in terms of basmati rice equivalent was recorded higher with 100% inorganic nutrient management (5901 kg/ha) followed by integrated (5727 kg/ha). Among the crop-sequences, rice-vegetable pea- sorghum fodder led to record highest basmati rice equivalent yields (5785 kg/ha) followed by rice-wheat.

Karjat

The rice-based cropping systems including vegetable crops were evaluated. Higher mean yield of rice (4752 kg/ha) was recorded with application of 50% organic+50% inorganic nutrient in integrated package but on par with organic. The yield variation by management package with organic (100%) and inorganic was recorded only 2.3 and 1.71% lower than integrated management. Chickpea and onion also resulted good yield with integrated package and found to be higher by 5.8 & 15.8% and 6.1 & 18.2% over organic and inorganic respectively. Field bean yield recorded higher with organic package having 100% nutrient application through organic sources but difference in yield was only 20kg/ha over inorganic nutrient management. Other crops such as brinjal resulted in higher with inorganic package (50155 kg/ha). System productivity in term of rice equivalent yield, rice- brinjal system grown with organic package of 100% nutrient by organic sources produced maximum rice equivalent yield (62967 kg/ha) compared to other treatments followed by



same system grown under 75% organic + innovative practices (57201kg/ha). Among the management package, organic management with 100% nutrient supply through organic sources recorded 22.0% higher over inorganic management practice.

Ludhiana

In case of basmati rice, organic, inorganic and integrated management package did not differ and found in range from 3890-4050 kg/ha, however maximum yield of basmati rice (4050 kg/ha) was recorded in organic management with through application of 75% organic manure + innovative practice under basmati rice-wheat system. Other *kharif* crop, soybean was also obtained higher yield (1580 kg/ha) under organic package (100% organic) and it was 26.4% higher compare to inorganic packages. Summer moong (1300 kg/ha) performed better with 75% organic + innovative practice under organic package and produced significantly 88.4% more yield compared to inorganic practices. However, wheat recorded higher yield (6030 kg/ha) under inorganic package under cluster bean-wheat-summer moong system and it was about 5.31% higher over 100% organic management. In term of system productivity among the management practices, wheat equivalent yield resulted in higher either in organic (100%) or with 75% organic + innovative practice. Among the cropping systems, it was higher in cluster bean-wheat-summer moong followed by basmati rice-wheat system.





Rice, wheat and soybean crops under organic farming at Ludhiana

Modipuram

The response of different crops in the systems differed for the type of input packages applied. Among the various crops in the systems, basmati rice, recorded higher yield (4398 kg/ha) under organic production package, while rice, maize (popcorn), barley, potato, okra and green gram recorded higher yield towards organic under integrated system. In case of basmati rice yield, it was 32.9% higher under organic compared to inorganic package, whereas the reduction in yield was noticed with organic by 13.5, 16.9, 13.6, 25 and 27.1% in rice, maize (popcorn), barley, potato and green gram, over integrated package, respectively. Maize (sweet corn), wheat and mustard performed better under inorganic package. The yield under organic was decreased to the tune of 26.5, 42.6 and 17.2% compared to inorganic. Productivity among the various systems, maize-potato-okra-sesbania recorded higher rice equivalent yield of 32499 kg/ha because of higher yield of potato and

good premium price followed by maize (sweet corn)-mustard-sesbania (GM). The system equivalent yield was higher (19346 and 19769 kg/ha) in integrated packages and on par with inorganic nutrient package (19195 kg/ha).

Pantnagar

Higher yield of basmati rice during *kharif* was recorded with organic package as it recorded mean grain yield of 4976 kg/ha followed by integrated package 4858 kg/ha but been on par. The yield increase under organic was 18.1% over inorganic package. Among *rabi* crops, wheat recorded higher yield under integrated package (4852 kg/ha) but, the same was at par with inorganic (4735 kg/ha). Coriander was raised as intercrop with chickpea and vegetable pea in the manner of 4:2 ratio. Yield of main and intercrop converted into chickpea and vegetable pea equivalent. Chickpea and vegetable equivalent yield were influenced by different nutrient management and recorded highest (2586 and 9491

kg/ha) in organic (100% nutrient application through organic sources). Organic management package was increased for chickpea and vegetable pea equivalent to the tune of 9.5 and 16.7% over inorganic practice. A remarkable difference in tuber yield of potato was observed under organic management and increase in yield was found to be 19.6% over inorganic. The straw yield of both *kharif* and *rabi* crops have resulted in similar trend. System productivity in

terms of basmati rice equivalent yield found to be higher with organic management (11505 kg/ha) having 100% nutrients through organic manures followed by integrated (50% each organic + input) of 11106 kg/ha. Among all the cropping systems, higher system productivity was recorded with basmati rice-chickpea +coriander-sesbania system (13398 kg/ha) followed by rice-vegetable pea +coriander-sesbania (11331kg/ha).



Performance of Basmati rice (Pant Basmati-1) under different production systems at Pantnagar



Basmati rice-chickpea (4:2) and basmati rice-potato cropping system at Pantnagar under organic management

Raipur

Soybean based cropping systems were evaluated with maize, pea, chilli, and onion under different mode of management. Organic production system either by 100% organic manure or 75% organic + innovative practice (foliar spray of vermin-wash (10%) followed by cow urine (10%) at 20 days interval) resulted in higher soybean yield (1790 and 1935 kg/ha respectively). The yield of soybean with 100% organic manure and 75% organic + innovative practice was enhanced by 14.4 and 3.6% compare

to 100% inorganic. Other crops such as maize (sweet corn), pea, and chilli (14217, 7347 and 8613 kg/ha respectively) also resulted higher yield with 75% organic manures+ innovative practices (foliar spray of vermin-wash (10%) followed by cow urine (10%) under organic while, onion bulb yield recorded higher with state recommendation (15896 kg/ha). Yield reduction in onion with organic was found to be 17.6%. The yield differences from 100% organic to inorganic were found to be 17.5, 51.6 and 6.4% for maize, pea and chilli respectively. The straw yield

of all crops was also found to be in same trend. The productivity of cropping system in term of soybean equivalent yield recorded higher under organic management with 75% organic nutrient + innovative

practices (7201 kg/ha) and it was increased by 14.9% over inorganic. Soybean-maize cropping system registered higher soybean equivalent yield (7485 kg/ha) followed by soybean-chilli (6753 kg/ha).



Soybean and chilli crop under organic management at Raipur

Ranchi

Rice based cropping systems were evaluated wherein different crops such as wheat, lentil, potato and linseed were grown with basmati rice variety Birsamati. In rice, organic management practice (100% and 75% organic manure +innovative practice "Azolla along with vermiwash spray") resulted in higher mean yield (3359 and 3518 kg/ha respectively). The differences from 100% organic to inorganic were found to be 19.5 and 25.2% respectively. Other crops like potato and linseed recorded higher with organic package whereas, lentil perform better with integrated. The yield was increased with

organic in potato and linseed to the tune of 34.2 and 30.0% respectively over inorganic package. Wheat recorded highest yield (2678kg/ha) under inorganic package. The yield was decrease with 100% organic and towards organic (75% organic+25% inorganic) by 9.3 and 6.7% respectively. Among the management practice, systems equivalent yield was higher (6189 kg/ha) in organic with 100% organic source of nutrients followed by 75% organic + innovative practices. Among the cropping systems, rice-potato recorded highest system equivalent yield (8508 kg/ha) while rice-linseed recorded lower equivalent yield (4145 kg/ha).



Performance of rice under organic and management at Ranchi



Linseed crop



Wheat



Lentil



Potato

Umiam

Four vegetable-based cropping system namely broccoli-carrot, broccoli -potato, broccoli -french bean, broccoli -tomato on raised beds and four rice varieties Megha Aromatic 2, Shahsarang-1, Ngoba, Lampnah on sunken beds were evaluated under four management practices viz. 100% organic, 75% organic + innovative practice i.e. (10 % vermiwash and 10% cow urine), integrated management with 50% inorganic+50% organic and 100 %inorganic. The higher broccoli yield was recorded with broccoli-french bean cropping system (15310 kg/ha) under organic management followed by integrated. The yield of broccoli was enhanced on raised bed by 13.7 and 5.4% over inorganic and towards organic (integrated). Other vegetable crops viz. carrot, potato, french bean and tomato recorded maximum yield under 100% organic with 16210, 16150, 9070 and 18390 kg/ha respectively which was followed by integrated management practice. Among the

vegetable crops, carrot potato, frenchbean and tomato have recorded 8.9, 7.4, 6.6 and 12% higher yield with organic (100% nutrients application through organic sources) over inorganic package. Residue yield of vegetables have also given same trend. Rice equivalent yield of broccoli-vegetables cropping system were recorded maximum with 100% organic (39440 kg/ha) followed by integrated treatment (38620 kg/ha). Among the cropping systems, system productivity in terms of rice equivalent yield, rice-tomato systems recorded higher equivalent yield (39270 kg/ha) while rice-carrot system was the second-best system. Among the management practices on sunken beds, the higher rice yield (4630 kg/ha) was recorded with integrated package having 50% organic+50% inorganic nutrients followed by 100% organic (4570 kg/ha). Among the rice varieties, Shahsharang-1 produced maximum grain yield (4620 kg/ha) followed by Lampnah (4440 kg/ha), Megha Aromatic 2 (4250 kg/ha) and Ngoba (4130 kg/ha).



Rice in sunken bed



Broccoli on raised bed



Vegetables (carrot, potato, French bean and tomato) on raised beds at Umiam

Table 7.2.1: Influence of organic, inorganic and integrated package on grain yield (kg/ha) of crops in cropping systems at various locations

Locations/Crop- ping systems	Organic						Inorganic						Integrated (towards organic)					
	100% Organic			75% Irganic + Innova- tive organic practices			100% Inorganic			State recommendation			50% Organic +50% Inorganic			75% Organic +25% Inorganic		
	Kharif	Rabi	Sum- mer	Kharif	Rabi	Sum- mer	Kharif	Rabi	Sum- mer	Kharif	Rabi	Sum- mer	Kharif	Rabi	Sum- mer	Kharif	Rabi	Sum- mer
Bajaura																		
Tomato-cauliflow- er- french bean	1520	9640	4540	1550	8460	4020	1250	6930	3040	1580	10580	4450	1600	10680	4860	1650	10380	5050
Fallow-cauliflow- er-tomato	-	7370	10640	-	8000	11080	-	6830	6020		8220	8060		8890	10020		8090	9040
Black gram-cau- liflower- summer squash	950	8030	8710	960	8560	9510	760	5280	7380	980	8830	11870	990	10540	14000	950	9170	15380
Lady finger-pea	4110	7480		4260	7800		2890	6490		4530	8240		5580	8640		5320	8330	
Bhopal																		
Soybean-durum wheat	1483	3853		1456	3673		1311	3263		1294	3253		1323	3450		1460	3780	
Soybean- mustard	1492	1654		1436	1593		1224	1493		1267	1463		1301	1520		1460	1617	
Soybean- chickpea	1533	1850		1342	1780		1252	1647		1284	1627		1402	1703		1445	1813	
Soybean- linseed	1471	1587		1415	1490		1283	1372		1342	1353		1318	1377		1363	1530	
Mean (Soybean)	1495			1412			1268			1297			1336			1432		
Calicut																		
Ginger	25933			23866			14067						22400			25867		
Turmeric	32267			29008			29317						33750			34667		
Black pepper (Fresh yield kg/ vine)	1.76			-			1.07						1.72			-		
Coimbatore																		
Maize - cotton - green manure	5233	1478		5784	1625		5908	1453		5626	1519		6138	1606		6057	1675	
Chillies - sunflow- er - green manure	4914	1369		5126	1483		5438	1394		5695	1516		5502	1478		5893	1655	
Beetroot - maize - green manure	20100	4487		19200	4576		17400	4735		18600	4695		21500	4968		22800	5401	
Dharwad																		

Locations/Crop- ping systems	Organic						Inorganic						Integrated (towards organic)					
	100% Organic			75% Organic + Innovative organic practices			100% Inorganic			State recommendation			50% Organic + 50% Inorganic			75% Organic + 25% Inorganic		
	Khariif	Rabi	Sum- mer	Khariif	Rabi	Sum- mer	Khariif	Rabi	Sum- mer	Khariif	Rabi	Sum- mer	Khariif	Rabi	Sum- mer	Khariif	Rabi	Sum- mer
Cowpea/green-gram-safflower	65	780		61	1106		48	950		49	869		60	878		55	794	
Pigeon pea (Sole)	915			761			800			937			807			761	-	
Green gram-sorghum	40	1768		24	1608		49	1280		48	1597		45	1820		56	1724	
Groundnut + hybrid cotton (2:1)	748+805			1174+852			953+775			1107+1108			840+864			1030+881		
Maize-chickpea	5374			4370			5319			4676			5306			4497		
Jabalpur																		
Basmati rice-wheat (durum)-green manure	2427	3851		2153	3420		2838	4360		1706	4125		2722	4236		2661	4082	
Basmati rice-chickpea - maize fodder	2501	503	45600	2170	490	31000	2644	632	51000	1938	488	61000	2966	690	45600	2597	415	37400
Basmati rice-berseem (Seed and fodder)	2619	175 S + 71200 GF		2348	145 S + 68200 GF		2931	225 S + 76500 GF		2115	195 S + 68200 GF		2793	195 S + 65200 GF		2670	156 S + 62200 GF	
Basmati rice-vegetable pea - sorghum (fodder)	2573	2652	65500	2286	2221	61000	2804	3565	83100	2459	3125	74100	2641	3551	75100	2503	3100	74000
Mean (Rice)	2530			2239			2804			2055			2781			2608		
Karjat																		
Rice-brinjal	-	45227			41270			50155			36130			46440			44846	
Rice-chickpea	-	1727			1527			1578			1406			1827			1817	
Rice-field bean	-	1240			1077			1220			1049			1234			1149	
Rice-onion (White)	-	16538			11481			14842			11350			17549			13211	
Mean (Rice)	4644			4236			4672			4375			4752			4432		
Ludhiana																		
Basmati rice-chickpea-GM	3980			3920			3890			3930			4030			4010		
Basmati rice-wheat-GM	3900	4080		4050	3920		3870	4500		3910	4350		3960	4380		4020	4080	

Locations/Crop- ping systems	Organic						Inorganic						Integrated (towards organic)					
	100% Organic			75% Irganic + Innova- tive organic practices			100% Inorganic			State recommendation			50% Organic +50% Inorganic			75% Organic +25% Inorganic		
Kharif	Rabi	Sum- mer	Kharif	Rabi	Sum- mer	Kharif	Rabi	Sum- mer	Kharif	Rabi	Sum- mer	Kharif	Rabi	Sum- mer	Kharif	Rabi	Sum- mer	
Cluster bean- wheat-summer moong		5710	1260		5570	1300		6030	690		5830	690		5790	1020		5920	970
Soybean -wheat	1580	4650		1500	4470		1250	5000		1270	4810		1500	4880		1550	4930	
Modipuram																		
Basmati rice- wheat (durum) - sesbania green manure	4398	2583		4130	3000		3308	4250		3486	4500		3980	4083		3920	3500	
Rice- barley (malt) - green gram	2742	3969	516	2872	4017	466	2967	4330	508	3129	4409	566	3170	4594	708	2931	4123	641
Maize (pop corn) - potato- okra - sesbania green manure	1186	19916	1316	1205	19457	627	1018	21832	907	1129	23749	1010	1398	25998	1334	1427	26540	753
Maize (sweet corn) - mustard - Sesba- nia green manure	4281	2815		3892	2593		4670	3402		5838	3349		5448	3312		4281	3143	
Pantnagar																		
Basmati rice- wheat	4704	4701		4624	4460		4088	4735		4200	4564		4680	4852		4856	4678	
Basmati rice -chickpea (4rows+2rows coriander)	5272	2586 (1060** +998*)		4536	2501 (987** +990*)		4448	2362 (842** +994*)		4496	2440 (888** +1015*)		4976	2484 (942** +1008*)		4864	2425 (851** +1029*)	
Basmati rice -veg- etable pea (4 rows vegetable pea +2 rows coriander)	5080	9491 (4759** +1092*)		4872	8830 (4583** +980*)		4304	8133 (4528** +832*)		4384	8326 (4443** +896*)		4936	9081 (4813** +985*)		4768	8992 (4910** +942*)	
Basmati rice -potato	4848	11739		4720	11491		4008	9814		4096	10062		4840	10559		4768	10248	
Mean (Basmati rice)	4976			4688			4212			4294			4858			4814		
Raipur																		
Soybean-maize	1787	13309		1947	14217		1632	12104		1652	13147		1433	9131		1543	9347	

Locations/Crop- ping systems	Organic						Inorganic						Integrated (towards organic)					
	100% Organic			75% Organic + Innovative organic practices			100% Inorganic			State recommendation			50% Organic + 50% Inorganic			75% Organic + 25% Inorganic		
	Kharif	Rabi	Sum- mer	Kharif	Rabi	Sum- mer	Kharif	Rabi	Sum- mer	Kharif	Rabi	Sum- mer	Kharif	Rabi	Sum- mer	Kharif	Rabi	Sum- mer
Soybean-pea	1954	5668		1990	7347		1547	4847		1797	5078		1473	4384		1463	4264	
Soybean-chilli	1793	7935		1857	8613		1595	8094		1648	8558		1370	8175		1453	8305	
Soybean-onion	1627	13092		1947	13559		1485	15669		1718	15896		1420	11363		1511	12117	
Mean (Soybean)	1790			1935			1565			1704			1424			1493		
Ranchi																		
Rice -wheat	3359	2428		3559	2321		2838	2678		2499	1964		3199	2570		3277	2499	
Rice -lentil	3299	500		3477	428		2720	536		2399	393		3077	678		3159	571	
Rice -potato	3499	11495		3599	10710		2920	8568		2478	7140		3199	9282		3277	9818	
Rice -linseed	3277	928		3438	875		2760	714		2360	643		2999	750		3077	821	
Mean (Rice)	3359			3518			2810			2434			3119			3198		
Umiam																		
Vegetable-vegetable systems on raised bed																		
Broccoli -carrot	12210	16210		11230	14090		12130	14880					12530	16070				
Broccoli - potato	12430	16150		11160	14400		11890	15040					12110	15770				
Broccoli -french bean	15310	9070		13730	7810		13470	8510					14520	8960				
Broccoli -tomato	14580	18390		13330	15710		13120	16420					14340	17950				
Mean (Broccoli)	13633			12363			12653						13375					
Rice- fallow system in sunken bed																		
Megha aromatic 2-fellow													4250					
Shasharang -fellow													4620					
Ngoba -fellow													4130					
Lampnah -fellow													4440					
Mean (Rice)	4570			4040			4210						4630					
Centres started from 2015-16																		
Ajmer																		
Green gram - fennel	602	1423		606	1551		664	1513		745	1698		627	1658		792	1777	

Locations/Crop- ping systems	Organic						Inorganic						Integrated (towards organic)					
	100% Organic			75% Organic + Innovative organic practices			100% Inorganic			State recommendation			50% Organic + 50% Inorganic			75% Organic + 25% Inorganic		
<i>Kharif</i>		<i>Rabi</i>	<i>Sum- mer</i>	<i>Kharif</i>	<i>Rabi</i>	<i>Sum- mer</i>	<i>Kharif</i>	<i>Rabi</i>	<i>Sum- mer</i>	<i>Kharif</i>	<i>Rabi</i>	<i>Sum- mer</i>	<i>Kharif</i>	<i>Rabi</i>	<i>Sum- mer</i>	<i>Kharif</i>	<i>Rabi</i>	<i>Sum- mer</i>
Green gram - cori- ander	602	601		606	621		664	573		745	658		627	615		792	684	
Cluster bean - fennel	1146	1423		1108	1551		1124	1513		1232	1698		1139	1658		1343	1777	
Cluster bean - coriander	1146	601		1108	621		1124	573		1232	658		1139	615		1343	684	
Gangtok																		
Maize + ginger (1:1) - french bean	3030+	4580		2980+	4560					1390+	3240		2560+	4300				
Maize + soybean (1:1) - buckwheat	3360+	2770		3120+	2430					1440+	950		2670+	1740				
Maize + turmeric (1:1) - rajmash	3060+	1380		2980+	1070					1230+	400		2640+	760				
Maize + pigeon pea (2:1)	3360+			3450+						1080+			2980+					
	1120			1150						570			920					
Narendrapur																		
Basmati rice - broccoli - sesbania green manure	2719	1630		2725	1578		2322	1389		2425	1327		2630	1436		2590	1489	
Paddy - mustard- green gram	5760	756	1310	5720	698	1319	5200	660	1191	5362	638	1152	5800	785	1240	5820	640	1210
Paddy - capsicum- green gram	5720	2542	1310	5538	2456	1299	5298	2010	1181	5315	2222	1161	5983	2128	1226	5895	2308	1221
Paddy - french bean - sesame	6021	6588	1308	5730	6600	1370	5442	6100	1211	5630	6145	1200	5815	6445	1286	5850	6047	1259
Sardar Krushi- nagar																		
Groundnut- Wheat - Green gram	1747	3963	669	1586	3858	601	1881	4243	666	1933	4765	672	1944	4343	718	1906	4226	693

Locations/Crop- ping systems	Organic						Inorganic						Integrated (towards organic)						
	100% Organic			75% Irganic + Innova- tive organic practices			100% Inorganic			State recommendation			50% Organic +50% Inorganic			75% Organic +25% Inorganic			
Kharif		Rabi	Sum- mer		Kharif	Rabi	Sum- mer		Kharif	Rabi	Sum- mer		Kharif	Rabi	Sum- mer		Kharif	Rabi	Sum- mer
Greengram- Cum- in- Vegetable cowpea	578		4252		562		4359		573	415	4845		625	539	5115		672	410	5833
Greengram-Fen- nel- Fennel cont.	546		1217		533	1200			543	1639			636	1828			669	1706	
Thiruvanantha- puram																			
Cassava-veg. cowpea	27610	1540			27860	1085			36750	1047			29960	985			32880	1022	
Cassava-ground- nut	27610	813			27860	823			36750	1060			29960	607			32880	885	
Taro-black gram	3700	643			2830	628			793	449			896	579			2810	710	
Taro-greengram	3700	453			2830	395			793	112			896	288			2810	175	
Udaipur																			
Maize + black- gram (2:2)-wheat (durum)-sesbania (GM)	1600 +150	3000			1607 + 178	3286			1607+ 207	4000			1685 +192	4286			1628 +171	3357	
Blackgram-wheat (Triticum aestivum)	342	2929			407	3000			421	3571			371	3714			411	3429	
Sweet corn + blackgram (2:2)- chickpea	2000 +157	486			2178 +171	500			2714+ 185	679			2857 +192	700			2357 +200	607	
Soybean - fenu- greek	464	1786			471	1929			642	1857			607	1893			571	1786	
																	535	1500	

Table 7.2.2: Influence of organic, inorganic and integrated package on straw yield (kg/ha) of crops in cropping systems at various locations

Locations/Crop- ping systems	Organic						Inorganic						Integrated (towards organic)					
	100% Organic			75% Irganic + Innovative organic practices			100% Inorganic			State recommenda- tion			50% Organic +50% Inorganic			75% Organic +25% Inorganic		
	Kharif	Rabi	Sum- mer	Kharif	Rabi	Sum- mer	Kharif	Rabi	Sum- mer	Kharif	Rabi	Sum- mer	Kharif	Rabi	Sum- mer	Kharif	Rabi	Sum- mer
Bajaura																		
Tomato-Cauli- flower- French bean			1410	1730		1660	1610		1000	1820		1600	1830		1550	1790		1580
Fallow-Cauli- flower-Tomato			3000			2810			2540			3080			3060			3200
Black gram-Cau- liflower- Sum- mer squash	1720			1720			1630			1730			1790			1770		
Lady finger-Pea	1880			1900			1700			1900			2020			2050		
Bhopal																		
Soybean-durum wheat	6134	9037		5474	8533		5174	7500		5113	7797		5592	7947		4843	8427	
Soybean- mus- tard	4827	6853		5404	5923		5002	5573		5490	5130		5049	5053		6026	5673	
Soybean- chick- pea	5961	5067		5230	4887		5576	4373		5060	4378		5313	4713		5188	4930	
Soybean- lin- seed	4838	4377		5300	4017		4963	3577		5167	3517		4969	3677		5467	4143	
Mean	5440			5352			5179			5207			5231			5381		
Jabalpur																		
Basmati rice- durum wheat- green manure	3689	4189		3109	3900		4185	5715		2407	5341		4003	7112		3907	6650	
Basmati rice- chickpea - maize fodder	3656	1216		3136	1133		3880	1480		2771	1287		4386	1216		3806	1133	
Basmatirice-ber- seem (fodder and seed)	3841			3415			4331			4132			4114			3921		

Locations/Crop- ping systems	Organic				Inorganic				Integrated (towards organic)						
	100% Organic		75% Irganic + Innovative organic practices		100% Inorganic		State recommenda- tion		50% Organic +50% Inorganic			75% Organic +25% Inorganic			
	Kharif	Rabi	Sum- mer	Kharif	Rabi	Sum- mer	Kharif	Rabi	Sum- mer	Kharif	Rabi	Sum- mer	Kharif	Rabi	Sum- mer
Basmati rice- vegetable pea- sorghum (fodder)	3769			3318			3050	3590		3876			3659		
Basmati rice Mean	3739			3245			3862	3225		4095	4164		3823		
Ludhiana															
Basmati rice- chickpea-GM	6900	-		6780	-		3890	-	3930	-	4030	-	4010	-	
Basmati rice- wheat-GM	6520	6150		7300	6040		3870	6700	3910	6490	3960	6620	4020	6340	
Cluster bean- wheat-summer moong	2800	8450		2840	9010		690	9580	690	8470	1020	8430	970	9630	
Soybean -wheat	3560	7490		3230	7220		1250	7440	1270	6970	1500	7220	1550	7440	
Modipuram															
Basmati rice- wheat (durum) - sesbania green manure	8800	4983		7820	4958		7070	6517	7280	6550	7640	6225	7590	6542	
Rice- barley (malt) - green gram	5990	5841	1828	5930	6583	1497	5720	7075	5890	7608	6280	7766	6130	6858	2258
Maize (pop corn) - potato- okra + Sesbania green manure	1877	-		1991	-		1786	-	2005	-	2243	-	2323	-	
Maize (sweet corn) - mustard - Sesbania green manure	5597	7768		5107	7073		6262	12098	7698	9484	7094	9772	5568	8440	
Pantnagar															
Basmati rice- wheat	5522	5400		5428	5146		4255	5472	4930	5271	5494	5669	5701	5417	

Locations/Crop- ping systems	Organic				Inorganic				Integrated (towards organic)			
	100% Organic		75% Organic + Innovative organic practices		100% Inorganic		State recommenda- tion		50% Organic +50% Inorganic		75% Organic +25% Inorganic	
	Khari	Rabi	Sum- mer	Khari	Rabi	Sum- mer	Khari	Rabi	Sum- mer	Khari	Rabi	Sum- mer
Basmati rice -chickpea (4rows+2rows coriander)	5945	3146		5115	2839		5070	2811		5841	2856	
Basmati rice -vegetable pea (4 rows vegeta- ble pea +2 rows coriander)	5963			5719			4944			5566		
Basmati rice -potato	5467			5769			4437			5458		
Basmati rice mean	5725			5503			4842			5589		
Ranchi												
Rice -wheat	5301	3749		5398	3641		4587	3356		5159	3927	
Rice -lentil	5177	1553		5355	1428		4463	1321		4962	1999	
Rice -potato	5476	1856		5598	1821		4355	1464		5177	1571	
Rice -linseed	5105	2499		5284	2338		4587	1821		4784	2035	
Rice mean	5265			5409			4498			5021		
Umiam												
Rice- fallow sys- tem on sunken bed												
Megha aromatic 2-fellow	6830											
Shasharang - fellow	6710											
Ngoba -fellow	6930											
Lampnah -fel- low	6790											
Mean	6470			6910						6890		
Centre started from 2015-16												
Sardarkrushi- nagar												

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Table 7.2.3: Influence of organic, inorganic and integrated package on systems productivity (kg/ ha) at various locations

Locations/Treatments	Organic		Inorganic		Integrated (towards organic)		Mean
	100% organic	75% organic + innovative organic practices	100% inorganic	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bajaura (CEY)							
Tomato-cauliflower- frenchbean	16455	14648	11668	17328	17955	17930	15997
Fallow-cauliflower-tomato	18010	19080	12850	16280	18910	17130	17043
Black gram-cauliflower- summer squash	20935	21955	15810	23585	26450	25410	22358
Lady finger-pea	11590	12060	9380	12770	14220	13650	12278
Mean	16748	16936	12427	17491	19384	18530	
Bhopal (SEY)							
Soybean-durum wheat	3928	3786	3381	3358	3512	3858	3637
Soybean-mustard	3773	3633	3283	3285	3398	3690	3510
Soybean- chickpea	4340	4043	3751	3753	3986	4196	4011
Soybean- linseed	3222	3470	3175	3208	3217	3473	3294
Mean	3816	3733	3398	3401	3528	3804	
Dharwad (Cotton EY)							
Cowpea/greengram-safflower	470	631	537	497	513	466	519
Pigeon pea (Sole)	741	617	648	759	654	617	673
Green gram-sorghum	659	585	499	608	682	661	616
Groundnut + hybrid cotton (2:1)	1470	1896	1622	2091	1611	1797	1748
Maize-chickpea	1431	1163	1416	1245	1412	1197	1311
Mean	954	978	944	1040	975	947	
Jabalpur (REY)							
Basmati rice - wheat (durum) - green manure	5312	4728	6071	4706	6016	5817	5442
Basmati rice - chickpea - maize fodder	4402	3719	4916	3890	5203	4228	4393
Basmati rice-berseem (fodder and seed)	5005	4529	6113	4897	5535	5136	5203
Basmati rice - vegetable pea-sorghum (fodder)	5600	4957	6505	5729	6155	5761	5785
Mean	5080	4483	5901	4806	5727	5236	
Karjat (REY)							
Rice-brinjal	62967	57201	55213	40808	51613	49750	52925
Rice-chickpea	13141	11988	10179	9451	10997	10624	11063
Rice-field bean	13843	12371	12391	9920	11184	10347	11676

Locations/Treatments	Organic		Inorganic		Integrated (towards organic)		Mean
	100% organic	75% organic + innovative organic practices	100% inorganic	State recommendation	50% organic + 50% inorganic	75% organic+ 25% inorganic	
Rice-onion (White)	45131	32838	32973	26184	38193	29791	34185
Mean	33771	28600	27689	21591	27997	25128	
Ludhiana (WEY)							
Basmati rice-chickpea-GM	6900	6800	5400	5400	5600	5500	5933
Basmati rice-wheat-GM	14400	14600	12100	11900	12100	11900	12833
Cluster bean-wheat-summer moong	15600	16500	11800	10700	11700	12700	13167
Soybean -wheat	12800	12300	9600	9200	9900	10200	10667
Mean	12425	12550	9725	9300	9825	10075	
Modipuram (REY)							
Basmati rice- wheat (durum) - sesbania green manure	9579	9209	9136	9106	9090	9627	9291
Rice- barley (malt) - green gram	9100	8749	8679	8651	8636	9146	8827
Maize (popcorn) - potato- okra + sesbania green manure	34399	33602	29261	32251	32968	32514	32499
Maize (sweet corn) - mustard - sesbania green manure	18997	21453	21325	26770	26688	27788	23837
Mean	18019	18253	17100	19195	19346	19769	
Pantnagar (Basmati rice EY)							
Basmati rice-wheat	8782	8494	8195	8160	8889	8914	8572
Basmati rice -chickpea (4rows+2rows coriander)	14323	13290	12715	13036	13670	13352	13398
Basmati rice -vegetable pea (4 rows vegetable pea+2 rows coriander)	12198	11495	10404	10629	11747	11512	11331
Basmati rice -potato	10718	10465	8915	9127	10120	9892	9873
Mean	11505	10936	10057	10238	11106	10917	
Raipur (SEY)							
Soybean-maize	8308	8913	7563	8094	5907	6123	7485
Soybean-pea	5468	6545	4553	4946	4191	4106	4968
Soybean-chilli	6713	7196	6614	6954	6439	6601	6753
Soybean-onion	5686	6150	6343	6646	4942	5267	5839
Mean	6544	7201	6268	6660	5370	5524	
Ranchi (REY)							
Rice -wheat	5913	6000	5654	4564	5902	6000	5672
Rice -lentil	4445	4460	3948	3300	4633	4460	4208
Rice -potato	9841	9508	7647	6223	8320	9508	8508



Locations/Treatments	Organic		Inorganic		Integrated (towards organic)		Mean
	100% organic	75% organic + innovative organic practices	100% in-organic	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Rice -linseed	4558	4644	3744	3246	4033	4644	4145
Mean	6189	6153	5248	4333	5722	6153	
Umiam (BEY)							
Vegetable-vegetable systems on raised bed							
Broccoli -carrot	-	-	-	-	-	-	37710
Broccoli - potato	-	-	-	-	-	-	34260
Broccoli -french bean	-	-	-	-	-	-	35830
Broccoli -tomato	-	-	-	-	-	-	39270
Mean	39440	34510	34490	-	38620		
Gangtok (MEY)							
Maize + ginger (1:1)-french bean	-	-	-	-	-	-	15000
Maize + soybean (1:1) - buckwheat	-	-	-	-	-	-	7100
Maize + turmeric (1:1) - rajmash	-	-	-	-	-	-	10700
Maize + pigeon pea (2:1)	-	-	-	-	-	-	2600
Mean	11300	10600		5300	8400		
Sardar Krushinagar (GEY)							
Groundnut- Wheat- Green gram	4962	4646	4372	4646	4548	4429	4601
Greengram- Cumin- Vegetable cowpea	13241	13429	15136	16863	17426	15604	15283
Greengram-Fennel- Fallow	6943	6801	6020	6816	6675	6181	6573
Mean	8382	8292	8509	9442	9550	8738	
Udaipur (MEY)							
Maize + blackgram (2:2)-wheat (durum)-sesbania (GM)	8200	8921	10450	10985	9035	9905	9583
Blackgram - wheat (<i>Triticum aestivum</i>)	7622	8142	9312	9284	8983	8343	8614
Sweet corn + blackgram (2:2)-chickpea	6562	7051	8805	9204	7937	7427	7831
Soybean - fenugreek	4152	4409	4723	4693	4423	3857	4376
Mean	6634	7131	8323	8542	7595	7383	

Ajmer

Seed spices coriander and fennel was evaluated with green gram and cluster bean in system mode. The performance of green gram, cluster bean, coriander and fennel were found to be better towards organic practice with integration of 75% organic +25%

inorganic input under integrated package followed by state recommendation package. Among nutrient management practice, seed yield of green gram, clusterbean, coriander and fennel was higher by 19.3, 19.5, 17.4 and 19.4% respectively over inorganic whereas, it was higher by 31.6, 17.2, 24.9 and 13.8% respectively over organic production package



Performance of green gram, cluster bean, coriander and fennel crops with 75% organic +25% inorganic input under integrated package at Ajmer

Almora

Different nutrient sources were evaluated for finger millet + black soybean (2:1 ratio - substitution of row)-wheat + toria (2:1 ratio) and grain amaranth-wheat + lentil (2:1 ratio) under rainfed system. Among crop management systems, application of 100% N requirement of crop through organic manure

produced highest wheat equivalent grain yield of 3535 and 8306 kg/ha for finger millet + black soybean-wheat + toria and grain amaranth-wheat + lentil, respectively (Fig. 1). The highest yielding treatment recorded 68 and 107% higher wheat equivalent grain yield of finger millet + black soybean-wheat + toria and grain amaranth-wheat + lentil, respectively than 100% inorganic package, respectively.

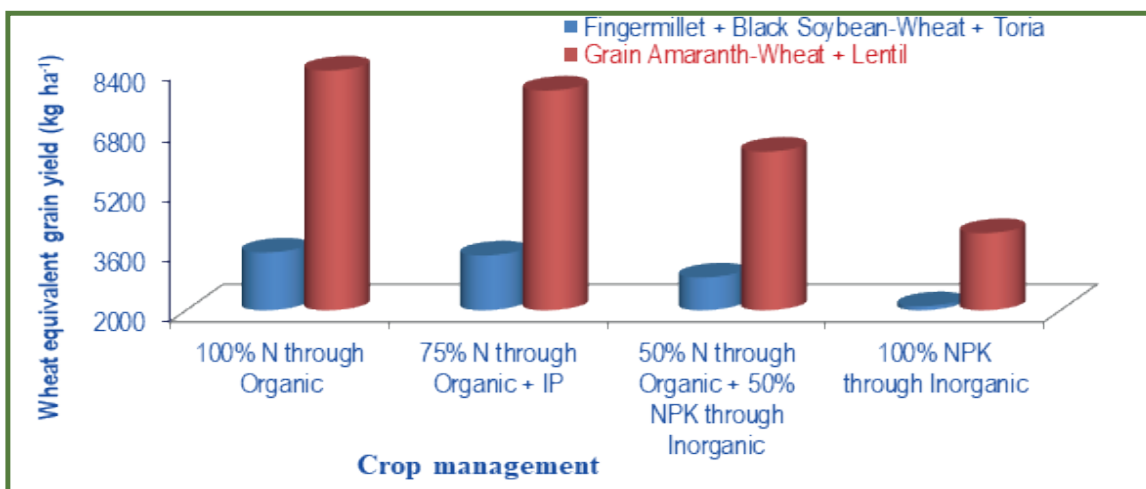


Fig.3. Wheat equivalent grain yield of finger millet + black soybean-wheat + toria and grain amaranth-wheat + lentil in different crop management system (IP = Innovative practices - 3% Panchagavya and vermiwash)

Gangtok

Four production package with intensified nutrient sources viz. T1:100% N equivalent though organics (25% FYM+25% VC+25% NK+25% MC), T2:75% N equivalent though organics (25% FYM+25%VC+25%MC) + panchgavya + vermiwash, T3: 50% N equivalent though organics (50% FYM+50%VC) + panchgavya + vermiwash + Cow urine+ BF and T4:Farmer's practices (50% of recommended dose of organic N on individual crop basis) were evaluated. In general, yield of all crops with intensified nutrient sources were more productive over the farmer's practices. Yield of



maize with intercrops ginger, turmeric, soybean and pigeon pea during *kharif* remarkably higher with organic package. . Similarly, frenchbean, buckwheat and rajmash also recorded higher yield with organic (100% N equivalent though organics (25% FYM+25% VC+25% NK+25% MC), while comparing the total productivity of intensified cropping systems in terms of maize grain equivalent yield of system, significantly higher maize grain equivalent yield (MEY) was recorded with maize + ginger (1:1)- french bean (15000 kg/ha) followed by maize + turmeric (1:1)- rajmash (10700 t/ha).



Maize and French bean crops at Gangtok

Narendrapur

Four cropping systems including basmati rice, two rice varieties sohini and shatabdi in *kharif* with different crops namely broccoli, mustard, capsicum, frenchbean during *rabi* and greengram, sesame in summer were evaluated under organic, inorganic and integrated nutrient management. Basmati rice and rice recorded maximum yield (2719 and 6021 kg/ha respectively) under organic nutrient management followed by integrated having 50% each nutrient through organic and inorganic or by 75% nutrient through organic+25% inorganic. The differences in yield of basmati rice and rice were found to be 17.1 and 10.6% compare to inorganic nutrient package. Other crops in the systems such as

broccoli, mustard, capsicum and frenchbean during *rabi* resulted higher yield by 21.7, 14.5, 26.5 and 8.0% with organic compared to inorganic respectively. Similarly, sesame and green gram during summer also recorded maximum yield in organic and being higher by 8.0 and 10.9% respectively.

Sardarkrushinagar

Among the crops evaluated under different cropping systems and nutrient management package, crops wheat (4765kg/ha) and fennel (1828 kg/ha) recorded higher yield under state recommendation whereas, crops groundnut, green gram, vegetable cowpea and resulted in higher yield (1944, 718 and 5833 kg/ha respectively) in integrated nutrient management with 50% organic +50% inorganic input. Reduction

in the yield from 100% organic management to state recommendation was found to be 20.2 and 50.2% for wheat and fennel crop respectively. Performance of groundnut, green gram, vegetable cowpea with integrated package recorded higher to the tune of 11.2, 2.7 and 37.2%. In term of groundnut equivalent yield, response of different production system was found to be higher in integrated package (50% each organic + inorganic input) followed by state recommendation. Among the cropping systems, greengram- cumin-vegetable cowpea system recorded highest groundnut equivalent yield (15283 kg/ha).

Thiruvananthapuram

Tuber yield of cassava was higher in 100% inorganic

followed by integrated with 75% organic + 25% inorganic while comel yield of taro was higher with 100% organic followed by 75% organic + innovative practices. Variation in yield for cassava was 24.9% from inorganic to organic however, in taro it was 367% higher with organic over inorganic. Vegetable cowpea and green gram yield (1540 and 453 kg/ha) was higher in organic management with 100% manure supplied through manure while, groundnut and blackgram was higher in integrated package (1091 and 710 kg/ha). The yield differences from organic to inorganic for cowpea and green gram being (47.1 and 304.5%). Yield for groundnut and blackgram was found to the tune of 34.2 and 10.4% higher with integrated practice over organic respectively.



Cassava



Taro



Cassava-vegetable cowpea



Cassava-ground nut



Taro-black gram



Taro-green gram

Udaipur

Response of organic, inorganic and integrated production practices observed that all crops in cropping systems recorded higher yield with either by inorganic practices or state recommendation except fenugreek and maize with intercrop of blackgram which gave higher yield with organic practice. During *kharif*, maize+blackgram recorded higher yield (3121 kg/ha MEY) towards organic with integrated packages (75% organic +25% inorganic) whereas maximum yield of maize (sweetcorn)+black gram (8671 kg/ha MEY) was higher under 100% inorganic nutrient management. Sole black gram (421 kg/ha) and soybean (642 kg/ha) during *kharif*

and wheat *durum* and *aestivum* (4286 & 3714kg/ha) recorded maximum yield either in inorganic or in state recommendation practice. Reduction in yield of soybean (27.3%), blackgram (18.8%), wheat (30.0 & 21.1 *durum* and *aestivum*) and chickpea (30.6%) were found with organic over inorganic. About 4% higher yield was observed in fenugreek with organic compared to inorganic practice. Total productivity among the management practices in term of maize equivalent yield, inorganic production system being the highest followed by integrated. Out of four cropping systems, maize + blackgram (2:2)-wheat (*durum*)-*sesbania* (GM) cropping system gave maximum maize equivalent yield of 79583 kg/ha.



Maize + black gram under 75% organic +25% inorganic



Durum wheat under 100% organic



Sole black gram 75% organic+ innovative practice



(Wheat (*T. aestivum*) under 100 % organic management



Sweetcorn+ black gram under integrated (50% organic +50% inorganic)



Chickpea towards organic (75% organic+ 25% inorganic)



Soybean towards organic (75% organic+ 25% inorganic)



Fenugreek towards organic (75% organic+ 25% inorganic)

Field view of effect of organic, inorganic and integrated systems on different kharif and rabi crops in maize-based cropping systems at Udaipur

Influence of organic management with reduced dose of organic manures, integrated and inorganic nutrient management packages on Bulk density, electric conductivity, pH, organic carbon, available nitrogen, phosphorus and potassium (Table 7.2.4 -7.2.8)

Bajaura

Variation in soil pH found in range from 6.70 -7.20 in all the treatments. The soil pH in different cropping systems as influenced by nutrient management was higher with integrated management either 50% each organic and inorganic or 75% organic+ 25% inorganic package whereas lower value of soil pH was recorded in inorganic management. Different cropping systems and nutrient management package recorded soil organic carbon ranging

from 0.67 as minimum under inorganic to 1.50% as maximum in organic management with 100% nutrients application through organic manures in tomato-cauliflower-frenchbean system. Organic management recorded 75.3% higher organic carbon compared to inorganic. The highest available N (273.0 kg/ha) was recorded in lady finger-pea system with integrated nutrient management (50% organic+ 50% inorganic). Likewise, the available P_2O_5 (77.0 kg/ha) and K_2O (258.0 kg/ha) was maximum in black gram-cauliflower- summer squash system with integrated under 50% organic+ 50% inorganic.. Irrespective of different cropping systems, minimum value for all the major soil available nutrients was observed in tomato-cauliflower- french bean with 100% Inorganic package.



Calicut

In ginger, soil pH was higher under integrated while organic carbon being highest in 75% organic +innovative organic practices under organic package. In turmeric, higher pH and organic carbon (5.62 and 2.99% respectively) was recorded also with 75% organic +innovative organic practices under organic management. Similarly, in black pepper, pH, OC and available N was higher in organic package. In case of available P, it was higher in integrated followed by organic package however, availability of K in the soil was found to be higher in ginger and turmeric (554 and 388.5 kg/ha) respectively with inorganic nutrient management.

Dharwad

Physical properties like bulk density slightly decreased from 1.25 g/cm³ with 100% inorganic to 1.20 g/cm³ with 100% organic management. Among the management package, organic and integrated being on par with higher EC compared to inorganic. Higher pH was recorded in inorganic package (7.62) while, lower was in organic (6.94). The organic carbon increased significantly from 4.46 g/kg with 100% inorganic to 7.26 g/kg with 100% organic and it was increased by 62.8%. Among the cropping systems, groundnut + hybrid cotton (2:1) recorded maximum OC (6.3 g/kg). Irrespective of cropping systems as well as management package, availability of major nutrients, N, P and K (313.6, 69.7 and 590 kg/ha respectively) recorded higher under inorganic package in groundnut + hybrid cotton (2:1).

Jabalpur

Among the nutrient managements, bulk density significantly decreased from 1.41 g/cm³ with inorganic to 1.28 g/cm³ with organic package. The soil electrical conductivity varied from 0.52 as lowest in organic to inorganic package (0.76 dsm⁻¹) as highest. Cropping systems did not influence to each other for electrical conductivity and bulk density.

The pH was neutral in reaction ranging from 7.18 with organic to 7.34 under state recommendation in basmati rice-chickpea-maize (fodder). Application of organic manure either fully (100% organic) or integrated exhibited higher organic content in the soil. Management practice under organic condition, holding 19.3% more organic carbon content over inorganic. Among the cropping systems, basmati rice-wheat-green gram system recorded (7.96 g/kg) higher organic carbon whereas, basmati rice-berseem (fodder and seed) recorded least (7.51 g/kg). Available nitrogen, phosphorus and potassium were not influenced due to the cropping system however, organic management practices either 100% or reduce dose of manure up to 25% + innovative practice recorded higher N.P and K.

Karjat

Non-Significant variation in EC and pH of soil was observed in different cropping as well as input package. Soil organic carbon was higher under organic (1.52%) and increased to the tune of 20.6% over inorganic. Both rice-fieldbean and rice-chickpea owing to their higher drop of dry matter to the soil recorded higher organic carbon (1.45 and 1.43% respectively) compared to other systems. Variation in soil available N, P and K was observed among different input packages but these were not influenced due to different cropping systems. Organic packages registered significantly higher residual N, P and K (272.3, 28.6 and 385.5 kg/ha respectively). Rice-fieldbean recorded maximum available N, P and K compared to other systems.

Ludhiana

Electrical conductivity, pH, soil organic carbon, soil available nitrogen, phosphorus and potassium were higher under organic management either with 100% nutrient application through manure or 75% nutrient application through organic manure+25% innovative practice. Soil organic carbon found to be

higher by 35.6 10.9% over inorganic and integrated. Available N, P and K were also higher under organic management and found to be (N 10.5%), (P 8.7%) and (K 8.1%) than inorganic package respectively. Among the cropping systems, all the systems did not found to be significant to each other for retention of N, P and K as residue in the soil.

Pantnagar

Lower EC (0.36 dsm^{-1}) was recorded under organic package with 75% nutrient application through organic manure + 25% innovative practice as compared with other packages. Basmati rice-wheat and basmati rice-wheat-potato system recorded lowest EC (0.42 and 0.43 dsm^{-1}). pH varied from 6.70 to 7.50 across the various management options and cropping systems. At the end of cropping cycle, maximum soil organic carbon (1.29%) was recorded under 100 % organic

followed by 75% organic + innovative technology (1.23%). The variation between organic to inorganic was found to be 65.4%. Cropping systems did not influenced for organic carbon. Likewise, maximum available P and K (70.3 and 225 kg/ha) was recorded under organic management with 75% organic + 25% innovative practice whereas, availability of N was higher with 100% organic input package.

Ranchi

Higher pH, organic carbon, available N, P & K was retained in the soil with 100% organic followed by 75% organic + innovative practices. Among cropping system, pH, organic carbon was maximum in rice-lentil, available N and P in rice-potato and K was higher with rice-linseed system. But there was decrease in available K content was observed in all the cropping system than its initial value

Table 7.2.4: Influence of organic, inorganic and integrated package on soil physical properties (bulk density and electrical conductivity) at the end of cropping cycle at various locations

Locations/ Treatments	Bulk density (g/cc)							Soil EC (ds/m)						
	Organic		Inorganic		Integrated (Towards organic)		Mean	Organic		Inorganic		Integrated (Towards organic)		Mean
	100% or- ganic	75% or- ganic +in- no- va- tive or- ganic prac- tices	100% Inor- ganic	State rec- om- men- da- tion	50% or- ganic + 50% inor- ganic	75% or- ganic + 25% inor- ganic		100% or- ganic	75% or- ganic +in- no- va- tive or- ganic prac- tices	100% Inor- ganic	State rec- om- men- da- tion	50% or- ganic + 50% inor- ganic	75% or- ganic + 25% inor- ganic	
Dharwad														
Cowpea/green gram-safflower	1.23	1.22	1.28	1.25	1.18	1.16	1.22	0.07	0.10	0.07	0.09	0.09	0.08	0.08
Pigeon pea (Sole)	1.19	1.16	1.27	1.18	1.24	1.23	1.21	0.08	0.07	0.07	0.08	0.10	0.06	0.08
Green gram-sor- ghum	1.23	1.23	1.26	1.26	1.14	1.24	1.23	0.10	0.10	0.06	0.08	0.08	0.06	0.08



Locations/ Treatments	Bulk density (g/cc)							Soil EC (ds/m)						
	Organic		Inorganic		Integrated (Towards organic)		Mean	Organic		Inorganic		Integrated (Towards organic)		Mean
	100% or- ganic	75% or- ganic +in- no- va- tive or- ganic prac- tices	100% Inor- ganic	State rec- om- men- da- tion	50% or- ganic + 50% inor- ganic	75% or- ganic + 25% inor- ganic		100% or- ganic	75% or- ganic +in- no- va- tive or- ganic prac- tices	100% Inor- ganic	State rec- om- men- da- tion	50% or- ganic + 50% inor- ganic	75% or- ganic + 25% inor- ganic	
Groundnut + hybrid cotton (2:1)	1.18	1.19	1.27	1.25	1.20	1.25	1.22	0.10	0.11	0.09	0.09	0.10	0.06	0.09
Maize-chick- pea	1.17	1.22	1.17	1.26	1.24	1.22	1.21	0.10	0.12	0.06	0.10	0.11	0.06	0.09
Mean	1.20	1.20	1.25	1.24	1.20	1.22		0.09	0.10	0.07	0.09	0.10	0.07	
Jabalpur														
Basmati rice -wheat (duram)-green manure	1.27	1.27	1.38	1.40	1.40	1.36	1.35	0.64	0.63	0.76	0.75	0.69	0.68	0.69
Basmati rice - chickpea - maize fodder	1.28	1.26	1.41	1.42	1.35	1.34	1.34	0.52	0.61	0.72	0.69	0.62	0.63	0.63
Basmati rice - berseem (fodder and seed)	1.28	1.29	1.42	1.40	1.32	1.33	1.34	0.59	0.60	0.73	0.71	0.67	0.64	0.66
Basmati rice - vegetable pea- sorghum (fodder)	1.28	1.29	1.40	1.41	1.33	1.35	1.34	0.62	0.61	0.69	0.70	0.69	0.70	0.67
Mean	1.28	1.28	1.40	1.41	1.35	1.35		0.59	0.61	0.73	0.71	0.67	0.66	
Karjat														
Rice-brinjal	-	-	-	-	-	-	-	-	-	-	-	-	-	0.34
Rice-chickpea	-	-	-	-	-	-	-	-	-	-	-	-	-	0.34
Rice-field bean	-	-	-	-	-	-	-	-	-	-	-	-	-	0.34
Rice-onion (White)	-	-	-	-	-	-	-	-	-	-	-	-	-	0.34
Mean	-	-	-	-	-	-	-	0.34	0.34	0.34	0.34	0.34	0.34	
Ludhiana														



Locations/ Treatments	Bulk density (g/cc)							Soil EC (ds/m)						
	Organic		Inorganic		Integrated (Towards organic)		Mean	Organic		Inorganic		Integrated (Towards organic)		Mean
	100% or- ganic	75% or- ganic +in- no- va- tive or- ganic prac- tices	100% Inor- ganic	State rec- om- men- da- tion	50% or- ganic + 50% inor- ganic	75% or- ganic + 25% inor- ganic		100% or- ganic	75% or- ganic +in- no- va- tive or- ganic prac- tices	100% Inor- ganic	State rec- om- men- da- tion	50% or- ganic + 50% inor- ganic	75% or- ganic + 25% inor- ganic	
Basmati rice- chickpea-GM	-	-	-	-	-	-	-	0.26	0.24	0.23	0.24	0.20	0.19	0.23
Basmati rice- wheat-GM	-	-	-	-	-	-	-	0.29	0.28	0.23	0.24	0.21	0.26	0.25
Clusterbean -wheat -sum- mer moong	-	-	-	-	-	-	-	0.31	0.29	0.23	0.22	0.24	0.29	0.26
Soybean -wheat	-	-	-	-	-	-	-	0.26	0.26	0.22	0.20	0.24	0.26	0.24
Mean	-	-	-	-	-	-	-	0.28	0.27	0.23	0.23	0.22	0.25	
Pantnagar	-	-	-	-	-	-	-							
Basmati rice- wheat	-	-	-	-	-	-	-	0.42	0.32	0.51	0.48	0.42	0.39	0.42
Basmati rice -chickpea (4rows+2rows coriander)	-	-	-	-	-	-	-	0.45	0.35	0.63	0.56	0.4	0.4	0.47
Basmati rice -vegetable pea (4 rows vegetable pea +2 rows cori- ander)	-	-	-	-	-	-	-	0.46	0.37	0.55	0.45	0.47	0.45	0.46
Basmati rice -potato	-	-	-	-	-	-	-	0.39	0.39	0.51	0.5	0.38	0.39	0.43
Mean	-	-	-	-	-	-	-	0.43	0.36	0.55	0.5	0.42	0.41	
Umiam														
<i>Vegetable-vegetable systems on raised bed</i>														
Broccoli -car- rot	-	-	-	-	-	-	1.11	-	-	-	-	-	-	-



Locations/ Treatments	Bulk density (g/cc)							Soil EC (ds/m)						
	Organic		Inorganic		Integrated (Towards organic)		Mean	Organic		Inorganic		Integrated (Towards organic)		Mean
	100% or- ganic	75% or- ganic +in- no- va- tive or- ganic prac- tices	100% Inor- ganic	State rec- om- men- da- tion	50% or- ganic + 50% inor- ganic	75% or- ganic + 25% inor- ganic		100% or- ganic	75% or- ganic +in- no- va- tive or- ganic prac- tices	100% Inor- ganic	State rec- om- men- da- tion	50% or- ganic + 50% inor- ganic	75% or- ganic + 25% inor- ganic	
Broccoli - po- tato	-	-	-	-	-	-	1.12	-	-	-	-	-	-	-
Broccoli -french bean	-	-	-	-	-	-	1.10	-	-	-	-	-	-	-
Broccoli -to- mato	-	-	-	-	-	-	1.13	-	-	-	-	-	-	-
Mean	1.09	1.10	1.15	-	1.11	-		-	-	-	-	-	-	-
Rice- fallow system in sunken bed														
Megha aro- matic 2-fellow							1.12	-	-	-	-	-	-	-
Shasharang- fellow							1.10	-	-	-	-	-	-	-
Ngoba-fellow							1.13	-	-	-	-	-	-	-
Lampnah-fel- low							1.10	-	-	-	-	-	-	-
Mean	1.07	1.08	1.19		1.11			-	-	-	-	-	-	-
New centres started from 2015-16														
Gangtok														
Maize + ginger (1:1)-french bean	1.27	1.28		1.30	1.29		1.29	-	-	-	-	-	-	-
Maize + soybean (1:1)- buckwheat	1.28	1.29		1.30	1.29		1.29	-	-	-	-	-	-	-
Maize + tur- meric (1:1)-ra- jmath	1.28	1.29		1.30	1.29		1.29	-	-	-	-	-	-	-

Locations/ Treatments	Bulk density (g/cc)							Soil EC (ds/m)						
	Organic		Inorganic		Integrated (Towards organic)		Mean	Organic		Inorganic		Integrated (Towards organic)		Mean
	100% or- ganic	75% or- ganic +in- no- va- tive or- ganic prac- tices	100% Inor- ganic	State rec- om- men- da- tion	50% or- ganic + 50% inor- ganic	75% or- ganic + 25% inor- ganic		100% or- ganic	75% or- ganic +in- no- va- tive or- ganic prac- tices	100% Inor- ganic	State rec- om- men- da- tion	50% or- ganic + 50% inor- ganic	75% or- ganic + 25% inor- ganic	
Maize + pi- geon pea (2:1)	1.27	1.28		1.31	1.28		1.29	-	-	-	-	-	-	-
Mean	1.28	1.29		1.30	1.29			-	-	-	-	-	-	-
Narendrapur														
Basmati rice-broccoli – sesbania green manure	1.51	1.50	1.50	1.51	1.51	1.52	1.51	0.22	0.23	0.31	0.26	0.48	0.39	0.49
Paddy- mus- tard- green gram	1.77	1.85	1.79	1.80	1.80	1.80	1.80	0.46	0.58	0.39	0.42	0.28	0.33	0.61
Paddy- cap- sicum- green gram	1.86	1.86	1.87	1.86	1.83	1.85	1.86	0.73	0.39	0.43	0.33	0.36	0.30	0.63
Paddy –french bean – sesame	1.81	1.79	1.83	1.82	1.81	1.82	1.81	0.54	0.50	0.34	0.53	0.22	0.55	0.64
Mean	1.74	1.75	1.75	1.75	1.74	1.75		0.49	0.43	0.37	0.39	0.34	0.39	
Sardarkrushni- nagar														
Groundnut- Wheat- Green gram	1.44	1.43	1.48	1.45	1.43	1.44	1.45	0.14	0.14	0.14	0.14	0.14	0.15	0.14
Greengram- Cumin- Vege- table cowpea	1.45	1.45	1.48	1.48	1.43	1.45	1.46	0.14	0.14	0.15	0.15	0.13	0.13	0.14
Green- gram-Fennel- Fennel cont.	1.44	1.46	1.47	1.45	1.47	1.47	1.46	0.13	0.14	0.13	0.13	0.14	0.14	0.14
Mean	1.44	1.45	1.48	1.46	1.45	1.45		0.14	0.14	0.14	0.14	0.14	0.14	

Table 7.2.5: Influence of organic, inorganic and integrated package on soil chemical properties (pH and organic carbon) at the end of cropping cycle at various locations

Locations/Treatments	pH				Organic carbon				
	Organic		Inorganic		Integrated (Towards organic)		Mean		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic	100% organic	75% organic + innovative organic practices	
Bajura (%)									
Tomato-cauliflower-french bean	7.10	7.10	6.60	6.80	7.10	7.20	6.98	1.50	1.18
Fallow-cauliflower-tomato	7.20	7.10	6.80	7.10	7.20	7.20	7.10	1.28	1.20
Black gram-cauliflower-Summer squash	7.10	7.20	6.70	7.00	7.20	7.10	7.05	1.32	1.22
Lady finger-pea	7.00	7.20	6.70	7.10	7.20	7.20	7.07	1.28	1.21
Mean	7.10	7.15	6.70	7.00	7.18	7.18		1.35	1.20
Calicut (%)									
Ginger-fallow	4.87	5.91	4.70	-	6.19	5.17	5.37	2.22	2.53
Turmeric-fallow	5.44	5.62	4.64	-	4.95	5.39	5.21	2.88	2.99
Black papper	4.85	-	4.57	-	4.66	-	4.69	1.97	-
Dharwad									
Cowpea-safflower	6.85	7.02	7.46	7.67	7.17	6.83	7.17	7.80	6.00
Pigeon pea (sole)	6.90	7.09	7.34	7.71	6.73	6.97	7.12	7.20	5.20
Green gram- sorghum	6.86	6.90	7.34	7.74	7.03	7.02	7.15	8.30	4.90
Groundnut + hybrid cotton (2:1)	6.94	6.74	7.46	7.47	7.06	7.22	7.15	7.10	7.50
Maize-chickpea	7.15	7.10	7.34	7.52	7.23	7.27	7.27	5.90	6.80
Mean	6.94	6.97	7.39	7.62	7.04	7.06		7.26	6.08
Jabalpur (g/kg)									

Locations/Treatments	pH						Organic carbon				
	Organic		Inorganic		Integrated (Towards organic)		Organic		Inorganic		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic	100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation	
Basmati rice -wheat-green manure	7.19	7.20	7.29	7.26	7.23	7.22	7.23	8.45	7.25	7.20	7.96
Basmati rice - chickpea - maize (fodder)	7.18	7.21	7.24	7.34	7.31	7.27	8.18	6.70	7.62	7.58	7.53
Basmati rice - berseem (fodder and seed)	7.20	7.24	7.27	7.27	7.28	7.27	8.16	6.64	7.69	7.55	7.51
Basmati rice - vegetable pea- sorghum (fodder)	7.23	7.24	7.33	7.34	7.31	7.28	8.25	7.05	7.80	7.76	7.74
Mean	7.20	7.22	7.28	7.30	7.28	7.26	8.36	8.26	7.01	7.75	
Karjat											
Rice-brinjal	-	-	-	-	-	-	6.63	-	-	-	1.31
Rice-Cchickpea	-	-	-	-	-	-	6.56	-	-	-	1.43
Rice-field bean	-	-	-	-	-	-	6.61	-	-	-	1.45
Rice-onion (White)	-	-	-	-	-	-	6.63	-	-	-	1.25
Mean	6.63	6.59	6.62	6.61	6.52	6.69	1.52	1.51	1.26	1.24	
Ludhiana											
Basmati rice-chickpea-GM	7.40	7.40	7.30	7.30	7.40	7.30	7.35	0.51	0.47	0.43	0.50
Basmati rice-wheat-GM	7.40	7.40	7.50	7.10	7.40	7.20	7.33	0.64	0.49	0.47	0.57
Cluster-bean-wheat-summer moong	7.20	7.20	7.50	7.40	7.50	7.20	7.33	0.6	0.43	0.42	0.54
Soybean -wheat	7.90	7.30	7.20	7.10	7.50	7.40	7.40	0.58	0.42	0.42	0.51
Mean	7.48	7.33	7.38	7.23	7.45	7.28	0.61	0.58	0.45	0.44	
Pantnagar											
Basmati rice-wheat	7.40	6.90	7.40	7.50	6.70	7.20	7.18	1.21	0.81	0.95	1.10

Locations/Treatments	pH						Organic carbon							
	Organic		Inorganic		Integrated (Towards organic)		Mean	Organic		Inorganic		Integrated (Towards organic)		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Basmati rice -chickpea (4rows+2rows coriander)	6.80	6.70	7.30	7.40	7.20	7.10	7.08	1.25	1.17	0.78	1.01	1.1	1.18	1.08
Basmati rice -vegetable pea (4 rows vegetable pea +2 rows coriander)	7.20	6.60	7.30	7.30	7.00	7.20	7.10	13.1	1.27	0.82	0.98	1.09	1.17	3.07
Basmati rice -potato	7.30	6.80	7.40	7.40	7.20	7.10	7.20	1.3	1.25	0.71	0.97	1.11	1.14	1.08
Mean	7.18	6.75	7.35	7.40	7.03	7.15		4.23	1.23	0.78	0.98	1.10	1.18	
Umiam														
Vegetable-vegetable systems on raised bed														
Broccoli -carrot	-	-	-	-	-	-	5.23	-	-	-	-	-	-	2.56
Broccoli - potato	-	-	-	-	-	-	5.26	-	-	-	-	-	-	2.51
Broccoli -french bean	-	-	-	-	-	-	5.25	-	-	-	-	-	-	2.64
Broccoli -tomato	-	-	-	-	-	-	5.28	-	-	-	-	-	-	2.53
Mean Management practices	5.39	5.18	5.13		5.32			2.80	2.54	2.20		2.71		
Rice- fallow system on sunken bed														
Megha aromatic 2-fellow	-	-	-	-	-	-	5.50	-	-	-	-	-	-	2.64
Shasharang-fellow	-	-	-	-	-	-	5.54	-	-	-	-	-	-	2.71
Ngoba -fellow	-	-	-	-	-	-	5.38	-	-	-	-	-	-	2.62
Lampnah -fellow	-	-	-	-	-	-	5.47	-	-	-	-	-	-	2.65
Mean (management practices)	5.49	5.32	5.50		5.57			2.70	2.58	2.67		2.68		

Locations/Treatments	pH					Organic carbon							
	Organic		Inorganic		Integrated (Towards organic)	Mean	Organic		Inorganic		Integrated (Towards organic)	Mean	
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation			50% organic + 50% inorganic	75% organic + 25% inorganic	100% organic	75% organic + innovative organic practices			100% Inorganic
Centres started from 2015-16													
Ajmer							(%)						
Green gram - fennel	-	-	-	-	-	-	0.31	0.31	0.30	0.31	0.27	0.28	0.30
Green gram - coriander	-	-	-	-	-	-	0.32	0.31	0.29	0.30	0.29	0.31	0.30
Cluster bean - fennel	-	-	-	-	-	-	0.31	0.31	0.30	0.31	0.27	0.28	0.30
Cluster bean - coriander	-	-	-	-	-	-	0.32	0.31	0.29	0.30	0.29	0.31	0.30
Mean	-	-	-	-	-	-	0.32	0.31	0.30	0.31	0.28	0.30	
Gangtok													
Maize + ginger (1:1)- french bean	-	-	-	-	-	-	1.04	0.98		0.97	0.99		0.98
Maize + soybean (1:1)- buckwheat	-	-	-	-	-	-	1.04	1.00		0.96	1.00		1.00
Maize + turmeric (1:1)- rajmash	-	-	-	-	-	-	1.00	0.97		0.97	0.98		0.98
Maize + pigeon pea (2:1)	-	-	-	-	-	-	1.02	0.99		0.90	0.96		0.97
Mean	-	-	-	-	-	-	1.02	0.99		0.95	0.98		
Narendrapur													
Basmati rice-broccoli - sesbania green manure	6.75	7.98	7.47	7.11	7.44	7.39	0.93	0.95	0.82	0.74	1.03	0.97	0.91
Paddy- mustard- green gram	6.43	6.42	6.43	6.45	6.48	6.47	1.00	0.94	0.60	0.48	0.96	0.91	0.82
Paddy- capsicum- green gram	7.37	7.43	7.50	7.70	7.57	7.57	0.78	0.92	0.74	0.66	0.72	0.72	0.76

Locations/Treatments	pH					Organic carbon				
	Organic		Inorganic		Mean	Organic		Inorganic		Integrated (Towards organic)
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation		100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation	
Paddy -french bean - sesame	7.57	7.53	7.50	7.37	7.45	0.70	0.77	0.57	0.70	0.67
Mean	7.03	7.34	7.23	7.16		0.85	0.89	0.68	0.65	0.82
Sardarkrushinagar										
Groundnut- Wheat- Green gram	7.16	7.22	7.15	7.19	7.22	0.346	0.328	0.241	0.269	0.29
Greengram- Cumin- Vegetable cowpea	7.14	7.13	7.3	7.21	7.21	0.278	2.73	0.227	0.235	0.237
Greengram-Fennel-Fennel cont.	7.01	7.18	7.25	7.21	7.16	0.295	0.262	0.22	0.228	0.251
Mean	7.10	7.18	7.23	7.20		0.31	1.11	0.23	0.24	0.26

Table 7.2.6: Influence of organic, inorganic and integrated package on soil available nitrogen at the end of cropping cycle at various locations

Location/treatments	Available Nitrogen (kg ha ⁻¹)						Mean
	Organic		Inorganic		Integrated (towards organic)		
	100% organic	75% organic + innovative organic practices	100% In-organic	State recommendation	50% organic + 50% in-organic	75% organic + 25% in-organic	
Bajara							
Tomato-cauliflower- french bean	256.4	254.5	231.3	247.0	255.7	249.2	249.0
Fallow-cauliflower-tomato	251.6	252.0	246.0	249.0	236.1	239.0	245.6
Black gram-cauliflower- summer squash	248.0	242.1	212.0	224.5	265.0	263.0	242.4
Lady finger-pea	267.3	262.0	234.2	239.4	273.0	271.0	257.8
Mean	255.8	252.7	230.9	240.0	257.5	255.6	
Calicut							
Ginger-fallow	-	-	-	-	-	-	-
Turmeric-fallow	-	-	-	-	-	-	-
Black pepper	282.50	-	211.50	-	244.50	-	246.17
Dharwad							
Cowpea-safflower	181.4	199.7	207.2	274.4	210.9	196.0	211.6
Pigeon pea (sole)	168.0	196.0	268.8	276.3	186.7	218.4	219.0
Green gram - sorghum	170.3	227.7	268.8	302.4	168.0	205.3	223.8
Groundnut + hybrid cotton (2:1)	203.9	197.9	261.3	313.6	212.8	209.1	233.1
Maize-chickpea	221.8	194.1	263.2	302.4	199.7	225.9	234.5
Mean	189.1	203.1	253.9	293.8	195.6	210.9	
Jabalpur							
Basmati rice –wheat (duram)-green manure	295	289	262	258	288	286	280
Basmati rice – chickpea - maize fodder	286	279	242	237	274	271	265
Basmati rice – berseem (fodder and seed)	284	278	239	240	275	277	266
Basmati rice – vegetable pea- sorghum (fodder)	289	284	260	257	276	275	274
Mean	289	283	251	248	278	277	
Karjat							



Location/treatments	Available Nitrogen (kg ha ⁻¹)						Mean
	Organic		Inorganic		Integrated (towards organic)		
	100% organic	75% organic + innovative organic practices	100% In-organic	State recommendation	50% organic + 50% in-organic	75% organic + 25% in-organic	
Rice-Brinjal	-	-	-	-	-	-	257.6
Rice-Chickpea	-	-	-	-	-	-	272.7
Rice-Field bean	-	-	-	-	-	-	276.4
Rice-Onion (White)	-	-	-	-	-	-	249.0
Mean	274.8	272.3	252.8	243.1	269.2	271.3	
Ludhiana							
Basmati rice-chickpea-GM	363.8	360.1	311.2	318.7	348.9	351.2	342.3
Basmati rice-wheat-GM	358.4	352.0	343.5	339.8	351.2	351.2	349.4
Clusterbean-wheat-summer moong	319.5	313.6	306.1	308.9	314.9	313.8	312.8
Soybean -wheat	368.9	358.5	316.3	313.6	357.9	351.2	344.4
Mean	352.7	346.1	319.3	320.3	343.2	341.9	
Pantnagar							
Basmati rice-wheat	327	328	292	290	330	385	325
Basmati rice -chickpea (4rows+2rows coriander)	368	370	304	300	338	392	345
Basmati rice -vegetable pea (4 rows vegetable pea +2 rows coriander)	362	392	295	355	325	385	352
Basmati rice -potato	346	380	276	350	333	380	344
Mean	351	368	292	324	332	386	
Ranchi							
Rice -wheat	321.5	305.6	260.7	254.9	296.1	281.3	286.7
Rice-lentil	339.2	329.1	272.4	245.1	303.1	284.2	295.5
Rice-potato	317.7	313.9	290.1	265.3	306.7	304.3	299.7
Rice- linseed	316.6	299.5	257.4	230.5	289.8	259.1	275.5
Mean	323.7	312.0	270.2	248.9	298.9	282.2	
Umiam							
Vegetable-vegetable systems on raised bed							
Broccoli -carrot	-	-	-	-	-	-	239.0
Broccoli - potato	-	-	-	-	-	-	235.8

Location/treatments	Available Nitrogen (kg ha ⁻¹)						Mean
	Organic		Inorganic		Integrated (towards organic)		
	100% organic	75% organic + innovative organic practices	100% In-organic	State recommendation	50% organic + 50% in-organic	75% organic + 25% in-organic	
Broccoli -french bean	-	-	-	-	-	-	254.6
Broccoli -tomato	-	-	-	-	-	-	247.7
Mean	241.9	260.3	235.0		271.0		
Rice- fallow system on sunken bed							
Megha aromatic 2-fellow	-	-	-	-	-	-	227.6
Shasharang-fellow	-	-	-	-	-	-	236.5
Ngoba-fellow	-	-	-	-	-	-	233.9
Lampnah-fellow	-	-	-	-	-	-	229.0
Mean	227.9	239.9	229.3		230.6		
Centres started from 2015-16							
Ajmer							
Green gram - fennel	144.1	141.3	139.5	138.1	138.8	136.5	139.7
Green gram - coriander	142.7	139.2	135.2	132.5	134.9	131.7	136.0
Cluster bean - fennel	144.1	141.3	139.5	138.1	138.8	136.5	139.7
Cluster bean - coriander	142.7	139.2	135.2	132.5	134.9	131.7	136.0
Mean	143.4	140.2	137.3	135.3	136.8	134.1	
Gangtok							
Maize + ginger (1:1)-french bean	379.7	365.0		303.3	346.3		348.6
Maize + soybean (1:1)-buckwheat	395.3	372.3		320.0	363.3		362.7
Maize + turmeric (1:1)-rajmash	370.0	339.0		260.7	331.7		325.3
Maize + pigeon pea (2:1)	376.7	357.7		282.3	330.7		336.8
Sardarkrushinagar							
Groundnut- Wheat- Green gram	152.3	150.7	144.7	146.0	151.7	150.3	149.3
Greengram- Cumin- Vegetable cowpea	152.3	148.3	145.0	144.7	149.0	147.0	147.7
Greengram-Fennel- Fennel cont.	147.3	150.3	139.0	143.3	146.3	145.3	145.3
Mean	150.6	149.8	142.9	144.7	149.0	147.5	



Table 7.2.7: Influence of organic, inorganic and integrated package on soil available phosphorus at the end of cropping cycle at various locations

Location/treatments	Available Nitrogen (kg ha ⁻¹)						
	Organic		Inorganic		Integrated (towards organic)		Mean
	100% organic	75% organic + inno- vative organic practices	100% In- organic	State rec- ommen- dation	50% organic + 50% in- organic	75% organic + 25% in- organic	
Bajara							
Tomato-cauliflower- french bean	69.2	68.3	40.0	49.4	71.0	66.7	60.8
Fallow-cauliflower-tomato	71.1	67.4	42.7	47.0	76.4	70.2	62.5
Black gram-cauliflower- summer squash	70.4	69.0	40.0	45.2	77.0	72.1	62.3
Lady finger-pea	74.0	73.0	39.0	46.0	45.0	72.3	58.2
Mean	71.2	69.4	40.4	46.9	67.4	70.3	
Calicut							
Ginger-fallow	56.0	52.0	18.0	-	66.0	40.0	46.4
Turmeric-fallow	46.25	19.67	4.40		30.33	41.92	28.5
Black papper	13.48	-	18.80	-	35.75	-	22.68
Dharwad							
Cowpea-safflower	49.4	59.4	39.6	55.3	69.9	55.8	54.9
Pigeon pea (sole)	38.0	42.4	44.3	53.4	39.2	45.3	43.8
Green gram - sorghum	40.8	62.5	32.2	53.6	45.7	31.8	44.4
Groundnut + hybrid cotton (2:1)	60.8	36.7	44.1	69.7	36.6	32.2	46.7
Maize-chickpea	50.5	39.9	35.3	69.3	45.0	34.0	45.7
Mean	47.9	48.2	39.1	60.2	47.3	39.8	
Jabalpur							
Basmati rice -wheat (duram)-green manure	18.1	17.9	16.4	16.1	17.2	18.1	17.3
Basmati rice – chickpea - maize fodder	17.6	17.0	16.1	14.4	16.6	17.1	16.5
Basmati rice – berseem (fodder and seed)	16.6	16.2	16.5	15.8	17.1	16.1	16.4
Basmati rice – vegetable pea- sorghum (fodder)	16.5	16.3	15.9	16.0	17.2	18.1	16.7
Mean	17.2	16.8	16.2	15.6	17.1	17.4	
Karjat							
Rice-Brinjal	-	-	-	-	-	-	27.4
Rice-Chickpea	-	-	-	-	-	-	28.8
Rice-Field bean	-	-	-	-	-	-	29.1

Location/treatments	Available Nitrogen (kg ha ⁻¹)						
	Organic		Inorganic		Integrated (towards organic)		Mean
	100% organic	75% organic + inno- vative organic practices	100% In-organic	State rec- ommen- dation	50% organic + 50% in-organic	75% organic + 25% in-organic	
Rice-Onion (White)	-	-	-	-	-	-	26.0
Mean	28.6	28.5	26.7	26.3	28.3	28.5	
Ludhiana							
Basmati rice-chickpea-GM	47.0	47.9	40.9	39.9	48.5	45.0	44.9
Basmati rice-wheat-GM	50.3	50.6	48.3	46.6	47.0	45.0	48.0
Clusterbean-wheat-summer moong	49.9	45.8	46.2	46.0	47.9	48.0	47.3
Soybean -wheat	47.0	45.0	43.4	41.5	46.6	49.9	45.6
Mean	48.6	47.3	44.7	43.5	47.5	47.0	
Pantnagar							
Basmati rice-wheat	70.2	54.2	40.1	46.0	66.5	59.2	56.0
Basmati rice -chickpea (4rows+2rows coriander)	65.9	60.3	38.3	65.1	68.8	60.9	59.9
Basmati rice -vegetable pea (4 rows veg- etable pea +2 rows coriander)	70.9	60.8	43.2	49.0	65.0	53.6	57.1
Basmati rice -potato	74.0	64.0	56.0	55.8	71.6	50.2	61.9
Mean	70.3	59.8	44.4	54.0	68.0	56.0	
Ranchi							
Rice -wheat	58.7	56.1	62.6	57.8	54.5	54.1	57.3
Rice-lentil	54.5	50.2	58.6	54.5	56.3	55.0	54.8
Rice-potato	58.8	57.2	62.5	61.1	57.6	56.7	59.0
Rice- linseed	59.5	56.8	59.1	56.0	54.5	854.7	190.1
Mean	57.9	55.1	60.7	57.4	55.7	255.1	
Umiam							
Vegetable-vegetable systems on raised bed							
Broccoli -carrot	-	-	-	-	-	-	19.4
Broccoli - potato	-	-	-	-	-	-	19.1
Broccoli -french bean	-	-	-	-	-	-	20.5
Broccoli -tomato	-	-	-	-	-	-	19.6
Mean	19.1	20.0	17.0		22.6		
Rice- fallow system on sunken bed							
Megha aromatic 2-fellow	-	-	-	-	-	-	19.4
Shasharang-fellow	-	-	-	-	-	-	20.2



Location/treatments	Available Nitrogen (kg ha ⁻¹)						Mean
	Organic		Inorganic		Integrated (towards organic)		
	100% organic	75% organic + innovative organic practices	100% In-organic	State recommendation	50% organic + 50% in-organic	75% organic + 25% in-organic	
Ngoba-fellow	-	-	-	-	-	-	19.5
Lampnah-fellow	-	-	-	-	-	-	19.4
Mean	18.3	22.0	15.0		23.2		
Centres started from 2015-16							
Ajmer							
Green gram - fennel	18.6	17.2	16.5	14.8	15.5	14.4	16.2
Green gram - coriander	18.8	17.8	14.7	15.2	15.2	14.8	16.1
Cluster bean - fennel	18.6	17.2	16.5	14.8	15.5	14.4	16.2
Cluster bean - coriander	18.8	17.8	14.7	15.2	15.2	14.8	16.1
Mean	18.7	17.5	15.6	15.0	15.4	14.6	
Gangtok							
Maize + ginger (1:1)-french bean	20.9	20.0		17.3	18.8		19.3
Maize + soybean (1:1)-buckwheat	21.9	20.6		18.8	19.5		20.2
Maize + turmeric (1:1)-rajmash	19.7	19.3		15.9	19.0		18.5
Maize + pigeon pea (2:1)	19.8	19.3		16.7	18.9		18.7
Narendrapur							
Basmati rice -broccoli - <i>sesbania</i> green manure	69.5	73.5	70.5	69.7	68.4	66.5	69.7
Paddy- mustard- green gram	99.6	95.7	92.8	101.4	126.9	105.4	103.6
Paddy - capsicum- green gram	78.0	84.2	83.9	86.3	72.0	79.6	80.7
Paddy -french bean - sesame	53.8	55.5	57.8	64.9	61.0	53.2	57.7
Mean	75.2	77.2	76.2	80.6	82.0	76.2	
Sardarkrushinagar							
Groundnut- Wheat- Green gram	17.9	17.8	16.4	16.2	18.2	17.1	17.3
Greengram- Cumin- Vegetable cowpea	15.4	14.5	15.4	14.6	14.6	15.5	15.0
Greengram-Fennel- Fennel cont.	15.8	17.5	14.9	13.2	12.9	15.6	15.0
Mean	16.3	16.6	15.6	14.7	15.3	16.0	

Table 7.2.8: Influence of organic, inorganic and integrated package on soil available potassium at the end of cropping cycle at various locations

Location/treatments	Available Nitrogen (kg ha ⁻¹)						Mean
	Organic		Inorganic		Integrated (towards organic)		
	100% organic	75% or- ganic + in- novative organic practices	100% In- organic	State rec- ommen- dation	50% organic + 50% in- organic	75% organic + 25% in- organic	
Bajaura							
Tomato-cauliflower- french bean	241.5	250.0	125.0	134.0	243.0	242.1	205.9
Fallow-cauliflower-tomato	245.0	249.3	144.6	149.0	252.0	255.8	216.0
Black gram-cauliflower- summer squash	247.4	230.3	137.8	150.6	258.0	249.9	212.3
Lady finger-pea	232.0	226.0	130.9	137.2	240.0	237.9	200.7
Mean	241.5	238.9	134.6	142.7	248.3	246.4	
Calicut							
Ginger-fallow	368.0	360.0	554.0		390.0	360.0	406.4
Turmeric-fallow	298.9	226.9	388.5		346.3	190.3	290.2
Black papper	127.8	-	107.8	-	126.5	-	120.7
Dharwad							
Cowpea-safflower	490	580	430	510	510	560	513
Pigeon pea (sole)	400	400	490	590	590	470	490
Green gram - sorghum	460	530	400	490	420	400	450
Groundnut + hybrid cotton (2:1)	450	440	490	590	520	490	497
Maize-chickpea	477	420	410	520	510	440	463
Mean	455	474	444	540	510	472	
Jabalpur							
Basmati rice -wheat (duram)-green manure	299	296	291	288	296	297	295
Basmati rice - chickpea - maize fodder	299	305	286	278	291	286	291
Basmati rice - berseem (fodder and seed)	302	293	287	279	297	295	292
Basmati rice - vegetable pea- sorghum (fodder)	297	296	267	262	296	284	284
Mean	299	298	283	277	295	291	
Karjat							
Rice-Brinjal	-	-	-	-	-	-	360.3
Rice-Chickpea	-	-	-	-	-	-	370.4
Rice-Field bean	-	-	-	-	-	-	375.3
Rice-Onion (White)	-	-	-	-	-	-	366.9



Location/treatments	Available Nitrogen (kg ha ⁻¹)						Mean
	Organic		Inorganic		Integrated (towards organic)		
	100% organic	75% or- ganic + in- novative organic practices	100% In- organic	State rec- ommen- dation	50% organic + 50% in- organic	75% organic + 25% in- organic	
Mean	383.5	380.9	356.6	337.7	373.2	377.4	
Ludhiana							
Basmati rice-chickpea-GM	155.5	153.7	146.2	139.7	143.5	148.2	147.8
Basmati rice-wheat-GM	159.3	156.7	147.0	146.4	150.0	148.2	151.3
Clusterbean-wheat-summer moong	150.3	144.0	142.5	146.2	145.9	141.5	145.1
Soybean -wheat	157.4	150.4	140.3	138.3	141.5	145.7	145.6
Mean	155.6	151.2	144.0	142.7	145.2	145.9	
Pantnagar							
Basmati rice-wheat	219	230	213	215	205	220	217
Basmati rice -chickpea (4rows+2rows coriander)	208	222	211	223	201	226	215
Basmati rice -vegetable pea (4 rows vegetable pea +2 rows coriander)	215	228	208	212	232	255	225
Basmati rice -potato	218	221	210	214	213	218	216
Mean	215	225	211	216	213	230	
Ranchi							
Rice -wheat	227.2	219.0	152.6	149.0	192.8	190.5	188.5
Rice-lentil	231.0	227.4	156.7	149.9	173.4	167.9	184.4
Rice-potato	201.1	196.3	155.3	144.5	176.6	172.5	174.4
Rice- linseed	229.5	226.9	166.2	157.6	198.1	187.7	194.3
Mean	222.2	217.4	157.7	150.2	185.3	179.6	
Umiam							
Vegetable-vegetable systems on raised bed							
Broccoli -carrot	-	-	-	-	-	-	266.1
Broccoli - potato	-	-	-	-	-	-	274.5
Broccoli -french bean	-	-	-	-	-	-	262.4
Broccoli -tomato	-	-	-	-	-	-	270.0
Mean	267.1	269.6	259.0		277.2		
Rice- fallow system on sunken bed							
Megha aromatic 2-fellow	-	-	-	-	-	-	275.7
Shasharang-fellow	-	-	-	-	-	-	281.7
Ngoba-fellow	-	-	-	-	-	-	273.7
Lampnah-fellow	-	-	-	-	-	-	279.5

Location/treatments	Available Nitrogen (kg ha ⁻¹)						Mean
	Organic		Inorganic		Integrated (towards organic)		
	100% organic	75% or- ganic + in- novative organic practices	100% In- organic	State rec- ommen- dation	50% organic + 50% in- organic	75% organic + 25% in- organic	
Mean	274.2	286.7	270.4		279.3		
Centres started from 2015-16							
Ajmer							
Green gram - fennel	326.7	343.0	313.0	305.6	307.3	350.9	324.4
Green gram - coriander	356.4	362.0	363.1	365.4	368.6	364.8	363.4
Cluster bean - fennel	326.7	343.0	313.0	305.6	307.3	350.9	324.4
Cluster bean - coriander	356.4	362.0	363.1	365.4	368.6	364.8	363.4
Mean	341.5	352.5	338.0	335.5	337.9	357.8	
Gangtok							
Maize + ginger (1:1)-french bean	425.0	405.0		377.3	400.3		401.9
Maize + soybean (1:1)-buckwheat	435.7	424.7		399.7	407.3		416.8
Maize + turmeric (1:1)-rajmash	414.3	409.3		373.3	392.0		397.2
Maize + pigeon pea (2:1)	427.3	406.3		386.7	406.0		406.6
Narendrapur							
Basmati rice -broccoli - <i>sesbania</i> green manure	240.3	307.9	214.0	217.4	316.0	306.6	267.0
Paddy- mustard- green gram	206.3	206.3	206.3	206.3	206.3	206.3	206.3
Paddy - capsicum- green gram	267.3	287.9	302.2	307.6	294.7	303.0	293.8
Paddy -french bean - sesame	222.8	228.0	237.8	234.0	232.7	249.2	234.1
Mean	234.2	257.5	240.0	241.3	262.4	266.3	
Sardarkrushinagar							
Groundnut- Wheat- Green gram	195.3	189.3	183.3	187.0	190.0	189.0	189.0
Greengram- Cumin- Vegetable cowpea	183.0	184.3	184.7	183.7	184.0	182.7	183.7
Greengram-Fennel- Fennel cont.	182.3	181.7	179.7	184.3	183.3	178.0	181.6
Mean	186.9	185.1	182.6	185.0	185.8	183.2	

Umiam

Among the nutrient management practices, bulk density in both raised and sunken bed was slightly decreased (1.09 and 1.07 g/cm³ respectively) compared to inorganic (1.15 and 1.19 g/cm³), whereas various cropping systems, did not influenced and being in range between 1.10 to 1.13 g/cm³. Organic carbon in raised beds soil (2.8%) was higher as compared

to sunken beds (2.70%) under organic management practice followed by integrated. Management practice 75% organic + innovative organic practices hold minimum organic carbon in the soil under both cultivation methods. Among the cropping systems, broccoli-frenchbean recorded maximum organic carbon (2.64%) under raised bed method however, under sunken bed methods it was maximum in rice



(Shasharang)-fellow system. Maximum available N was found under 100% organic (260.3 kg/ha) whereas, maximum P and K were found under integrated management (22.7 kg/ha and 277.2 respectively). In case of sunken beds, available N and K were found maximum under organic (239.9 kg/ha and 286.7 kg/ha) while available P was maximum under integrated (23.2 kg/ha) package. Among the cropping systems, broccoli -french bean recorded maximum N and P whereas K was higher in broccoli -potato

Ajmer

Maximum organic carbon (0.32 %), available N (143.4

kg/ha) and P (18.7 kg/ha) was recorded either by 100% organic or 75% organic + innovative practices while, K was found to be higher (357.8 kg/ha) under integrated with 75% organic +25% inorganic practices. Cropping systems been equal with value of 0.30% organic carbon in the soil.

Almora

After three years' cropping, the soil organic carbon increased from the initial value (0.54%). The increase (30%) was highest with 100% organic while lowest being in inorganic management, which is almost equal to initial level.

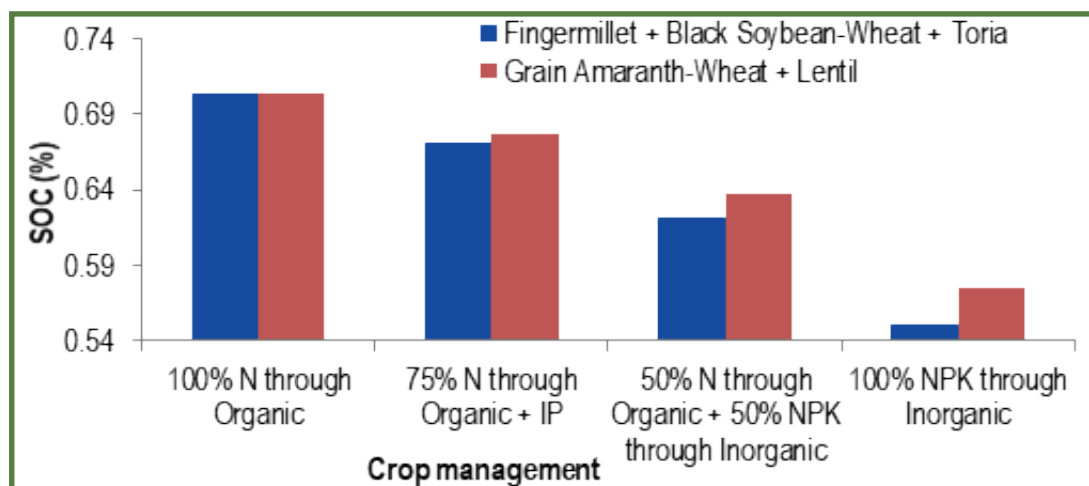


Fig. 6. Soil organic carbon of finger millet + black soybean-wheat + toria and grain amaranth-wheat + lentil in different crop management system (IP = Innovative practices – 3% Panchagavya and vermiwash) at Almora

Gangtok

Organic carbon and available NPK after two years experimentation showed that adoption of 100% organic input in all the cropping systems recorded marginal but positive increase in soil organic carbon, available N, P and K over to other cropping systems. In general, After two years cropping cycles, the highest OC (1.04%), soil available N (395.3 kg/ha), P (21.9 kg/ha) and K (435.7 kg/ha) were observed in maize+soybean (1:1)-buckwheat cropping sequence under organic management package with 100% nutrients equivalent through organics sources.

Narendrapur

Bulk density and pH did not influenced by the management practices and recorded ranging from 1.50 to 1.87 (g/cc) and 6.42 to 7.47 respectively across the management practice and cropping system. However, soil electrical conductivity and organic carbon did change due to different nutrient management and varied from 0.22 to 0.73 dsm⁻¹ and 0.48 to 1.03% respectively across the cropping system. Among the management practices, soil organic carbon was recorded higher with 100% organic management (0.89%) followed by integrated



(50% organic + 50% inorganic) of 0.87%. Basmati rice-broccoli – *sesbania* green manure system recorded higher soil organic carbon (0.91%) among the cropping systems. Available phosphorus and potassium in soil was higher in integrated package (82.0 and 262.4 kg/ha). Among the cropping systems, rice– mustard–green gram recorded higher available phosphorus (103.6 kg/ha) whereas, K was higher in rice–capsicum –green gram system of 293.8 kg/ha.

Thiruvananthapuram

In general, the pH and organic carbon status were

improved due to the impact of 100% organic or towards organic practices at the end of one cycle (Fig. 3). The pH was higher in integrated practices in cassava-vegetable cowpea cassava-groundnut and taro-green gram systems. In taro-black gram system, higher pH was recorded in 75% organic management. Organic C content was the highest in 75% organic (cassava-vegetable cowpea and taro-green gram) or 50% organic + 50% inorganic (cassava-groundnut) or 100% organic (taro-black gram). The electrical conductivity was within the safe limits among the management package.

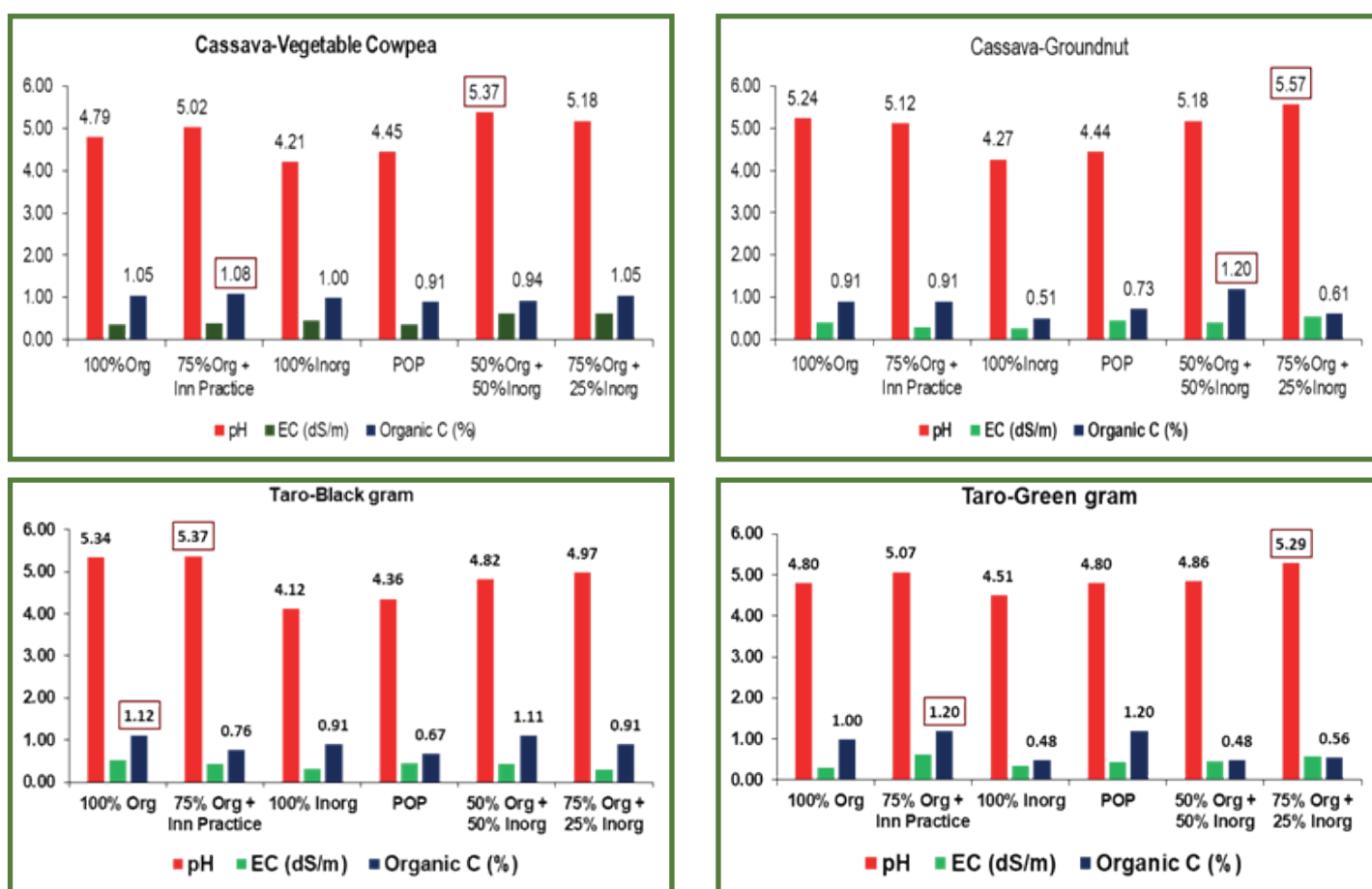


Fig.7. pH, EC and organic C status of the soil under various management options in the different systems

The available N and P content in the soil at the end of the various cropping systems was higher under organic or integrated management practices.

Available K status was mostly higher under 100% inorganic or state POP (Fig. 4).

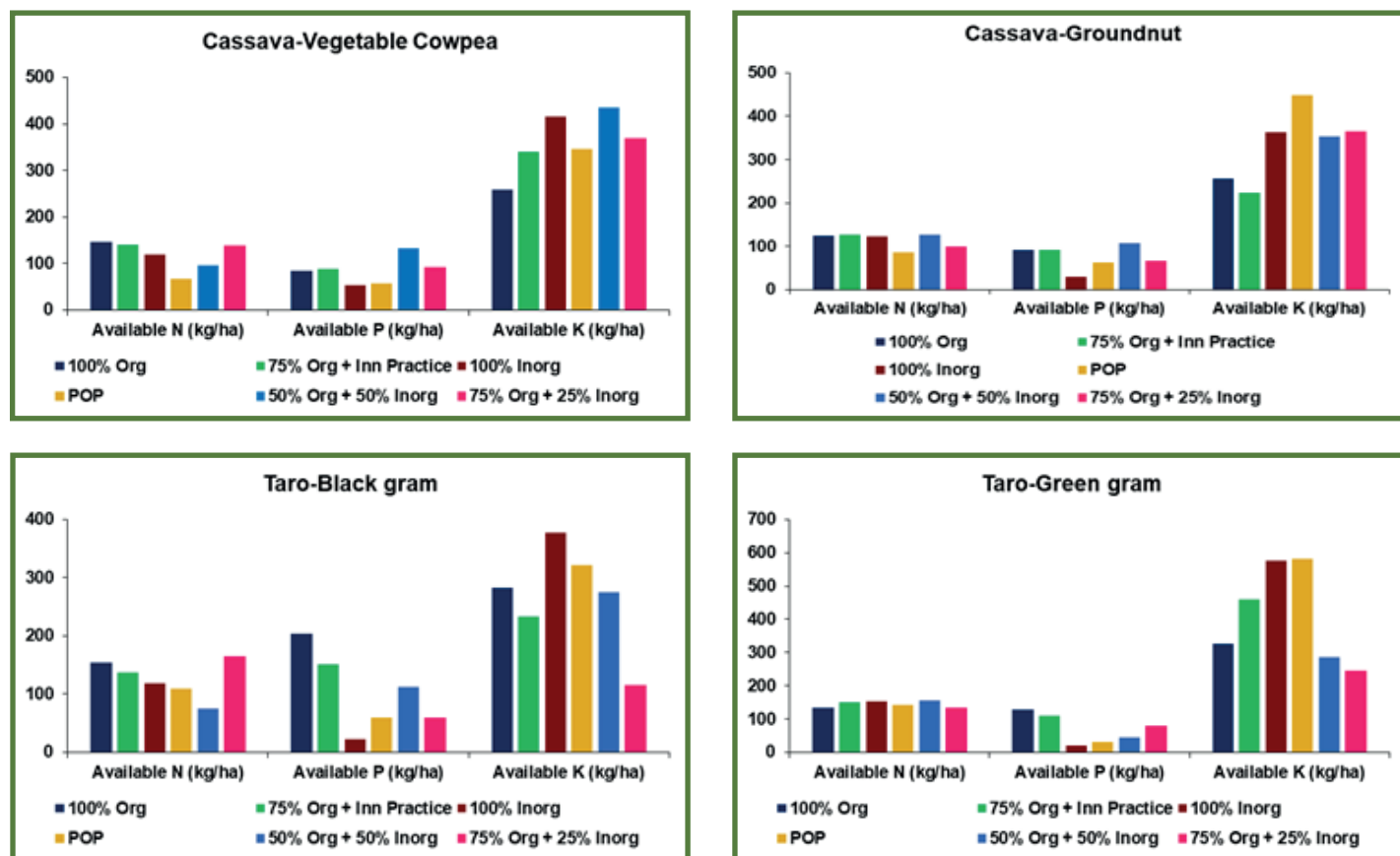


Fig.8. Available N, P and K status of the soil under various management options in the different systems

Influence of organic management package with reduced dose of organic manures, integrated and inorganic management packages on available micronutrients iron, manganese, zinc and copper in soil (Table 7.2.9 and 7.2.10)

Six centres estimated available micronutrients in the soil under different management systems.

Bajaura

Higher available iron and zinc (15.6 and 3.67 ppm) were recorded under organic package with 100% organic management and being on par with integrated while manganese and copper recorded higher under integrated package (50% each organic and inorganic) of 12.0 and 2.94 ppm. Available Fe and Zn was found to be higher (79.3 & 94.2%) compared to inorganic whereas, Mn and Cu (84.6 & 188.2 %) was higher than inorganic management respectively. In case of

cropping system, not much variation recorded with micronutrients. Black gram-cauliflower-summer squash recorded higher available Fe and Zn (13.8 and 2.9 ppm respectively) in the soil. Cauliflower-tomato recorded higher available Mn (10.1 ppm) while, ladyfinger-pea recorded higher copper (2.44 ppm) in the soil.

Calicut

Maximum available iron and manganese was recorded in ginger (36.0 and 37.0 ppm) and black pepper crop (19 and 1.7 ppm) respectively under integrated with 50% each organic and inorganic nutrient management whereas; in turmeric micronutrients Fe and Mn found to be higher under organic with adoption of 75% input through organic sources + innovative organic practice. Higher zinc (3.22 and 2.41 ppm) recorded higher under organic management package in ginger and turmeric respectively.

Dharwad

The DTPA extractable Cu, Zn and Mn were recorded higher in integrated farming system (50:50 organic and inorganic nutrients) whereas; the DTPA extractable Fe was higher under 100 % organic farming practice. The practice of 100 % inorganic farming or 100 % RDF+RDFYM practice, in general exhibited lower status of these micronutrients. The cropping systems showed mixed influence on micronutrient status and did not influence Zn and Fe status. The cropping systems greengram-sorghum (CS3) and groundnut+ cotton (CS4) registered higher status of Cu and Mn compared to other systems.

Pantnagar

Availability of Cu (4.59 ppm) and Fe (81.9 ppm) was higher in organic with (75% Organic+ Innovative Technology). However, the availability of Zn (0.89

ppm) was maximum under inorganic with state recommendation followed by 100 % chemical. Availability of Mn (15.1 ppm) was highest under 100% organic practice. Among the cropping systems, the availability of Zn and Fe were maximum in basmati rice- vegetable pea system (1.22 ppm and 59.1 ppm, respectively). While higher availability of Cu (4.29 ppm) and Mn (12.9 ppm) were found under basmati rice -potato system.

Sardarkrushinagar

Iron, manganese, zinc and copper were not differ significantly due to the nutrients management practices and cropping systems. The availability of micronutrient in the soil at the end of cropping cycle recorded higher in organic management practice under groundnut- wheat- green gram system for Fe (3.81ppm), Mn (6.43 ppm), Zn (0.47 ppm) and Cu (0.67 ppm).

Table 7.2.9: Influence of methods of organic, inorganic and integrated package on soil available micronutrients (Iron and Manganese) at the end of cropping cycle at different locations

Cropping systems/ Management practice	Soil Available Iron (ppm)							Soil Available Manganese (ppm)						
	Organic		Inorganic		Integrated (towards organic)		Mean	Organic		Inorganic		Integrated (towards organic)		Mean
	100% organ- ic	75% organ- ic + inno- vative or- ganic prac- tices	100% Inor- ganic	State rec- om- men- dation	50% or- ganic + 50% inor- ganic	75% or- ganic + 25% inor- ganic		100% organ- ic	75% organ- ic + inno- vative or- ganic prac- tices	100% Inor- ganic	State recom- mendation	50% or- ganic + 50% inor- ganic	75% or- ganic + 25% inor- ganic	
Bajura														
Tomato-cauliflower- french bean	14.8	12.4	7.8	10.0	14.5	12.4	12.0	11.2	9.7	7.0	7.8	12.9	10.1	9.8
Fallow-cauliflow- er-tomato	15.5	12.6	9.4	10.9	13.9	12.9	12.5	12.0	10.0	6.4	8.9	12.9	10.1	10.1
Black gram-cau- liflower- summer squash	17.7	14.0	8.6	10.8	16.8	14.7	13.8	11.2	8.0	6.0	7.3	11.1	9.9	8.9
Lady finger-pea	14.5	13.6	8.8	10.1	16.6	14.6	13.0	11.8	10.2	6.4	8.9	11.2	10.0	9.8
Mean	15.6	13.2	8.7	10.5	15.5	13.7		11.6	9.5	6.5	8.2	12.0	10.0	



Cropping systems/ Management practice	Soil Available Iron (ppm)							Soil Available Manganese (ppm)						
	Organic		Inorganic		Integrated (towards organic)		Mean	Organic		Inorganic		Integrated (towards organic)		Mean
	100% organ- ic	75% organ- ic + inno- vative or- ganic prac- tices	100% Inor- ganic	State rec- om- men- dation	50% or- ganic + 50% inor- ganic	75% or- ganic + 25% inor- ganic		100% organ- ic	75% organ- ic + inno- vative or- ganic prac- tices	100% Inor- ganic	State recom- mendation	50% or- ganic + 50% inor- ganic	75% or- ganic + 25% inor- ganic	
Calicut														
Ginger - fallow	28.0	35.0	30.0		36.0	28.0	31.4	13.3	16.6	15.0		19.0	15.0	15.8
Turmeric-fallow	34.8	35.8	25.9		32.3	33.2	32.4	17.5	21.6	13.9		18.3	16.2	17.5
Black papper-fallow	24.3	-	30.5	-	37.0	-	32.4	1.1	-	1.1	-	1.7	-	1.3
Dharwad														
Cowpea-safflower	14.3	14.4	12.7	12.7	14.2	13.1	13.6	18.6	18.1	15.4	14.3	18.1	16.8	16.9
Pigeon pea (sole)	14.6	13.7	14.0	12.9	15.8	12.5	13.9	18.2	18.0	16.5	14.5	21.2	17.3	17.6
green gram - sor- ghum	16.7	15.5	13.8	12.1	14.8	13.1	14.3	19.7	19.5	17.3	13.9	19.8	18.4	18.1
Groundnut + hybrid cotton (2:1)	17.0	16.7	13.1	12.8	14.9	13.8	14.7	19.7	19.8	17.1	15.3	18.5	17.9	18.1
Maize-chickpea	12.7	12.6	13.2	12.6	13.4	12.4	12.8	16.5	15.6	15.6	14.5	16.3	16.1	15.8
Mean	15.1	14.6	13.4	12.6	14.6	13.0		18.5	18.2	16.4	14.5	18.8	17.3	
Pantnagar														
Basmati rice-wheat	65.6	81.5	41.7	40.1	57.2	56.6	57.1	13.8	12.5	9.8	10.9	11.8	12.3	11.9
Basmati rice -chick- pea (4rows+2rows coriander)	77.8	82.2	51.3	39.9	63.2	53.8	61.4	14.9	12.9	9.2	10.2	13.2	13.8	12.4
Basmati rice -veg- etable pea (4 rows vegetable pea +2 rows coriander)	70.7	81.7	45.5	38.6	60.3	57.8	59.1	17.0	13.2	10.8	8.9	12.8	11.9	12.4
Basmati rice -potato	69.9	82.0	41.9	39.5	46.3	60.2	56.6	14.8	16.4	9.7	10.0	13.9	12.8	12.9
Mean	71.0	81.9	45.1	39.5	56.8	57.1		15.1	13.8	9.9	10.0	12.9	12.7	
Sardarkrushinagar														
Groundnut- Wheat- Green gram	3.81	3.70	3.46	3.45	3.63	3.58	3.61	6.43	6.41	5.63	5.75	6.30	6.09	6.10
Greengram- Cumin- Vegetable cowpea	3.72	3.80	3.40	3.29	3.52	3.45	3.53	5.92	5.96	5.29	5.54	5.80	5.70	5.70
Greengram-Fennel- Fennel cont.	3.94	3.71	3.51	3.36	3.65	3.51	3.61	6.14	6.02	5.44	5.43	5.81	5.61	5.74
Mean	3.82	3.74	3.46	3.37	3.60	3.51		6.16	6.13	5.45	5.57	5.97	5.80	

Table 7.2.10: Influence of methods of organic, inorganic and integrated package on soil available micronutrients (Zinc and copper) at the end of cropping cycle

Cropping systems/ Management practice	Soil Available Zinc (ppm)							Soil Available Copper (ppm)						
	Organic		Inorganic		Integrated (towards organic)		Mean	Organic		Inorganic		Integrated (towards organic)		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bajura														
Tomato-cauliflower- french bean	3.96	2.87	1.95	1.98	3.12	2.92	2.80	2.19	1.74	1.00	1.48	2.38	2.18	1.83
Fallow-cauliflower-tomato	3.38	2.89	1.75	2.15	3.12	2.94	2.71	3.18	1.90	1.09	1.70	3.77	2.48	2.35
Black gram-cauliflower- summer squash	3.75	3.16	1.88	2.89	2.95	2.78	2.90	1.36	1.18	1.00	1.05	1.68	1.48	1.29
Lady finger-pea	3.57	2.62	1.96	2.42	3.14	2.79	2.75	3.60	2.16	0.99	1.48	3.92	2.49	2.44
Mean	3.67	2.89	1.89	2.36	3.08	2.86		2.58	1.75	1.02	1.43	2.94	2.16	
Calicut														
Ginger - fallow	3.2	3.0	1.7		2.8	2.6	2.7	10.0	9.7	10.0		12.0	11.0	10.5
Turmeric-fallow	2.41	2.62	0.57		1.74	2.25	1.92	1.64	1.94	1.21		1.58	1.58	1.59
Black paper-fallow														
Dharwad														
Cowpea-safflower	0.64	0.70	0.43	0.46	1.09	0.69	0.67	2.98	2.64	2.57	2.41	2.93	2.71	2.71
Pigeon pea (sole)	0.48	0.59	0.45	0.45	0.62	0.50	0.52	2.72	2.55	2.53	2.36	2.91	2.49	2.59
green gram - sorghum	0.67	0.74	0.51	0.48	0.63	0.45	0.58	2.96	2.74	2.67	2.44	2.97	2.75	2.76
Groundnut + hybrid cotton (2:1)	0.79	0.48	0.47	0.62	0.69	0.50	0.59	2.99	2.78	2.52	2.66	2.94	2.64	2.76
Maize-chickpea	0.94	0.44	0.46	0.58	0.63	0.50	0.59	2.43	2.30	2.37	2.47	2.59	2.48	2.44
Mean	0.70	0.59	0.46	0.52	0.73	0.53		2.82	2.60	2.53	2.47	2.87	2.61	
Pantnagar														
Basmati rice-wheat	1.38	1.5	0.85	0.89	1.35	1.09	1.18	3.18	4.45	3.33	3.98	3.57	3.46	3.66

Cropping systems/ Management practice	Soil Available Zinc (ppm)							Soil Available Copper (ppm)						
	Organic		Inorganic		Integrated (towards organic)		Mean	Organic		Inorganic		Integrated (towards organic)		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Basmati rice-chickpea (4rows+2rows coriander)	1.4	1.48	0.82	0.9	1.39	1.15	1.19	4.14	4.89	3.41	4.2	3.96	3.83	4.07
Basmati rice-vegetable pea (4 rows vegetable pea +2 rows coriander)	1.54	1.5	0.86	0.92	1.28	1.22	1.22	3.39	4.68	3.39	3.92	3.74	4.27	3.9
Basmati rice-potato	1.49	1.38	0.88	0.85	1.18	1.18	1.16	4.05	5.12	3.92	4.18	3.83	4.61	4.29
Mean	1.45	1.47	0.85	0.89	1.3	1.16		3.69	4.79	3.51	4.07	3.78	4.04	
Sardarkrushinagar														
Groundnut-Wheat- Green gram	0.47	0.45	0.26	0.37	0.40	0.39	0.39	0.67	0.58	0.38	0.46	0.57	0.56	0.54
Greengram-Cumin- Vegetable cowpea	0.45	0.44	0.32	0.42	0.43	0.38	0.41	0.55	0.52	0.36	0.42	0.50	0.48	0.47
Green-gram-Fennel-Fennel cont.	0.39	0.36	0.24	0.29	0.32	0.31	0.32	0.53	0.53	0.38	0.42	0.52	0.45	0.47
Mean	0.44	0.41	0.27	0.36	0.38	0.36		0.58	0.54	0.37	0.43	0.53	0.50	

Thiruvananthapuram

Organic practices or towards organic practices enhanced the secondary and micronutrient status of the soil after end of all cropping systems evaluated. Available S content was highest under integrated management practices in all the systems, except cassava-groundnut, where 100% organic resulted in the highest S status. Available Fe, Mn, and Zn contents were higher under 100% inorganic practice and available Cu in state recommendation in cassava-

vegetable cowpea. Integrated or inorganic practices resulted in higher micronutrient contents in cassava-groundnut system. In taro-black gram, organic and towards organic (75% organic + 25% inorganic) practices favoured available Fe, Mn, Zn and Cu status in the soil. In taro-green gram system, 75% organic + 25% inorganic practice resulted in higher Mn and Cu status in soil whereas, 100% organic practice resulted in higher Fe content and state recommendation resulted in higher Zn content in the soil.

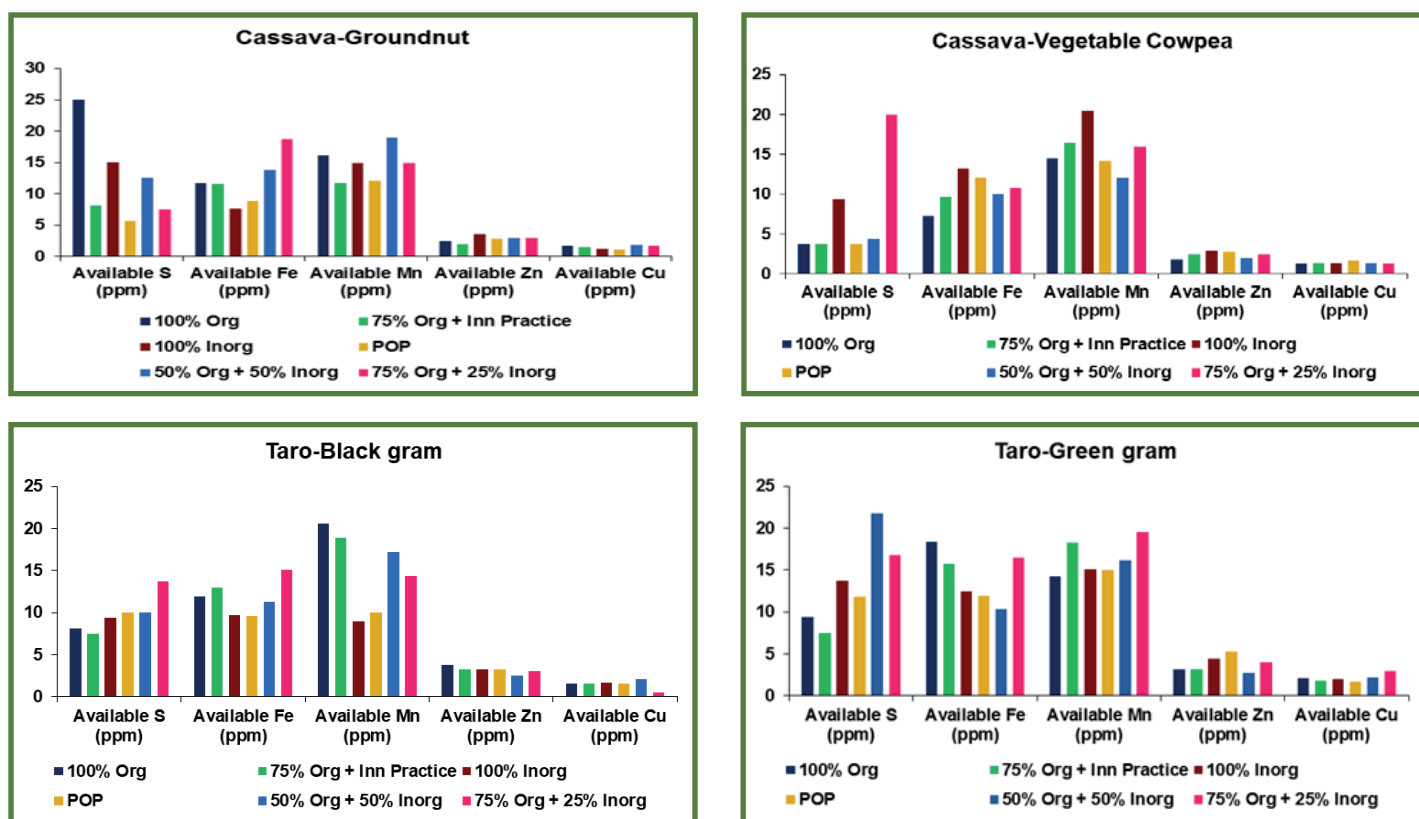


Fig. 9. Available S and micronutrient (Fe, Mn, Zn and Cu) status of the soil under various management options in the different systems

Influence of organic management package with reduced dose of organic manures, integrated and inorganic management packages on N, P and K uptake (Table 7.2.11-7.2.13)

Nine centres estimated uptake of nutrients for all the crops evaluated influenced by management practice.

Bajaura

Crops like french bean, black gram and pea recorded higher N uptake under organic package (2.43, 2.46 and 3.46% respectively) whereas cauliflower, tomato, summer squash and okra uptake were maximum under integrated (3.03, 2.28, 1.87 and 3.46% respectively). Almost all the crops grown in the system during *kharif*, *rabi* and in summer took higher P under integrated consisting of 50:50% each organic and inorganic nutrient except french bean

which was higher with organic. Crop's cauliflower (0.45%), tomato (0.35%), black gram (0.33%), summer squash (0.31%), okra (0.30%) and pea (0.39%) were observed with integrated package for P uptake. K uptake was also found to be higher towards organic under integrated package for almost all the crops grown in the system except summer squash and cauliflower which took maximum K in organic and inorganic respectively. Integrated package recorded higher K with tomato, (2.38%), frenchbean (2.05%), okra (2.16%), pea (0.96%) and black gram (2.15%).

Calicut

Leaf nutrient status in ginger recorded the higher nitrogen uptake under inorganic practice whereas, phosphorus and potassium were significantly higher in organic practice. In case of turmeric, nutrient uptake of nitrogen in rhizome was found to be higher in organic management practice



followed by integrated, phosphorus and potassium were significantly higher in integrated nutrient management practice either with 50:50 each organic and inorganic or with 75 % organic manure +25% inorganic input.

Karjat

Nutrient's status of nitrogen and phosphorus in *kharif* and *rabi* crops were found to be higher with application of organic manure (100%) followed by integrated while potassium uptake in all the crops were higher under integrated (50:50 each organic and inorganic input). Rice crops took 7.3% more N whereas *rabi* crops took 22.7% more N than the inorganic.

Pantnagar

During *kharif* in basmati rice, highest uptake of macronutrient, N was observed in 100% organic practice (87.9 kg/ha) which was closely on par with integrated (75 organic + 25 % inorganic) of 87.3 kg/ha. Uptake of P in basmati rice was highest in integrated with 75 organic + 25 % inorganic of 26.4 kg/ha followed by 50% organic + 50% inorganic (25.5 kg/ha). Higher uptake of K was also observed in integrated nutrient managements 50% organic+50% inorganic (76.4 kg/ha) followed by organic 100 % (75.5 kg/ha). During *rabi*, uptake of nitrogen by wheat recorded highest under inorganic practice (125.6 kg/ha) while chickpea uptake was maximum in organic practice (89.2 kg/ha). uptake of phosphorus (51.8 kg/ha) and potassium (99.4 kg/ha) by wheat crop was recorded maximum in integrated (75% org. + 25% chem.). However, maximum total uptake of P and K in chickpea was higher with 100% organic practice (37.3 and 59.6 kg/ha).

Raipur

Uptake of macro nutrients by soybean, the highest uptake of N, P and K was recorded under 75% organic + foliar spray of vermiwash (10%) followed by cow urine (10%) at 20 days interval at 30 DAS and 50 DAS

in organic practice which was significantly superior over rest of the nutrient management practices, but it was on par with 100% organic treatment. Soybean crop took by 24.6, 27.5 and 28.9% more macro-nutrients N, P and K respectively with organic practice than the other management practices.

Ranchi

Total nitrogen uptake by rice crop was maximum (87.8 kg/ha) in the 75% organic + innovative practices followed by with 100% organic sources (82.9 kg/ha). Similar trend was observed with P & K uptake. During *rabi*, the uptake of N, P and K in wheat was higher in inorganic package (68.8, 13.9 and 39.4 kg/ha respectively) while, lentil recorded higher in integrated nutrient management with 75% nutrient supply through organic sources +25% though inorganic. Potato and linseed crops recorded highest uptake of N, P and K in organic with 75% organic + innovative organic practices. N, P and K uptake was found to be 20.5, 29.3 and 22.3% higher for potato respectively similarly for linseed crop, the uptake of macro nutrient N, P and K were 23.1, 24.1 and 34.0% higher with organic than inorganic.

Ajmer

Uptake of nutrient N (17.8 and 51.9 kg/ha), P (4.3 and 11.5 kg/ha) and K (14.4 and 41.0 kg/ha) by coriander and fennel respectively were recorded highest in integrated with 75% organic + 25% inorganic practices followed by state recommendation. Uptake of nutrient by coriander. Spice crop coriander and fennel received 31.4 & 19.5 and 22.1 & 28.7% higher N compared to organic and inorganic, respectively

Sardarkrushinagar

Macro nutrients nitrogen and potassium uptake in groundnut was higher under inorganic with state recommendation practice (230.0 kg/ha and 144 kg/ha respectively) whereas highest uptake of P (37.06 kg/ha) recorded higher in integrated (50 % organic + 50% inorganic). N, P and K status in green gram was

higher towards organic with 50:50 each nutrient through organic and inorganic sources.

Udaipur

The maximum total uptake of N, P and K (69.41, 12.95 and 89.14 kg/ha, respectively) in maize + black gram was found in 75% organic + 25% inorganic under integrated management practices. The maximum total uptake of N, P and K in sole blackgram (38.12,

5.55 and 18.53 kg/ha, respectively) was recorded with 50% organic + 50 % inorganic followed by 100% inorganic management. The sweet corn + blackgram intercropping system uptake, maximum total N, P and K (105.97, 17.20 and 84.24 kg/ha, respectively) was recorded in 100% inorganic practice. In rabi uptake of macro nutrients N, P and K in wheat (*durum* and *aestivum*) chickpea and fenugreek was higher under inorganic package.

Table 7.2.11: Influence of organic, inorganic and integrated package on N uptake of crops and cropping systems

Locations/Treatments	Organic						Inorganic						Integrated (towards organic)					
	100% Organic			75% organic + innovative organic practices			100% inorganic			State recommendation			50% organic+ 50% inorganic			75% organic+ 25% inorganic		
	Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer
Bajaura (%)																		
Tomato-cauliflower- french bean	2.05	2.83	2.43	1.95	2.78	2.38	2.21	2.91	2.27	2.27	2.94	2.33	2.23	2.96	2.34	2.03	2.95	2.37
Fallow-cauliflower-tomato		2.83	2.05		2.78	2.03		2.88	2.03		2.93	2.28		3.03	2.26		2.98	2.28
Black gram-cauliflower - summer squash	2.46	2.83	1.85	2.37	2.78	1.78	2.21	2.93	1.83	2.28	2.98	1.85	2.35	2.99	1.87	2.31	3.01	1.85
Lady finger-pea	1.95	3.46		1.88	3.43		1.95	3.33		2.00	3.39		2.00	3.46		1.98	3.43	
Calicut																		
Ginger-fallow (%)	3.34			3.35			3.85			-			3.68			3.77		
Turmeric-fallow (kg/ha)	124.4			110.8			105.2			-			123.4			121.2		
Karjat																		
Rice-brinjal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice-chickpea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice-field bean	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice-onion (White)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	81.1	94.9		69.8	72.8		75.6	77.1		67.3	45.8		77.5	84.7		69.9	70.7	
Pantnagar																		
Basmati rice - wheat	82.8	112.8		84.7	108.0		71.9	125.6		64.4	116.8		81.6	125.2		90.3	124.6	
Basmati rice-chickpea (4 rows chickpea + 2 rows coriander)	90.0	89.2		83.4	83.6		80.0	79.0		80.3	84.2		88.6	84.7		88.9	56.3	



Locations/Treatments	Organic						Inorganic						Integrated (towards organic)					
	100% Organic			75% organic + innovative organic practices			100% inorganic			State recommendation			50% organic+ 50% inorganic			75% organic+ 25% inorganic		
	Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer
Basmati rice-vegetable pea (4 rows vegetable pea + 2 rows coriander)	92.4			89.3			75.7			78.5			86.4			83.7		
Basmati rice - potato	86.2			85.5			70.6			72.7			89.6			86.1		
Mean	87.9			85.7			74.6			74.0			86.6			87.3		
Raipur																		
Soybean-maize	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soybean-pea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soybean-chilli	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soybean-onion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	130.4			137.9			110.7			121.6			101.3			105.9		
Ranchi																		
Rice- wheat	83.8	62.8		88.8	59.8		69.4	68.8		62.1	51.0		78.5	64.9		47.9	67.0	
Rice - lentil	79.7	29.8		85.2	26.3		64.6	33.2		56.6	23.6		73.8	33.9		45.4	40.8	
Rice- potato	89.5	40.0		93.2	37.3		74.1	33.2		62.1	25.6		82.7	35.3		49.0	33.5	
Rice - linseed	78.4	61.7		82.8	56.1		64.6	50.1		56.7	39.8		71.2	55.3		43.9	51.9	
Mean	82.9	48.6		87.5	44.9		68.2	46.3		59.4	35.0		76.5	47.4		46.5	48.3	
Centres started from 2015-16																		
Ajmer																		
Green gram - fennel		39.5			43.8			40.3			48.6			45.3			51.9	
Green gram - coriander		14.9			13.8			14.5			17.0			14.6			17.8	
Cluster bean - fennel		39.5			43.8			40.3			48.6			45.3			51.9	
Cluster bean - coriander		14.9			13.8			14.5			17.0			14.6			17.8	
Sardarkrushinagar																		
Groundnut- wheat-green gram	200.0			188.0			228.0			230.0			227.0			220.0		
Greengram- cum- in- vegetable cowpea	68.0			70.0			83.0			79.0			92.0			84.0		
Greengram-fennel-fennel	54.0			49.0			63.0			68.0			71.0			63.0		
Udaipur																		

Locations/Treatments	Organic						Inorganic						Integrated (towards organic)					
	100% Organic			75% organic + innovative organic practices			100% inorganic			State recommendation			50% organic+ 50% inorganic			75% organic+ 25% inorganic		
	Kha-rif	Rabi	Sum-mer	Kha-rif	Rabi	Sum-mer	Kha-rif	Rabi	Sum-mer	Kha-rif	Rabi	Sum-mer	Kha-rif	Rabi	Sum-mer	Kha-rif	Rabi	Sum-mer
Maize + blackgram (2:2) - durum wheat - sesbania (GM)	48.7	83.3		50.3	92.7		58.8	115.5		46.9	117.0		60.9	97.2		69.4	105.8	
Blackgram - wheat	23.9	80.8		27.6	84.4		36.2	101.5		26.0	93.3		38.1	97.1		32.9	93.0	
Sweet corn + blackgram (2:2)-chickpea	73.8	30.9		77.4	32.8		106.0	43.5		85.4	41.4		100.5	38.2		94.8	40.3	
Soybean - fenu-greek	45.3	99.5		45.8	107.9		73.3	108.7		71.1	107.8		75.7	101.8		60.6	88.6	

Table 7.2.12: Influence of inorganic, inorganic and integrated on P uptake of crops at different locations

Locations/Treatments	Organic						Inorganic						Integrated (towards organic)					
	100% Organic			75% organic + innovative organic practices			100% inorganic			State recommendation			50% organic+ 50% inorganic			75% organic+ 25% inorganic		
	Kha-rif	Rabi	Sum-mer	Kha-rif	Rabi	Sum-mer	Kha-rif	Rabi	Sum-mer	Kha-rif	Rabi	Sum-mer	Kha-rif	Rabi	Sum-mer	Kha-rif	Rabi	Sum-mer
Bajaura (%)																		
Tomato-cauliflower- french bean	0.24	0.43	0.25	0.25	0.41	0.26	0.23	0.33	0.23	0.28	0.39	0.24	0.26	0.45	0.25	0.31	0.43	0.22
Fallow-cauliflower-tomato		0.44	0.28		0.43	0.26		0.38	0.3		0.41	0.33		0.4	0.35		0.42	0.33
Black gram-cauliflower - summer squash	0.29	0.38	0.29	0.28	0.35	0.31	0.32	0.38	0.28	0.31	0.36	0.3	0.3	0.42	0.31	0.33	0.4	0.29
Lady finger-pea	0.23	0.35		0.21	0.37		0.27	0.36		0.29	0.38		0.3	0.39		0.28	0.38	
Calicut																		
Ginger-fallow (%)	0.62			0.61			0.38			-			0.51			0.51		
Turmeric-fallow (kg/ha)	53.3			44.9			31.6			-			53.1			54.4		
Karjat																		
Rice-brinjal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice-chickpea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice-field bean	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice-onion (White)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	15.5	17.1		13.7	14.4		14.7	16.9		7.6	10.9		16.0	16.9		13.5	15.7	
Pantnagar																		
Basmati rice - wheat	20.8	35.5		23.9	42.2		20.3	40.3		24.8	48.8		24.6	49.1		25.6	51.8	



Locations/ Treatments	Organic						Inorganic						Integrated (towards organic)					
	100% Organic			75% organic + innovative or- ganic practices			100% inorganic			State recom- mendation			50% organic+ 50% inorganic			75% organic+ 25% inorganic		
	Kha- rif	Rabi	Sum- mer	Kha- rif	Rabi	Sum- mer	Kha- rif	Rabi	Sum- mer	Kha- rif	Rabi	Sum- mer	Kha- rif	Rabi	Sum- mer	Kha- rif	Rabi	Sum- mer
Basmati rice- chickpea (4 rows chickpea + 2 rows coriander)	21.4	37.3		24.6	33.1		23.0	30.9		21.1	30.2		26.5	34.4		24.8	32.0	
Basmati rice-veg- etable pea (4 rows vegetable pea + 2 rows coriander)	24.9			26.3			23.0			20.9			25.3			29.8		
Basmati rice - potato	23.2			21.6			21.7			18.9			25.5			25.5		
Raipur																		
Soybean-maize	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soybean-pea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soybean-chilli	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soybean-onion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	16.5			16.7			13.1			14.9			12.0			12.6		
Ranchi																		
Rice- wheat	15.6	12.3		15.9	11.1		12.3	13.9		9.6	9.9		14.1	12.5		13.6	12.3	
Rice -lentil	15.1	7.6		16.0	6.8		12.1	8.9		10.4	5.9		13.6	9.1		13.3	10.9	
Rice- potato	16.9	25.6		17.9	22.5		13.4	19.8		10.5	16.7		14.9	21.4		15.3	20.7	
Rice - linseed	14.6	7.2		15.5	6.7		11.2	5.8		9.1	5.1		13.3	6.4		13.5	6.0	
Mean	15.5	13.2		16.3	11.8		12.3	12.1		9.9	9.4		14.0	12.3		13.9	12.5	
Centres started from 2015-16																		
Ajmer																		
Green gram - fennel		8.9			9.7			8.8			10.9			9.5			11.5	
Green gram - cori- ander		3.2			3.8			3.4			4.0			3.7			4.3	
Cluster bean - fennel		8.9			9.7			8.8			10.9			9.5			11.5	
Cluster bean - coriander		3.2			3.8			3.4			4.0			3.7			4.3	
Mean																		
Sardarkrushina- gar																		
Groundnut- wheat- green gram	32.7			30.7			36.3			35.6			37.1			35.1		

Locations/ Treatments	Organic						Inorganic						Integrated (towards organic)					
	100% Organic			75% organic + innovative or- ganic practices			100% inorganic			State recom- mendation			50% organic+ 50% inorganic			75% organic+ 25% inorganic		
	Kha- rif	Rabi	Sum- mer	Kha- rif	Rabi	Sum- mer	Kha- rif	Rabi	Sum- mer	Kha- rif	Rabi	Sum- mer	Kha- rif	Rabi	Sum- mer	Kha- rif	Rabi	Sum- mer
Greengram- cum- in- vegetable cowpea	9.9			9.4			16.0			14.5			16.4			13.9		
Greengram-fen- nel- fennel	13.3			12.8			16.9			16.2			17.9			16.3		
Udaipur																		
Maize + black- gram (2:2) – durum wheat – sesbania (GM)	9.4	25.7		9.8	29.6		10.3	36.8		8.7	34.1		10.9	30.2		13.0	34.0	
Blackgram – wheat	3.4	23.9		3.9	25.0		5.3	30.5		4.2	28.1		5.6	28.9		4.7	28.3	
Sweet corn + blackgram (2:2) – chickpea	12.0	5.9		12.4	6.4		17.2	8.5		13.0	6.9		17.1	7.4		16.1	8.0	
Soybean - fenu- greek	5.0	15.7		5.0	17.2		8.2	17.8		8.0	16.9		8.5	16.5		6.8	14.6	

Table 7.2.13: Influence of inorganic, inorganic and integrated on K uptake of crops at different locations

Locations/Treatments	Organic						Inorganic						Integrated (towards organic)					
	100% Organic			75% organic + innovative or- ganic practices			100% inor- ganic			State recom- mendation			50% organic+ 50% inorganic			75% organic+ 25% inorganic		
Bajaura (%)																		
Tomato-cauliflower- french bean	2.25	2.52	1.95	2.22	2.50	1.92	2.29	2.54	1.97	2.35	2.50	2.01	2.38	2.54	2.05	2.36	2.52	2.03
Fallow-cauliflower-to- mato		2.52	2.30		2.56	2.29		2.51	2.25		2.55	2.31		2.58	2.33		2.54	2.32
Black gram-cauliflower - summer squash	2.08	2.53	2.16	2.10	2.50	2.19	2.15	2.57	2.14	2.14	2.59	2.16	2.12	2.55	2.17	2.15	2.56	2.15
Lady finger-pea	2.14	0.85		2.13	0.88		2.15	0.95		2.16	0.94		2.16	0.96		2.13	0.95	
Calicut																		
Ginger-fallow (%)	2.57			2.49			2.55						2.47			2.56		
Turmeric-fallow (kg/ha)	146.2			129.8			118.4						151.8			147.3		
Karjat																		
Rice-brinjal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice-chickpea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice-field bean	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice-onion (White)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	86.8	59.4		77.6	50.5		86.7	60.9		78.3	44.2		88.5	62.1		82.3	55.5	

Locations/Treatments	Organic						Inorganic						Integrated (towards organic)					
	100% Organic			75% organic + innovative organic practices			100% inorganic			State recommendation			50% organic+ 50% inorganic			75% organic+ 25% inorganic		
Pantnagar																		
Basmati rice - wheat	74.4	91.0		68.2	91.3		60.7	97.4		64.2	92.3		71.1	98.2		76.3	99.4	
Basmati rice-chickpea (4 rows chickpea + 2 rows coriander)	79.6	59.6		67.7	57.1		65.3	52.7		67.8	52.3		78.8	57.7		72.2	54.1	
Basmati rice-vegetable pea (4 rows vegetable pea + 2 rows coriander)	77.8			76.4			64.1			66.2			77.9			74.2		
Basmati rice - potato	70.2			78.6			59.4			56.3			77.8			77.2		
Ranchi																		
Rice- wheat	72.8	35.7		75.2	33.9		60.3	39.4		52.5	29.3		68.4	36.8		66.9	37.6	
Rice - lentil	65.2	17.7		68.6	15.8		63.2	20.0		55.4	14.3		63.6	20.5		62.5	23.2	
Rice- potato	76.3	80.7		78.6	75.5		63.9	66.0		49.9	58.4		68.0	70.9		66.9	68.2	
Rice - linseed	67.0	32.7		72.4	30.3		54.6	24.4		50.4	21.5		60.9	28.3		61.8	25.5	
Mean	70.3	41.7		73.7	38.9		60.5	37.5		52.0	30.9		65.2	39.1		64.5	38.6	
Centres Started from 2015-16																		
Ajmer																		
Green gram - fennel		30.8			31.8			32.7			38.1			33.9			41.0	
Green gram - coriander		11.8			12.3			11.1			13.5			11.9			14.4	
Cluster bean - fennel		30.8			31.8			32.7			38.1			33.9			41.0	
Cluster bean - coriander		11.8			12.3			11.1			13.5			11.9			14.4	
Mean																		
Sardarkrushinagar																		
Groundnut- wheat- green gram	130.0			120.0			139.0			144.0			136.0			128.0		
Greengram- cumin- vegetable cowpea	56.0			57.0			79.0			78.0			90.0			81.0		
Greengram-fennel- fennel	38.0			37.0			48.0			52.0			51.0			47.0		
Udaipur																		
Maize + blackgram (2:2) - durum wheat - sesbania (GM)	53.4	129.1		57.9	143.5		60.7	179.9		53.2	179.1		69.8	152.8		89.1	166.8	
Blackgram - wheat	12.5	105.8		14.3	111.6		21.3	133.8		14.8	132.7		23.0	128.1		19.5	121.4	
Sweet corn + blackgram (2:2)-chickpea	62.8	30.2		64.9	33.1		84.2	42.7		70.8	35.8		81.0	36.6		79.3	39.7	
Soybean - fenugreek	21.8	50.7		22.2	55.2		39.1	57.8		41.7	57.5		42.4	52.9		29.8	47.4	

Influence of organic, inorganic and integrated management on micronutrient (iron, manganese, zinc and copper) uptake (Table 7.2.14)

Bajaura

Micronutrients, iron, manganese, zinc and copper uptake among cropping systems was recorded higher in integrated nutrient management consisting of

50% organic+ 50% inorganic or in 75% organic+25% inorganic nutrients inputs while, minimum being with 100% inorganic. Across of different cropping systems and management practices, the uptake of Fe, Mn and Zn found to be higher in black gram-cauliflower-summer squash cropping system of 1481, 627, 542 kg/ha respectively under integrated consisting of 50% organic + 50% inorganic nutrient inputs whereas, Cu (258 kg/ha) was highest with 75% organic+25% inorganic.

Calicut

Among the different management practices, uptake of micronutrients iron (505 kg/ha) and copper (552.6 kg/ha) in ginger was highest with organic management practice whereas, manganese (388 kg/ha) and zinc (74.4 kg/ha) were higher with inorganic package. In case of turmeric, significantly higher zinc (53.2 kg/ha) and copper (19.3 kg/ha) was recorded in organic practice. Iron was higher with integrated consisting of 50% organic+ 50% inorganic while, manganese found to be higher under inorganic.

Microbial population in soil as influenced by the different management practices (Table 7.2.15 and 7.2.16).

Bajaura

In general, the organic management practice improved soil microbial properties irrespective of cropping systems compare to inorganic and integrated practice. At the end of cropping cycle, microbial bacteria (18.3×10^6 cfu/g) recorded maximum in lady finger-pea system with organic management practice. Fungi (14.4×10^6 cfu/g) was maximum in tomato-cauliflower- french bean system also with organic management practice. Actinomycetes and phosphate solubilizing bacteria (14.7×10^3 and 16.4×10^4 cfu/g respectively) were in black gram-cauliflower- summer squash cropping system followed the same trends. Among nutrient

management packages, the micronutrients with organic found to be higher by 78.1, 48.4, 63.9 and 56% for bacteria, fungi, actinomycetes and phosphate solubilizing bacteria respectively compared to inorganic package.

Bhopal

Microbial count in soil (bacteria, fungi and actinomycetes) recorded highest under 100% organic followed state recommendation in both the cropping system (soybean-wheat and soybean-chickpea). Rhizosphere microbial population of bacteria, fungi and actinomycetes was increased to the tune of 27.0, 22.6 and 29% for soybean-wheat, whereas in soybean-chickpea, it was increased by 25, 28 and 19.7% respectively with organic compared to inorganic package.

Dharwad

Higher bacteria and phosphate solubilizing bacteria population was maximum under integrated consisting of 50% organic+ 50% inorganic nutrients inputs (78.2×10^6 cfu/g and 32.2×10^4 cfu/g). Fungi and actinomycetes recorded higher (14.6×10^6 cfu/g and 46.1×10^3 cfu/g respectively) with organic and increased by 47.7 and 55.9% compared to inorganic. Among the cropping systems, green gram sorghum system recorded higher bacteria and fungi population (72.9 and $12 \log^6$ cfu/g) while actinomycetes was maximum in pigeon pea sole ($40.6 \log^4$ cfu/g).

Jabalpur

Adoption of organic nutrients either fully (100% organic) or reduced dose (75% organic +innovative organic practice) exhibited improvement in microbial population in the soil viz. fungi, bacteria, actinomycetes and phosphate solubilizing bacteria (PSB). Population of fungi, bacteria, actinomycetes and phosphate (69.8 , 57.6 , 45.3 and $23.5 \log$ cfu/g) was highest with organic, and these were increased by 45.1 , 5.4 , 54.6 and $47.8 \log$ cfu/g respectively compared to inorganic. Among the cropping systems, basmati-



rice- wheat-green manure system registered highest microbial population.

Narendrapur

Application of organic nutrient consisting of 75% organic+25% innovative organic practice resulted in higher microbial population in the soil viz. fungi, bacteria and actinomycetes. Population of bacteria (20.5 log cfu/g), fungi (15.2 log cfu/g) and actinomycetes (26.3 log cfu/g) with 75% organic +innovative practices under organic management was increased to the tune 73.7, 44.8 and 52.0% for bacteria, fungi and actinomycetes of compared to inorganic management, respectively. Among the cropping systems, basmati rice-broccoli-sesbania green manure recorded higher bacteria, fungi

and actinomycetes of 24.4, 18.8 and 32.3 log cfu/g respectively.

Thiruvanthapuram

Microbial population of bacteria was higher under organic package consisting of 100% organic or 75% organic + 25% innovative organic practice in cassava-cowpea and taro-green gram systems. Fungi was higher under inorganic with 100% inorganic and state recommendation. Cassava followed by cowpea and groundnut resulted in higher actinomycetes under inorganic package while taro followed by blackgram and green gram recorded maximum actinomycetes under organic with 100% organic and 75% organic + 25% innovative organic.

Table 7.2.14: Influence of organic, inorganic and integrated nutrient management on micronutrients uptake kg/ha by different crops in cropping systems different centers

Cropping systems/ Treatments	Iron							Manganese						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% Or- ganic	75% Or- ganic+ Inno- vative Or- ganic prac- tice	100% Inor- ganic	State rec- om- men- dation	50% Or- ganic + 50% inor- ganic	75% Or- ganic + 25% Inor- ganic		100% Or- ganic	75% Or- ganic+ Inno- vative Or- ganic prac- tice	100% Inor- ganic	State rec- om- men- dation	50% Or- ganic + 50% inor- ganic	75% Or- ganic + 25% Inor- ganic	
Bajaura														
Tomato-cauliflower- french bean	1145	981	558	1142	1221	1211	1043	398	378	187	382	404	373	354
Fallow-cauliflow- er-tomato	960	994	523	781	1021	895	862	413	448	223	374	439	379	379
Black gram-cau- liflower- summer squash	1047	1062	607	1128	1481	1451	1129	450	446	214	477	627	613	471
Lady finger-pea	510	506	322	504	614	578	506	255	241	134	260	336	290	253
Mean	916	886	503	889	1084	1034		379	378	190	373	452	414	
Calicut														
Ginger	505	395	439	-	462	469	454	306	240	388	-	355	350	328
Turmeric	676	579	692	-	748	719	683	138	141	252	-	194	183	182
	Zinc							Copper						

Cropping systems/ Treatments	Iron							Manganese						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% Or- ganic	75% Or- ganic+ Inno- vative Or- ganic prac- tice	100% Inor- ganic	State rec- om- men- da- tion	50% Or- ganic + 50% inor- ganic	75% Or- ganic + 25% Inor- ganic		100% Or- ganic	75% Or- ganic+ Inno- vative Or- ganic prac- tice	100% Inor- ganic	State rec- om- men- da- tion	50% Or- ganic + 50% inor- ganic	75% Or- ganic + 25% Inor- ganic	
Bajaura														
Tomato-cauliflower- french bean	414.0	358.0	161.0	347.0	392.0	383.0	342.5	255.0	164.0	71.0	141.0	192.0	169.0	165.3
Fallow-cauliflow- er-tomato	379.0	357.0	161.0	292.0	394.0	323.0	317.7	192.0	169.0	87.0	137.0	181.0	155.0	153.5
Black gram-cau- liflower- summer squash	397.0	426.0	219.0	400.0	542.0	487.0	411.8	188.0	195.0	85.0	167.0	254.0	258.0	191.2
Lady finger-pea	179.0	162.0	93.0	155.0	176.0	180.0	157.5	197.0	180.0	91.0	163.0	197.0	207.0	172.5
Mean	342.3	325.8	158.5	298.5	376.0	343.3		208.0	177.0	83.5	152.0	206.0	197.3	
Calicut														
Ginger	71.4	69.4	74.4	-	73.8	72.5	72.3	552.6	530.9	171.9	-	151.4	385.4	358.4
Turmeric	53.2	42.5	32.6		44.6	43.8	43.3	19.3	10.3	8.7		8.9	7.9	11.0

Table 7.2.15: Rhizosphere microbial population (Bacteria and Fungi micro-organisms) in soil as influenced by the different nutrient practices and cropping systems

Locations/Treat- ments	Bacteria (x10 ⁶ cfu/g)							Fungi (x10 ⁶ cfu/g)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% Organ- ic	75% Or- ganic+ Inno- vative Organ- ic prac- tice	100% Inor- ganic	State rec- om- men- da- tion	50% Or- ganic + 50% inor- ganic	75% Or- ganic + 25% Inor- ganic		100% Or- ganic	75% Or- ganic+ Inno- vative Organ- ic prac- tice	100% Inor- ganic	State rec- om- men- da- tion	50% Or- ganic + 50% inor- ganic	75% Or- ganic + 25% Inor- ganic	
Bajaura														
Tomato-Cauliflow- er- French bean	17.8	14.9	9.6	13.1	13.8	14.9	14.0	14.4	13.2	9.4	13.3	12.6	13.7	12.8
Fallow-Cauliflow- er-Tomato	16.8	14.6	9.6	12.9	15.2	13.5	13.8	14.2	12.9	9.4	12.9	12.6	13.5	12.6
Black gram-Cau- liflower- Summer squash	15.6	12.9	9.4	13.0	13.2	13.6	13.0	13.8	12.3	9.5	13.3	13.6	14.3	12.8
Lady finger-Pea	18.3	15.0	9.8	13.2	13.5	14.6	14.1	13.9	12.2	9.6	12.2	13.2	14.0	12.5
Mean	17.1	14.4	9.6	13.1	13.9	14.2		14.1	12.7	9.5	12.9	13.0	13.9	



Locations/Treatments	Bacteria (x10 ⁶ cfu/g)							Fungi (x10 ⁶ cfu/g)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% Organic	75% Organic+ Innovative Organic practice	100% Inorganic	State recommendation	50% Organic+ 50% inorganic	75% Organic+ 25% Inorganic		100% Organic	75% Organic+ Innovative Organic practice	100% Inorganic	State recommendation	50% Organic+ 50% inorganic	75% Organic+ 25% Inorganic	
Bhopal														
Soybean- wheat	47.0	41.0	37.0	42.0	34.0	33.0	39.0	38.0	35.0	31.0	34.0	27.0	27.0	32.0
Soybean- chickpea	50.0	43.0	40.0	48.0	36.0	35.0	42.0	41.0	36.0	32.0	37.0	28.0	27.0	33.5
Dharwad														
Cowpea-safflower	75.3	69.5	55.3	57.0	78.0	59.3	65.7	15.0	11.3	7.0	12.5	9.0	5.5	10.0
Pigeon pea (sole)	80.0	77.3	56.3	39.3	79.3	86.5	69.8	20.5	8.5	10.5	6.8	9.5	4.0	10.0
Green gram - sorghum	68.0	67.5	85.8	51.8	80.5	84.0	72.9	17.3	13.5	14.0	11.5	8.0	7.5	12.0
Groundnut +hybrid cotton (2:1)	71.8	80.5	60.3	54.3	84.3	81.5	72.1	10.8	3.0	7.3	7.5	8.8	8.0	7.5
Maize-chickpea	61.8	78.5	63.8	60.5	69.0	65.0	66.4	8.8	9.0	7.5	9.0	6.0	5.0	7.5
Mean	71.4	74.7	64.3	52.6	78.2	75.3		14.5	9.1	9.3	9.5	8.3	6.0	
Jabalpur														
Basmati rice - wheat (durum) - green manure	72.6	70.0	50.7	48.4	58.6	60.2	60.1	58.1	56.7	38.1	36.6	51.6	53.7	49.1
Basmati rice - chickpea - maize fodder	68.2	65.1	46.1	48.4	54.2	55.3	56.2	56.8	55.5	37.2	35.3	44.3	46.3	45.9
Basmati rice - berseem (fodder and seed)	67.8	67.9	45.1	46.2	58.7	60.1	57.7	58.8	56.4	38.4	36.6	47.4	50.5	48.0
Basmati rice - vegetable pea-sorghum (fodder)	70.6	69.1	50.3	49.5	57.4	60.4	59.6	56.9	55.1	39.4	37.4	44.9	47.1	46.8
Mean	69.8	68.0	48.1	48.1	57.2	59.0		57.6	55.9	38.3	36.5	47.1	49.4	
Centres started from 2015-16														
Narendrapur														
Basmati rice-broccoli - sesbania green manure	28.7	30.7	20.3	20.7	21.0	25.0	24.4	21.7	24.3	13.3	12.3	20.0	21.3	18.8
Paddy- mustard-green gram	22.0	19.0	11.0	13.0	15.0	18.0	16.3	16.0	12.0	9.0	7.0	14.0	15.0	12.2
Paddy- capsicum-green gram	12.3	15.7	7.0	6.0	10.7	13.3	10.8	8.7	11.3	10.7	13.0	9.7	10.0	10.6
Paddy -french bean - sesame	14.3	16.7	8.7	7.3	10.3	13.7	11.8	13.7	13.0	9.0	9.3	12.7	14.0	11.9

Locations/Treatments	Bacteria (x10 ⁶ cfu/g)							Fungi (x10 ⁶ cfu/g)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% Organic	75% Organic+ Innovative Organic practice	100% Inorganic	State recommendation	50% Organic + 50% inorganic	75% Organic + 25% Inorganic		100% Organic	75% Organic+ Innovative Organic practice	100% Inorganic	State recommendation	50% Organic + 50% inorganic	75% Organic + 25% Inorganic	
Mean	19.3	20.5	11.8	11.8	14.3	17.5		15.0	15.2	10.5	10.4	14.1	15.1	
Thiruvananthapuram														
Cassava-veg. cow-pea	29.7	33.7	6.3	9.3	21.0	7.0	17.8	13.0	13.0	52.3	9.7	8.3	5.0	16.9
Cassava-groundnut	8.3	1.3	19.0	11.0	6.0	23.7	11.6	2.3	11.7	14.7	26.0	6.3	18.3	13.2
Taro-black gram	4.3	6.3	9.3	5.3	5.3	10.6	6.9	7.7	6.3	13.7	19.7	10.3	7.3	10.8
Taro-green gram	14.3	11.0	10.0	11.0	11.6	5.0	10.5	5.7	5.0	9.3	12.0	7.7	10.3	8.3

Table 7.2.16: Rhizosphere microbial population (Actinomycetes and phosphate solubilizing micro-organisms) in soil as influenced by the different nutrient practices and cropping systems

Location/cropping systems	Soil actinomycetes (x10 ³ cfu/g)							Phosphate solubilizing bacteria (x10 ⁴ cfu/g)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% Organic+ Innovative Organic practice	100% Inorganic	State recommendation	50% Organic + 50% inorganic	75% Organic + 25% Inorganic		100% organic	75% Organic+ Innovative Organic practice	100% Inorganic	State recommendation	50% Organic + 50% inorganic	75% Organic + 25% Inorganic	
Bajaura														
Tomato-Cauliflower- French bean	13.7	11.2	8.3	11.1	11.4	12.5	11.4	15.3	12.5	9.6	12.3	12.6	13.4	12.6
Fallow-Cauliflower-Tomato	13.5	11.6	8.2	10.4	11.5	12.6	11.3	14.4	12.0	10.0	13.2	13.1	13.4	12.7
Black gram-Cauliflower- Summer squash	14.7	13.1	8.4	11.9	12.1	13.3	12.3	16.4	12.3	10.2	12.3	13.0	13.6	13.0
Lady finger-Pea	12.5	11.3	8.4	11.8	12.3	12.9	11.5	16.4	12.7	10.3	12.3	12.4	13.5	12.9
Mean	13.6	11.8	8.3	11.3	11.8	12.8		15.6	12.4	10.0	12.5	12.8	13.5	
Bhopal														
Soybean- wheat	40.0	34.0	31.0	38.0	29.0	28.0	33.3	-	-	-	-	-	-	-
Soybean- chickpea	45.0	42.0	40.0	43.0	30.0	31.0	38.5	-	-	-	-	-	-	-



Location/cropping systems	Soil actinomycetes (x10 ³ cfu/g)							Phosphate solubilizing bacteria (x10 ⁴ cfu/g)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organ-ic	75% Or-ganic+ Inno-vative Or-ganic prac-tice	100% Inor-ganic	State rec-om-men-dation	50% Or-ganic + 50% inor-ganic	75% Or-ganic + 25% Inor-ganic		100% organ-ic	75% Or-ganic+ Inno-vative Or-ganic prac-tice	100% Inor-ganic	State rec-om-men-dation	50% Or-ganic + 50% inor-ganic	75% Or-ganic + 25% Inor-ganic	
Mean	42.5	38.0	35.5	40.5	29.5	29.5								
Dharwad														
Cowpea-safflower	45.2	43.1	32.6	28.4	36.8	33.7	36.6	35.4	27.2	35.6	11.2	31.5	31.3	28.7
Pigeon pea (sole)	44.1	31.0	30.1	53.4	40.0	44.7	40.6	24.9	29.7	25.9	13.4	41.1	16.2	25.2
Green gram - sor-gum	49.8	28.9	27.4	35.6	41.2	38.6	36.9	32.1	27.8	26.5	13.7	28.6	30.3	26.5
Groundnut +hy-brid cotton (2:1)	48.9	27.9	32.2	31.2	53.2	32.3	37.6	25.9	26.0	22.6	31.4	33.7	24.3	27.3
Maize-chickpea	42.7	20.9	33.8	23.2	36.9	31.7	31.5	20.0	26.0	25.3	15.9	25.9	33.9	24.5
Mean	46.1	30.4	31.2	34.4	41.6	36.2		27.7	27.3	27.2	17.1	32.2	27.2	
Jabalpur														
Basmati rice - wheat (durum) - green manure	46.6	41.1	33.5	30.4	37.4	39.1	38.0	24.1	24.0	18.9	17.2	21.1	20.9	21.0
Basmati rice - chickpea - maize fodder	45.4	39.1	26.2	24.1	21.2	33.4	31.6	25.2	22.2	16.3	16.1	16.1	18.2	19.0
Basmati rice - ber-seem (fodder and seed)	42.2	41.9	30.2	25.9	29.1	34.8	34.0	22.8	19.4	13.8	12.4	16.2	17.1	17.0
Basmati rice - vegetable pea-sor-gum (fodder)	47.3	45.1	27.4	24.2	38.3	40.6	37.1	22.2	20.6	14.5	12.8	21.2	12.5	17.3
Mean	45.3	41.8	29.3	26.2	31.5	37.0		23.5	21.6	15.9	14.6	18.7	17.2	
Centres started from 2015-16														
Narendrapur														
Basmati rice-broc-coli - <i>sesbania</i> green manure	40.7	40.0	23.7	22.3	30.7	36.3	32.3	-	-	-	-	-	-	-
Paddy- mustard-green gram	26.0	24.0	19.0	17.0	21.0	24.0	21.8	-	-	-	-	-	-	-
Paddy- capsicum-green gram	14.3	22.0	16.3	13.7	19.7	19.3	17.6	-	-	-	-	-	-	-

Location/cropping systems	Soil actinomycetes ($\times 10^3$ cfu/g)							Phosphate solubilizing bacteria ($\times 10^4$ cfu/g)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% Organic + Innovative Organic practice	100% Inorganic	State recommendation	50% Organic + 50% inorganic	75% Organic + 25% Inorganic		100% organic	75% Organic + Innovative Organic practice	100% Inorganic	State recommendation	50% Organic + 50% inorganic	75% Organic + 25% Inorganic	
Paddy - french bean - sesame	19.7	19.0	10.3	11.0	13.3	17.7	15.2	-	-	-	-	-	-	-
Mean	25.2	26.3	17.3	16.0	21.2	24.3		-	-	-	-	-	-	-
Thiruvananthapuram														
Cassava-veg. cow-pea	1.66	2.33	3.67	1.66	1.66	1.00	2.00	-	-	-	-	-	-	-
Cassava-ground-nut	1.33	1.33	9.00	8.33	2.00	4.00	4.33	-	-	-	-	-	-	-
Taro-black gram	1.00	6.33	4.00	4.66	1.66	1.00	3.11	-	-	-	-	-	-	-
Taro-green gram	5.33	4.33	3.66	3.33	3.33	2.33	3.72	-	-	-	-	-	-	-

Activity of different soil enzymes as influence by nutrient management (Organic, inorganic and integrated) and cropping system (Table 7.2.17 and 7.2.19).

Almora

The activity of 6 enzymes was estimated. Except urease, the activity of other enzymes was highest under 100% organic management system. But, for urease, the highest value was recorded under inorganic system (Table 7.2.17).

Table 7.2.17: Influence of cropping system and nutrient management on activity of different soil enzymes

Treatment		Dehydrogenase ($\mu\text{g TP-F/g/24 h}$)	Acid Phosphatase ($\mu\text{g p-NP/g/h}$)	Alkaline Phosphatase ($\mu\text{g p-NP/g/h}$)	Aryl Sulfatase ($\mu\text{g p-NP/g/h}$)	β -Glucosidase ($\mu\text{g p-NP/g/h}$)	Urease ($\mu\text{g urea/g/h}$)
Amaranth-wheat + lentil	100% Org	82.3	492	102	209	232	289
	75% Org + IP	75.6	451	71	183	191	319
	50% Org + 50% Inorg	64.8	389	52	170	183	299
	100% Inorg	52.4	353	47	89	136	340
FM + black soy-bean-wheat + toria	100% Org	79.9	476	131	203	233	288
	75% Org + IP	69.9	420	69	170	218	334
	50% Org + 50% Inorg	58.5	378	52	115	193	315
	100% Inorg	44.7	333	46	92	161	346

About overall productivity or sustainability of crops, as enzymes respond differently to different nutrient sources. Hence, soil enzyme activity index (SEAI) was developed to provide a single comprehensive unit less value. The non-linear scoring was done based on highest activity recorded of individual enzyme from the best management practices in this region. The highest soil enzyme activity index was recorded under 100% organic management system, although the highest value of urease was recorded under inorganic system (Fig. 10).

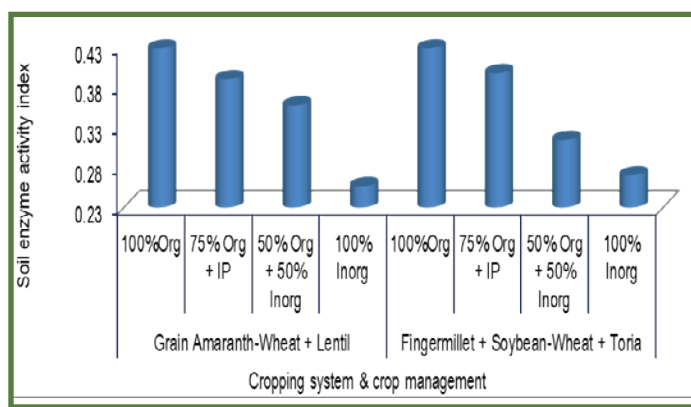
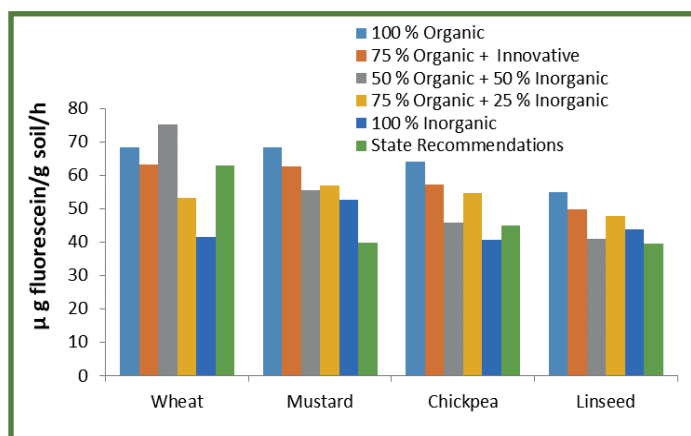


Fig. 10. Influence of cropping system and nutrient management on soil enzyme activity index

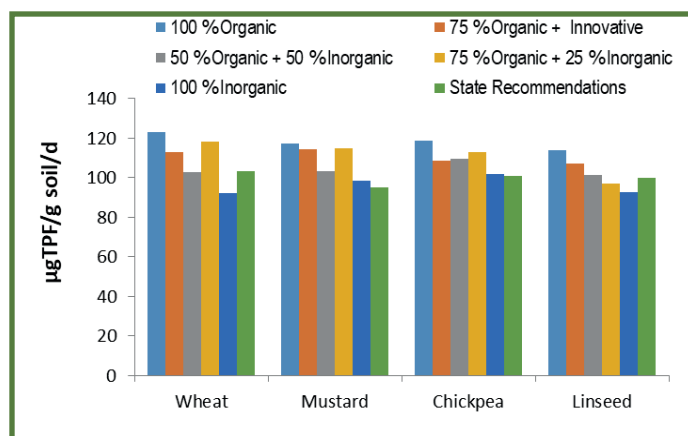
Bhopal

Fluorescein diacetate hydrolysis activity was found to be highest under 100% organic practice which was closely similar to 75% organic+ 25%

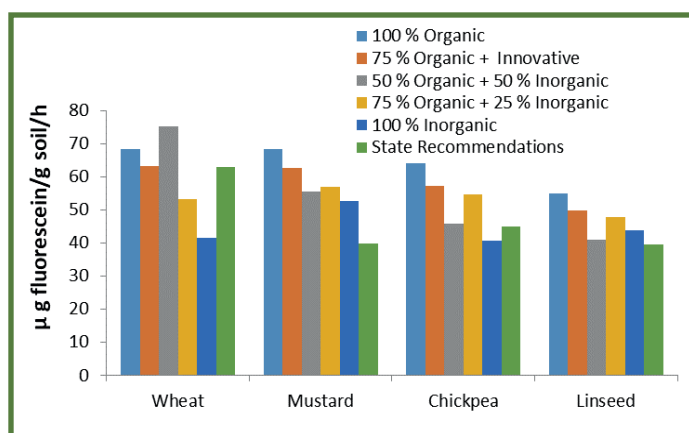


Fluorescein diacetate hydrolysis activity

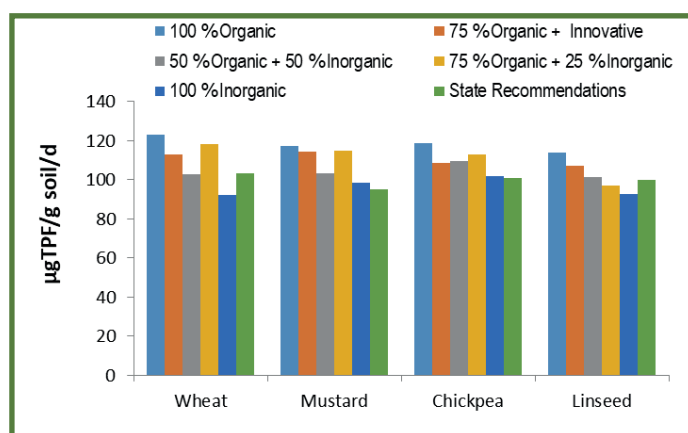
innovative as compared to inorganic or state recommendation in all crops except wheat.. Among the cropping systems, soybean-wheat recorded higher fluorescein diacetate activity followed by soybean-mustard, soybean-chickpea and soybean-linseed. Dehydrogenase, as respiratory chain enzymes, play the major role in the energy production of organisms. Dehydrogenase activity can, therefore, be used as an indicator of biological redox systems and as measure of microbial activity in soil. Concentration of soil dehydrogenase depends on conditions and intensity of biological conversion of organic compounds. Soil dehydrogenase activity was also found higher in organic management compared to inorganic and integrated management. However, among the crops/cropping systems, soybean-wheat recorded higher dehydrogenase activity as compared to others. Similarly the activity of alkaline phosphatase and β Glucosidase enzyme activity were recorded highest in 100 % organic followed by 75 % organic + inorganic and 75 % organic + innovative treatment indicating beneficial effect of addition of organics on soil microorganisms. Microbial count data also varied in the same pattern. Lowest count of three major group of soil microbes (Bacteria, Fungi and Actinomycetes) was noted in inorganic or state recommendation (Fig. 11).



Soil dehydrogenase activity



Alkaline phosphatase activity



β Glucosidase activity

Fig. 11 Fluorescein diacetate hydrolysis, soil dehydrogenase, alkaline phosphatase and β glucosidase activity as influenced by various management practice in different crops at Bhopal

Calicut

Effect of different management system on soil enzyme activities viz. acid phosphatase, alkaline phosphatases and dehydrogenase were found higher with organic management system in black pepper. In ginger crop, acid phosphatase was noticed in 75% organic + 25% inorganic under integrated (Table 7.2.18).

Thiruvananthapuram

Dehydrogenase activity was higher in towards

organic under integrated consisting of 50% organic + 50% inorganic or 75% organic + 25% inorganic in cassava-groundnut (11.28 µg TPF g⁻¹ soil h⁻¹) and taro-green gram (103.5 µg TPF g⁻¹ soil h⁻¹) system. Acid phosphatase activity was higher in state PoP (cassava-groundnut 35.24 µg p-nitro phenol g⁻¹ soil h⁻¹) and 75% organic + innovative practice (taro-green gram 27.34 µg p-nitro phenol g⁻¹ soil h⁻¹). Urease activity remained the same irrespective of management options and cropping systems (Table 7.2.19).

Table 7.2.18: Effect of different management systems on soil enzymes of ginger at Calicut

Crops	Enzymes/nutrient management	Organic		Inorganic		Integrated	
		100% organic	75% organic + innovative organic practices	100% inorganic	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic
Ginger	Acid Phosphatases (µmol PNP/g/h)	18.45	18.53	13.67	-	16.92	20.46
	Alkaline Phosphatases (µmol PN-P/g/h)	8.03	7.57	3.89	-	5.90	7.27
Black pepper	Acid Phosphatases (µmol PNP/g/h)	35.00	-	23.80	-	24.40	-
	Alkaline Phosphatases (µmol PN-P/g/h)	16.80	-	12.00	-	12.80	-
	Dehydrogenase (µmol TPF/g/h)	4344	-	3245	-	3713	-



Table 7.2.19: Effect of management options on biological properties of soil in cassava-vegetable cowpea and cassava-groundnut systems at Thiruvananthapuram

Crops	Enzymes/nutrient management	Organic		Inorganic		Integrated	
		100% organic	75% organic + innovative organic practices	100% inorganic	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic
Cassava-Veg-etable Cow-pea	Dehydrogenase ($\mu\text{g TPF g}^{-1} \text{ soil h}^{-1}$)	43.4	52.37	3.88	3.88	47.76	94.8
	Acid phosphatase ($\mu\text{g p-nitro phenol g}^{-1} \text{ soil h}^{-1}$)	4.86	1.22	5.47	17.92	2.73	34.94
	Urease ($\mu\text{g urea g}^{-1} \text{ soil h}^{-1}$)	66.4	66.55	66.29	66.6	66.52	66.56
Cassava-Ground-nut	Dehydrogenase ($\mu\text{g TPF g}^{-1} \text{ soil h}^{-1}$)	83.16	20.61	6.30	55.04	111.28	89.95
	Acid phosphatase ($\mu\text{g p-nitro phenol g}^{-1} \text{ soil h}^{-1}$)	6.68	4.25	7.90	35.24	1.82	0.91
	Urease ($\mu\text{g urea g}^{-1} \text{ soil h}^{-1}$)	66.55	66.41	66.54	66.57	66.53	66.59
Taro-Black gram	Dehydrogenase ($\mu\text{g TPF g}^{-1} \text{ soil h}^{-1}$)	87.28	69.1	21.09	33.22	73.22	42.43
	Acid phosphatase ($\mu\text{g p-nitro phenol g}^{-1} \text{ soil h}^{-1}$)	6.99	7.6	6.99	2.43	4.56	11.85
	Urease ($\mu\text{g urea g}^{-1} \text{ soil h}^{-1}$)	66.49	66.51	66.52	66.53	66.59	66.59
Taro-Green gram	Dehydrogenase ($\mu\text{g TPF g}^{-1} \text{ soil h}^{-1}$)	60.61	37.58	78.07	79.45	67.16	103.52
	Acid phosphatase ($\mu\text{g p-nitro phenol g}^{-1} \text{ soil h}^{-1}$)	5.16	27.34	10.63	11.85	6.38	10.03
	Urease ($\mu\text{g urea g}^{-1} \text{ soil h}^{-1}$)	66.55	66.46	66.59	66.48	66.6	66.54

Effect of different management systems (Organic, inorganic and integrated) on quality aspects of organic produce (Table 2.7.20)

Bajaura

Quality parameters protein, TSS ($^{\circ}\text{brix}$) and vitamin C in different vegetable crops namely frenchbean, black gram, tomato, pea and cauliflower were estimated under different management practice. Protein content was higher under organic nutrient management for frenchbean and blackgram whereas in pea, it protein was higher with integrated consisting of 50% each organic and inorganic nutrients. Tomato

fruits (*khari*) recorded maximum TSS content (5.2°Brix) with 100% organic management practice, whereas in during summer, tomato fruits recorded maximum value of TSS (5.5°Brix) under integrated in 50%organic+ 50% inorganic. TSS content in fresh pea grains (17.5°Brix) was found in higher under 100% Inorganic with state recommendation. The highest vitamin C content of tomato fruits ($35.4 \text{ mg}/100\text{g}$) was recorded in integrated consisting of 75% Organic + 25% Inorganic nutrients. However, the vitamin C content in cauliflower curds across the cropping systems was highest under 100%Organic management package.

Bhopal

Although, nutritional quality constituents in soybean, wheat and mustard did not influence significantly due to different nutrient management practices but all the quality parameters viz. protein, oil, methionine and tryptophan content in soybean, protein, globulin, ash and gluten in wheat and phenol and glucosinolate in mustard crop were maximum in organic either with 100% organic or in 75% organic and 25% innovative organic practice as compared to other nutrient management practices.

Calicut

In ginger crop, oil and oleoresin content was higher under integrated practice followed by inorganic but could not influenced due to management practice and found to be at par to each other. In turmeric, oleoresin and curcumin content was higher in organic management with 75% nutrient through organic manure+25% innovative practice. The difference in curcumin content was only 2.1% from organic to inorganic. Oil and oleoresin content in black pepper recorded higher under inorganic while, curcumin content being maximum in integrated.

Coimbatore

All the quality parameter in cotton did not differ significantly due to nutrient management. Span length and strength was higher under integrated practice however, uniformity ratio, elongation and micron Aire value was higher under organic practice but these were on par to other management practices.

Ranchi

Nutritional quality constituents such as protien

and moisture did not varied significantly due to production systems. Protein and moisture in rice was higher in organic production management either with 100% organic manure or with 75% organic + 25% innovative practice compared to inorganic. In case of wheat, reverse was recorded wherein protein and moisture was found to be higher in inorganic 100% followed by state recommendation.

Umiam

Specific gravity (1.28 g/ml), average fruit diameter (53.24 mm), TSS (4.85%), ascorbic acid (30.15 mg/100g), reducing sugar (2.67%), lycopene (17.96 mg/100g) of tomato are recorded highest under 100% organic management however the acidity (0.75%) and total sugar (5.04%) of tomato was recorded highest under integrated management practice.

Quality parameters of carrot such as root diameter (31.33 mm) and specific gravity (1.37g/ml), was recorded under integrated treatment, whereas TSS (8.67%), ascorbic acid (41.68 mg/100g), acidity (0.27%), beta carotene (98.13 mg/100), total carotenoid (74.38 mg/g), total sugar (6.17%) and reducing sugar (4.69%) were recorded under 100% organic treatment compared to other

Ajmer

Quality parameters such as protein (16.2 and 18.2% and essential oil (0.209 and 1.24%) in coriander and fennel crops respectively were not influenced by various nutrient management practices and, both are observed higher in integrated with 75% organic + 25% inorganic followed by inorganic with state recommendation that was on par with organic management package.


Table 7.2.20: Influence of organic, inorganic and integrated package on quality of crops at different locations

Locations	Crops	Quality parameter	Organic		Inorganic		Integrated	
			100% organic	75% organic + innovative organic practices	100% inorganic	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic
Bajura	French bean	Protein %	14.20	14.00	13.20	13.50	13.60	13.80
	Black gram		14.20	13.60	13.20	13.80	14.00	13.60
	Pea		21.00	20.50	20.20	20.80	21.20	20.90
	Tomato (Kharif)	TSS (° Brix)	5.20	4.60	3.80	4.60	4.80	5.00
	Tomato (Summer)		5.20	5.00	4.00	4.50	5.50	5.00
	Pea		16.20	15.50	13.40	17.50	17.20	15.50
	Tomato	Vitamin C (mg/100g)	34.80	33.50	30.20	31.60	34.50	35.40
	Cauliflower		47.67	45.67	42.03	44.03	45.27	44.73
Bhopal	Soybean	Protein %	35.33	34.61	34.46	34.50	34.56	35.04
		Oil (%)	17.92	17.85	17.75	17.71	17.81	17.88
		Methionine (g/16gN)	1.69	1.66	1.62	1.63	1.64	1.65
		Tryptophan (g/16gN)	1.84	1.82	1.81	1.82	1.81	1.83
	Wheat	Protein %	11.74	11.73	11.69	11.70	11.71	11.74
		Globulin %	24.75	24.31	23.93	24.05	24.12	24.55
		Ash%	1.90	1.80	1.72	1.72	1.75	1.84
		Moisture (%)	10.96	10.98	10.90	10.87	10.83	10.87
		Gluten%	17.47	17.26	16.72	16.90	17.10	17.37
	Mustard	Protein %	39.54	39.30	39.00	38.96	39.04	39.44
		Phenol (%)	9.91	9.78	9.69	9.63	9.74	9.85
		Glucosinolate (%)	96.17	93.89	91.50	90.84	92.09	94.01
Calicut	Ginger	Oil content (%)	1.79	1.84	1.88	-	1.96	1.92
		Oleoresin	4.89	4.74	4.89	-	4.74	4.94
	Turmeric	Oil (%)	5.42	5.56	5.68	-	5.44	5.49
		Oleoresin (%)	14.06	14.52	14.32	-	14.14	14.08
		Curcumin (%)	4.70	4.83	4.73	-	4.58	4.37
	Black pepper	Oil (%)	3.07	-	3.27	-	3.27	-
		Oleoresin (%)	8.83	-	8.92	-	8.77	-
		Curcumin (%)	5.10	-	5.65	-	6.52	-
Coimbatore	Cotton	2.5% span length (mm)	25.60	24.90	25.60	24.60	25.20	26.10
		Uniformity ratio (%)	48.40	48.20	45.30	45.10	46.00	46.40

Locations	Crops	Quality param-eter	Organic		Inorganic		Integrated	
			100% organic	75% organic + innova-tive organic practices	100% in-organic	State recom-menda-tion	50% organic + 50% in-organic	75% organic + 25% inor-ganic
Ranchi		Strength (g/tex)	18.50	18.50	17.60	17.60	18.60	18.50
		Elongation (%)	5.50	5.40	5.50	5.50	5.50	5.50
		Micronaire Value (µg/inch)	4.48	3.81	4.33	3.86	3.63	4.07
	Rice	Protein (%)	7.77	7.89	7.62	7.47	7.73	7.65
		Moisture (%)	14.20	14.13	14.02	13.99	14.06	14.10
	Wheat	Protein (%)	9.66	9.59	9.85	9.74	9.77	9.66
		Moisture (%)	10.16	10.23	10.34	10.28	10.27	10.24
Umiam	Tomato	Specific gravity (g/ml)	1.28	1.19	1.24	-	1.18	-
		Average fruit diameter (mm)	53.24	46.34	49.75	-	43.82	-
		TSS (%)	4.85	4.41	4.29	-	4.12	-
		Acidity (%)	0.66	0.71	0.73	-	0.77	-
		Ascorbic acid	30.15	26.03	27.90	-	25.16	-
		Reducing sugar (%)	2.67	2.59	2.50	-	2.43	-
		Total sugar (%)	4.68	4.76	4.81	-	5.05	-
		Lycopene	17.96	15.31	16.59	-	15.20	-
	Carrot	Root diameter (mm)	29.60	26.27	28.23	-	31.33	-
		TSS (%)	8.67	8.23	7.12	-	7.86	-
		Ascorbic acid (mg/100g)	41.68	39.12	35.89	-	41.40	-
		Acidity (%)	0.27	0.22	0.19	-	0.23	-
		Beta carotene (mg/100g)	9.13	8.67	6.55	-	8.47	-
		Total carotenoids (mg/g)	74.38	67.40	64.31	-	70.26	-
		Total sugar (%)	6.07	6.17	5.01	-	5.89	-
		Reducing sugar (%)	4.69	4.54	3.74	-	4.33	-
		Ajmer	Coriander	Protein (%)	15.38	13.75	15.75	16.06
Essential oil (%)	0.18			0.19	0.20	0.21	0.19	0.21
Fennel	Protein (%)		17.31	17.69	16.69	17.88	17.06	18.25
	Essential oil (%)		1.22	1.22	1.21	1.23	1.20	1.24



Influence of organic, inorganic and integrated management packages on energy of different cropping systems (Table 7.2.21 & 7.2.22)

Bajaura

With respect to energy input, state recommendation package required maximum energy (72058 MJ/ha) across the production systems compare to others whereas minimum was with 75% organic+ 25% inorganic (52091 MJ/ha) under integrated. Cropping systems tomato- cauliflower- frenchbean required maximum total mean energy (69528 MJ/ha) followed by blackgram-cauliflower- squash (63570 MJ/ha). Further, Okra-pea system had maximum mean output energy (92979 MJ/ha) followed by tomato-cauliflower- frenchbean (71368 MJ/ha). Highest net output energy was observed in integrated (50%:50% organic and inorganic) (61888 MJ/ha) and minimum was under 100% inorganic input through NPK alone (37868 MJ/ha). Further energy efficiency among all the cropping systems and management practices showed significant variation. However, it was highest with adoption of integrated nutrient management (1.27 and 1.28 MJ/ha). The mean energy efficiency among cropping system varied from 0.34 to 2.85 MJ/ha where in maximum was in okra-pea system followed by tomato-cauliflower-french bean. Highest energy productivity was observed for cauliflower - tomato (1.11 kg/MJ) and lowest was recorded under okra-pea system (0.13 kg/MJ). On the contrary, all management practices recorded almost similar energy productivity, but integrated practices had slightly improved energy effectiveness as compared to other practices of nutrient management.

Bhopal

The energy input and output, energy use efficiency and energy productivity of different crops (soybean, wheat, mustard, chickpea and linseed) were calculated. Among the different production systems,

the highest energy input efficiency was recorded under inorganic with 100% inorganic and state recommendation while, the highest output was recorded under 100% organic package followed integrated (75% organic+25% inorganic). The highest energy use efficiency and energy productivity were recorded under the application of 100% organic nutrient management followed by 75% organic + innovative organic practice. State recommendation recorded the least energy use efficiencies and energy productivity. Among the different cropping systems, soybean-wheat recorded the highest energy use efficiency whereas, soybean-chickpea, recorded maximum energy productivity.

Ranchi

Among the nutrient management packages, maximum energy requirement recorded in inorganic followed by integrated while output of energy resulted in higher with inorganic package. Among cropping systems, rice-potato required more and highest energy (27376 MJ/ha) however rice-wheat produced maximum energy output (191964 MJ/ha). In case of energy efficiency and productivity, organic production package resulted in higher use efficiency and productivity (11.26 and 376 Mj/ha respectively). Under organic 43.5% more productivity was obtained as compared to inorganic.

Gangtok

The energy budget showed that the energy input, output efficiency and productivity was higher in organic management practice. The maximum output energy (100.32×10^3 MJ/ha), energy use efficiency (6.26×10^3 MJ/ha) and energy productivity (84.08×10^3 MJ/ha) were obtained with 100% organic practice. Among the cropping systems, maize + ginger- french bean followed by maize + soybean-buckwheat recorded maximum output, efficiency and productivity.

Sardarkrushinagar

The energy input required maximum under organic practice (29786 MJ/ha) whereas minimum was with inorganic (18772 MJ/ha). Output of energy was observed in state recommendation (214558 MJ/ha) followed by integrated (212035 MJ/ha). Energy use efficiency and productivity (26.48 and 0.75 MJ/ha respectively) was higher in inorganic practice

followed by integrated. Groundnut- wheat- green gram cropping systems received highest total mean energy (35784 MJ/ha), resulted output (321673 MJ/ha), and energy efficiency (26.35 MJ/ha). On the contrary, green gram- cumin- vegetable cowpea recorded highest energy productivity which was 80.4 and 381% higher compared to groundnut- wheat- green gram and green gram-fennel- fennel respectively.

Thiruvananthapuram

Table 7.2.21: Total energy influenced by different management practices and cropping systems at different locations

Location/cropping systems	Energy Input (MJ/ha)							Energy Output (MJ/ha)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bajaura														
Tomato-Cauliflower-French bean	61155	58853	93895	73088	66846	63331	69528	74552	66101	50581	74278	80146	82552	71368
Fallow-Cauliflower-Tomato	42893	41238	53532	67909	48077	45114	49794	15882	16864	11646	14668	16906	15322	15215
Black gram-Cauliflower- Summer squash	57324	55560	64675	76995	64531	62333	63570	30069	31539	23323	34449	38430	37879	32615
Lady finger-Pea	36496	35747	39601	49431	38280	37584	39523	86910	90266	65923	95774	112070	106929	92979
Mean	49467	47850	62926	66856	54434	52091		51853	51193	37868	54792	61888	60671	
Bhopal														
Soybean- wheat	19023	18014	30054	41906	24358	21691	25841	43717	41771	37738	38356	39498	42096	40529
Soybean- Mustard	15134	14582	18454	27188	16614	15874	17974	29797	28794	26635	26723	27744	29108	28134
Soybean- Chickpea	15157	14330	19351	30061	17074	16116	18682	32110	29874	28111	27406	27662	29656	29137
Soybean- Linseed	16217	15390	20411	31120	18134	17176	19741	27683	26279	24299	24283	24819	26758	25687
Mean	16383	15579	22068	32569	19045	17714		33327	31680	29196	29192	29931	31905	
Ranchi			($\times 10^3$ MJ/ha)								($\times 10^3$ MJ/ha)			
Rice -wheat	-	-	-	-	-	-	20935	-	-	-	-	-	-	191964
Rice -lentil	-	-	-	-	-	-	12516	-	-	-	-	-	-	134254
Rice -potato	-	-	-	-	-	-	27376	-	-	-	-	-	-	161056
Rice -linseed	-	-	-	-	-	-	13787	-	-	-	-	-	-	151576

Location/cropping systems	Energy Input (MJ/ha)							Energy Output (MJ/ha)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Mean	18758	16511	20213	17833	19121	19485		171103	172234	152535	135070	162378	164956	
Gangtok														
Maize + ginger (1:1)- french bean	-	-	-	-	-	-	16.86	-	-	-	-	-	-	98.74
Maize + soybean (1:1) - buckwheat	-	-	-	-	-	-	16.59	-	-	-	-	-	-	94.53
Maize + turmeric (1:1) - rajmash	-	-	-	-	-	-	19.49	-	-	-	-	-	-	79.57
Maize + pigeon pea (2:1)	-	-	-	-	-	-	10.13	-	-	-	-	-	-	53.77
Mean	16.24	15.3		14.98	16.55			100.32	97.33		47.17	81.78		
Sardar Krushinagar														
Groundnut- wheat-green gram	42361	35886	27092	36092	34726	38544	35783	234704	295839	339173	366560	351636	342127	321673
Greengram- cumin-vegetable cowpea	21104	18159	14540	28060	17835	19483	19863	114064	116214	152761	166132	176295	159557	147503
Greengram-fennel-fennel cont.	25894	21250	14683	20683	20302	23129	20990	84216	81013	100125	110983	108175	98913	97237
Mean	29786	25098	18772	28278	24287	27052		144328	164355	197353	214558	212035	200199	

Table 7.2.22: Energy use efficiency and energy productivity of different management practices and cropping system at different locations

Location/cropping systems	Energy use efficiency (MJ/ha)							Energy productivity (kg/MJ)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bajaura														
Tomato-Cauliflower- French bean	1.22	1.12	0.54	0.79	1.20	1.30	1.03	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Fallow-Cauliflower-Tomato	0.37	0.41	0.22	0.22	0.35	0.34	0.32	1.13	1.13	1.09	1.10	1.11	1.11	1.11
Black gram-Cauliflower- Summer squash	0.52	0.57	0.36	0.45	0.60	0.61	0.52	0.59	0.60	0.58	0.63	0.66	0.67	0.62

Location/crop- ping systems	Energy use efficiency (MJ/ha)							Energy productivity (kg/MJ)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% or- ganic	75% organic + inno- vative organic practices	100% Inor- ganic	State rec- om- men- dation	50% or- ganic + 50% inor- ganic	75% or- ganic + 25% inor- ganic		100% organ- ic	75% organic + inno- vative organic practic- es	100% Inor- ganic	State rec- om- men- dation	50% or- ganic + 50% inor- ganic	75% or- ganic + 25% inor- ganic	
Lady finger-Pea	2.38	2.53	1.66	1.94	2.93	2.85	2.38	0.13	0.13	0.14	0.13	0.13	0.13	0.13
Mean	1.12	1.16	0.70	0.85	1.27	1.28		0.53	0.53	0.52	0.53	0.54	0.54	
Bhopal														
Soybean- wheat	3.91	3.97	2.06	1.76	2.73	3.24	2.95	0.82	0.84	0.46	0.42	0.60	0.68	0.64
Soybean- Mustard	3.38	3.40	2.33	1.86	2.82	3.09	2.81	0.80	0.82	0.56	0.46	0.68	0.73	0.68
Soybean- Chickpea	3.68	3.63	2.35	1.73	2.72	3.10	2.87	1.06	1.01	0.66	0.48	0.72	0.84	0.80
Soybean- Linseed	2.89	2.89	1.87	1.50	2.26	2.57	2.33	0.69	0.70	0.46	0.38	0.55	0.62	0.57
Mean	3.47	3.47	2.15	1.71	2.63	3.00		0.84	0.84	0.54	0.44	0.64	0.72	
Ranchi														
Rice -wheat	-	-	-	-	-	-	9.2	-	-	-	-	-	-	271
Rice -lentil	-	-	-	-	-	-	10.79	-	-	-	-	-	-	338
Rice -potato	-	-	-	-	-	-	5.91	-	-	-	-	-	-	307
Rice -linseed	-	-	-	-	-	-	11.08	-	-	-	-	-	-	298
Mean	9.79	11.26	8.1	8.06	9.15	9.11		331	376	262	245	305	302	
Gangtok				($\times 10^3$ MJ/ ha)						($\times 10^3$ MJ/ha)				
Maize + ginger (1:1)- french bean	-	-	-	-	-	-	5.86	-	-	-	-	-	-	81.88
Maize + soybean (1:1) – buckwheat	-	-	-	-	-	-	5.70	-	-	-	-	-	-	77.94
Maize + turmeric (1:1) – rajmash	-	-	-	-	-	-	4.08	-	-	-	-	-	-	60.08
Maize + pigeon pea (2:1)	-	-	-	-	-	-	5.31	-	-	-	-	-	-	43.64
Mean	6.18	6.26		3.15	4.94			84.08	82.03		65.23	32.19		
Sardar Krushina- gar														
Groundnut- wheat- green gram	19.10	23.25	33.74	26.46	29.24	26.31	26.35	0.48	0.50	0.70	0.54	0.60	0.54	0.56
Greengram- cumin- vegetable cowpea	18.21	21.45	32.89	20.45	31.67	26.39	25.18	0.77	0.91	1.28	0.81	1.27	1.03	1.01
Greengram-fennel- fennel cont.	6.99	7.81	12.82	9.98	10.63	8.75	9.50	0.15	0.17	0.28	0.22	0.24	0.20	0.21
Mean	14.77	17.50	26.48	18.96	23.85	20.48		0.47	0.53	0.75	0.52	0.70	0.59	

Thiruvananthapuram

Production efficiency and energy equivalent

In cassava-vegetable cowpea, 100% inorganic resulted in the highest equivalent energy and 75% organic + 25% inorganic in production efficiency. In cassava-groundnut system, 100% inorganic resulted in the highest equivalent energy and production

efficiency. In taro-green gram and taro-black gram systems, 100% organic and 75% organic respectively generated highest equivalent energy. The integrated management options, 50% organic + 50% inorganic for taro-green gram and 75% organic + 25% inorganic for taro-black gram resulted in higher tuber equivalent yield and production efficiency (Fig. 12).

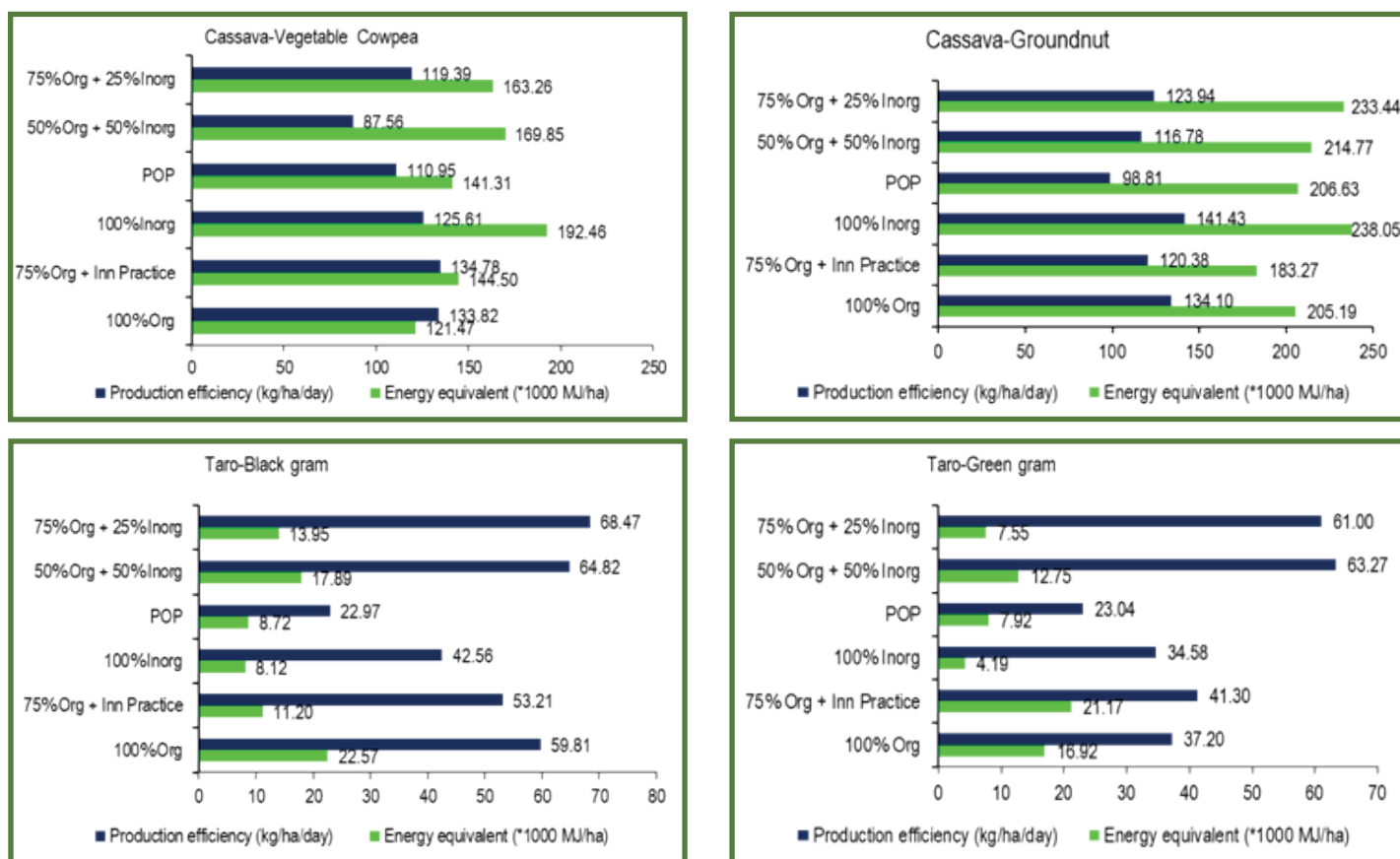


Fig. 12. Production efficiency and energy equivalent of cropping systems under various management options

Influence of organic, inorganic and integrated management packages on economics of different crops and cropping systems Table (7.2.23 and 24)

Bajaura

Gross return was significantly higher (72.9%) with organic followed by integrated (60.2%) over inorganic package. Among the cropping system, blackgram-cauliflower-summer squash gave the highest gross

return, net return and returns per rupee invested under organic package with 75% nutrient through manure + innovative organic practice followed by 100% organic practice. It was higher by more than 3 times for net return and NRPRI. In different management packages, lower cost of cultivation (Rs. 1,94,585/ha) was recorded with inorganic nutrient management while, highest cost of cultivation was recorded under state recommendation of Rs.2,62,360/ha.

Bhopal

Organic production package either by 100% organic nutrient input through manure or 75% nutrient through manure + innovative organic practice recorded maximum gross returns (Rs. 1,35,698 & 1,29,045/ha), net returns (Rs.90,671 & 84,458) and benefit cost ratio in term of return per rupee investment (2.01 & 1.89) as compared to inorganic management and it increased 88.8 and 75.9% in respect of net return than the inorganic management respectively.

Calicut

Gross return for ginger crop found to be significantly higher by 104.7% towards organic approach under integrated production system with 50% each nutrient through organic and inorganic input. Due to the lower cost of cultivation under these treatments, the increase in net returns was 100.4 and 159% higher with organic and integrated over inorganic package. In case of turmeric, gross return was highest with organic consisting of 100% organic nutrient whereas, net return/ha and return per rupee invested follows the same trends as ginger wherein it found 17.3 and 23.5% higher under organic and integrated nutrient management package over inorganic.

Coimbatore

Among the production systems, not much variation was observed in respect of gross return however, maximum gross return, net return and benefit cost ratio was recorded with towards organic approach in integrated management consisting of 50% each organic + inorganic or by 75% organic+25% inorganic under beetroot-maize-green manure. Cropping system beetroot-maize-green manure found more profitable in term of net return for Rs.2,02,920/ha and it is higher by 125.5 and 128.4% than chili-sunflower and cotton-maize system. Though lower cost of cultivation of Rs.68,811 /ha was under inorganic management resulted higher B:C ratio of

2.66 among the production systems but being on par with integrated.

Dharwad

Production practices involving recommended dose of inorganic fertilizers recorded higher net return and B:C ratio (38,277/ha and 2.67, respectively) in maize-chickpea system followed by groundnut + hybrid cotton which obtained of Rs 35,480/ha as net return with organic package. Other 2 cropping system were found not profitable across the production package.

Jabalpur

Basmati rice-vegetable pea-sorghum (fodder) recorded higher gross return with organic and inorganic package (Rs 1,95,148/ha), however, net return (Rs.1,15,771/ha) and benefit cost ratio (2.46) was higher in inorganic management owing to 25.8% lesser cost of cultivation resulted in 30.0% higher net returns compare to organic.

Karjat

Application of 100% organic input resulted in significantly higher gross and net returns as compared to other production systems followed by adoption of 75% organic + innovative organic practices. Though the net returns were higher under 100% organic package, the B:C ratio were significantly higher with inorganic package followed by 100% organic and adoption of 75% organic + Innovative organic practices. Among the cropping systems, higher net returns of Rs 6,97,934 and 5,03,240/ha and B:C ratio (3.17 and 3.21) were observed in rice-brinjal and rice-onion system respectively under organic package as compared to other cropping systems. Both the system found highest profitable among the systems.

Ludhiana

Though maximum gross return was obtained in cluster bean-wheat-summer moong system under organic management package (Rs 2,39,122/ha with 100 organic and Rs 2,40,693/ha with 75% organic



+innovative organic practice) but net return was recorded maximum in basmati rice-wheat-green manure under organic practice (Rs 1,47,270/ha) by adoption of 75% organic input +innovative organic practice which gave 15.5 and 17% higher net return/ha compare to inorganic and integrated package respectively. Cluster bean-wheat-summer moong system being the next performing system which recorded net returns of Rs.1,43,261/ha. Benefit cost ratio (2.82) was the highest with inorganic management condition in rice-wheat green manure system.

Modipuram

Among the management practices, organic management package with 100% organic application through manure recorded higher net return but being on par to all other production systems. Among the cropping system, maize (sweet corn) - mustard-*sesbania* green manure recorded maximum return (1,35,472/ha) with integrated package and found more profitable. It is higher by 5.5, 51.0 and 65.2% than maize-potato-okra+*sesbania*, rice-barley-green gram and basmati rice-wheat-*sesbania* and respectively.

Pantnagar

Among the management packages, application of organic input followed by application of 75% organic +25% innovative organic practices recorded higher gross return (Rs 2,87,632 & 2,73,394/ha) and net return (Rs.2,07,634 & 2,03,043/ha). Adoption of organic package, net return increased up to the 55.4 & 44.4% than inorganic and integrated management. Among the cropping systems, basmati rice-chickpea +coriander (4:2) recorded significantly higher net return of Rs. 2,25,097/ha and B:C ratio 3.44. It was higher by 25.6, 90 and 89.8% than basmati rice-vegetable pea coriander (4:2), basmati rice-wheat and basmati rice-potato system in term of net return.

Raipur

Among different cropping system, the maximum net

return of Rs 2,74,503/ha was obtained in soybean-maize (sweet corn) cropping sequence with adoption of 75% organic + innovative organic practice (foliar spray of vermin-wash 10%) followed by soybean-chili cropping sequence (Rs 2,11,818/ha) in same treatment. Similarly, highest B:C ratio (4.0) was also obtained with 75% organic + foliar spray of vermiwash (10%) followed by cow urine (10%) at 20 days interval at 30 DAT and 50 DAT in soybean-maize followed by soybean-garden pea (3.64) and soybean-chilli (3.61) under same nutrient management practices.

Ranchi

Adoption of organic package with 100% organic input and 75% organic manure +innovative practices produced higher net return and benefit cost ratio followed by integrated either by with 50:50% organic and inorganic or towards organic by 75% organic manure +25% inorganic. Application of 75% organic manure +innovative practices recorded net return of Rs 71,471/ha/year followed by 100% organic practice of Rs. 65,186/ha. 75% organic +innovative practices was found to be higher by 74.0 and 94.3% than inorganic and integrated respectively. Among cropping systems, rice-potato recorded maximum net return (Rs. 57,907/ha) along with benefit cost ratio of 1.87. Rice-wheat system was the next best cropping system in term of profitability.

Umiam

Maximum gross return and net return was recorded in broccoli-tomato followed by broccoli-carrot, under organic practices by 100% nutrient supply through organic manure or by application 75% organic +25% innovative practices which gave 30.4 and 14.3% more return over inorganic respectively. Net return per rupee invested being higher in broccoli -frenchbean (1.77) cropping system followed by broccoli-carrot (1.63) which being on par with broccoli- tomato (1.62).

Ajmer

Net returns of Rs 1,56,333 and 1,63,924 /ha recorded

higher under inorganic condition with 100% inorganic or by state recommendation practice in green gram grown with fennel and found to be more profitable in term of benefit cost ratio (3.63 and 3.09) but being on par grown with cluster bean. Green gram-fennel received more than 4 times return than green gram-coriander similarly, 217.4% more return than clusterbean- coriander. Results indicate that inclusion of fennel in the system either with green gram or clusterbean is more beneficial than coriander.

Gangtok

Production package organic with 100% N equivalent though organics (25% FYM+25% VC+25% NK+25% MC), gave the maximum net return (266.7×10^3 ₹/ha) with B:C ratio (3.69). Among the cropping systems, maize + ginger (1:1)-french bean (275.5×10^3 ₹/ha) recorded highest net return and being on par with maize + turmeric (1:1) - rajmash (273.9×10^3 ₹/ha).

Narendrapur

Among the nutrient managements practices, organic management with 100% nutrient through organic manure recorded maximum gross return (Rs.3,82,500/ha). Net return of Rs. 4,67,984/ha and net return per rupees invested (2.69) was obtained in organic with application of 75% organic +25% innovative practices under rice-frenchbean-sesame cropping system. Cropping systems rice-frenchbean-sesame differ significantly to other systems and found more than 2 times higher than basmati rice-broccoli-sesbania, rice-mustard-green gram and rice-capsicum-green gram.

Sardarkrushinagar

Maximum gross return (Rs. 2,17,941/ha) recorded under inorganic practices with state recommendation. Other management practices gave lower gross return than inorganic but being on par to each other. Net return of Rs.1,04,246 was obtained highest under 100% inorganic but being at par with integrated (50% each nutrient through organic and inorganic) package of Rs 1,10,101/ha. Among the cropping systems, greengram- cumin- vegetable cowpea system recorded higher net return of Rs. 1,43,418/h and Net return per rupee invested (1.46). Green gram-fennel gave minimum retrun of Rs. 26,138/ha.

Thiruvananthapuram

With premium price, cassava-groundnut resulted in higher net returns of Rs. 5,71,362/ha and net return per rupees invested (3.52) under organic condition followed by inorganic practices. Among the Systems, cassava-groundnut was the most remunerative system than cassava-vegetable cowpea

Udaipur

Among four cropping systems evaluated under different management practices, maize + black gram-durum wheat cropping system recorded maximum net return (Rs1,73,359/ha) under state recommendation practice followed by 100% inorganic practices (Rs1,73,236/ha). However, reverse was found in NRPRI which maximum in inorganic followed by state recommendation.

Table 7.2.23. Influence organic, inorganic and integrated production systems on economics (gross return and cost of cultivation) of different crops and cropping system at different locations

Locations/Treatments	Gross returns (Rs/ha)					Cost of cultivation (Rs/ha)				
	Organic		Inorganic		Mean	Organic		Inorganic		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation		100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation	
Bajaura										
Tomato-Cauliflower-french bean	4,11,264	3,66,299	2,33,439	3,46,506	3,41,731	2,88,760	2,78,260	2,47,056	3,21,056	2,80,674
Fallow-cauliflower-tomato	4,50,167	4,77,000	2,56,933	3,25,644	3,71,750	2,06,090	1,96,840	1,69,565	2,34,565	1,86,539
Black gram-cauliflower-summer squash	5,22,722	5,47,972	3,15,444	4,71,333	4,82,531	2,56,385	2,49,035	2,15,913	2,92,413	2,58,872
Lady finger-Pea	2,89,667	3,01,444	1,87,556	2,55,556	2,65,319	1,60,515	1,56,265	1,45,805	2,01,405	1,66,857
Mean	4,18,455	4,23,179	2,42,093	3,49,760		2,27,938	2,20,100	1,94,585	2,62,360	2,23,236
Bhopal										
Soybean- wheat	-	-	-	-	1,09,487	-	-	-	-	47,203
Soybean- Mustard	-	-	-	-	1,04,434	-	-	-	-	44,894
Soybean- Chickpea	-	-	-	-	1,19,094	-	-	-	-	45,141
Soybean- Linseed	-	-	-	-	1,02,277	-	-	-	-	45,003
Mean Nutrient Sources	1,35,698	1,29,045	93,959	94,107		45,027	44,587	45,939	47,599	45,136
Calicut										
Ginger	7,47,000	7,48,500	4,26,000	-	7,11,600	1,83,996	1,72,846	1,45,100	-	1,61,534
Turmeric	8,22,000	7,52,400	6,99,600	-	7,80,480	1,78,996	1,68,346	1,51,635	-	1,69,045
Coimbatore										
Maize - cotton - green manure	1,57,377	1,73,502	1,66,549	1,65,583	1,70,222	99,621	90,655	70,389	77,981	85,346
Chillies - sunflower - green manure	1,28,470	1,36,210	1,37,330	1,46,065	1,40,720	75,465	69,965	51,380	60,592	63,145
Beetroot - maize - green manure	2,70,989	2,63,418	2,47,933	2,59,433	2,74,601	1,12,955	1,02,227	84,663	94,295	99,782
Mean	1,85,612	1,91,043	1,83,937	1,90,360		96,014	87,616	68,811	77,623	87,917
Dharwad										

Locations/Treatments	Gross returns (Rs/ha)						Cost of cultivation (Rs/ha)					
	Organic			Inorganic			Organic			Inorganic		
	100% organic	75% organic + innovative organic practices	Mean	100% Inorganic	State recommendation	50% organic + 50% Inorganic	100% organic	75% organic + innovative organic practices	Mean	100% Inorganic	State recommendation	50% organic + 50% Inorganic
Cowpea/green gram-safflower	25,381	34,070	23,203	21,452	22,181	20,111	24,400	46,998	41,466	30,637	41,276	36,380
Pigeon pea (sole)	40,017	33,275	28,009	32,806	28,241	26,620	31,495	30,204	27,538	20,559	26,981	24,076
Green gram - Sorghum	35,568	31,615	21,540	26,267	29,461	28,562	28,835	49,099	43,480	30,295	40,935	36,791
Groundnut +hybrid cotton (2:1)	66,139	85,306	58,396	75,284	57,979	64,691	67,966	56,476	49,825	33,518	48,209	37,862
Maize-Chickpea	77,256	62,824	61,174	53,773	61,021	51,712	42,798	43,114	38,742	22,897	30,973	28,578
Mean	48,872	49,418	38,464	41,916	39,777	38,339		45,178	40,210	27,581	37,675	32,737
Jabalpur												
Basmati rice - wheat (durum) - green manure	1,85,914	1,65,404	1,82,116	1,41,179	1,80,494	1,74,510	1,71,603	1,04,160	95,220	73,013	70,060	91,586
Basmati rice - chickpea - maize fodder	1,54,084	1,30,159	1,47,494	1,16,715	1,56,080	1,26,851	1,38,564	1,06,944	1,02,654	79,378	69,689	92,825
Basmati rice - berseem (fodder and seed)	1,75,166	1,58,500	1,83,401	1,46,900	1,66,054	1,54,071	1,64,015	97,512	90,534	69,352	67,314	79,532
Basmati rice - vegetable pea-sorghum (fodder)	1,95,989	1,73,498	1,95,148	1,71,871	1,84,650	1,72,820	1,82,329	1,06,944	1,02,654	79,378	69,689	91,625
Mean	1,77,788	1,56,890	1,77,040	1,44,166	1,71,820	1,57,063		1,03,890	97,766	75,280	69,188	88,892
Karjat												
Rice-brinjal	10,19,563	9,27,341	8,94,398	6,60,738	8,36,560	8,06,450	8,57,508	3,21,629	2,94,394	2,32,916	2,25,508	2,77,927
Rice-chickpea	2,13,336	1,93,800	1,65,396	1,52,409	1,77,702	1,72,991	1,79,272	1,27,746	1,16,747	98,450	92,369	1,13,186
Rice-field bean	2,23,528	2,00,231	2,00,170	1,60,686	1,80,146	1,67,057	1,88,636	1,32,265	1,22,841	1,11,827	99,189	1,18,517
Rice-onion (White)	7,30,950	5,32,467	5,34,229	4,24,189	6,19,154	4,81,885	5,53,812	2,27,710	2,05,586	1,56,207	1,50,957	1,92,284
Mean	5,46,844	4,63,460	4,48,548	3,49,505	4,53,390	4,07,096		2,02,338	1,84,892	1,49,850	1,42,006	1,75,478
Ludhiana												
Basmati rice-chickpea-GM	1,24,920	1,23,024	98,432	99,504	1,02,488	1,02,112	1,08,413	90,747	90,517	76,492	76,594	77,881
Basmati rice-wheat-GM	2,30,699	2,31,995	98,432	99,504	1,98,348	1,93,633	1,75,435	86,642	84,724	70,131	70,233	72,498
Cluster bean-wheat-summer moong	2,39,122	2,40,693	1,97,810	1,95,461	1,84,719	1,88,087	2,07,649	99,847	97,431	76,979	76,708	77,245

Locations/Treatments	Gross returns (Rs/ha)						Cost of cultivation (Rs/ha)					
	Organic			Inorganic			Organic			Inorganic		
	100% organic	75% organic + innovative organic practices	Mean	100% Inorganic	State recommendation	Mean	100% organic	75% organic + innovative organic practices	Mean	100% Inorganic	State recommendation	Mean
Soybean -wheat	1,89,184	1,81,006	1,74,223	1,67,146	1,57,443	1,71,566	79,597	77,201	56,439	56,168	59,101	64,171
Mean	1,95,981	1,94,180	1,42,224	1,40,404	1,60,750	1,61,056	89,208	87,468	70,010	69,926	71,681	69,394
Pantnagar												
Basmati rice-wheat	2,19,559	2,12,342	1,63,910	1,63,192	1,77,787	1,85,846	77,166	64,261	59,267	58,217	70,711	74,771
Basmati rice -chickpea (4rows+2rows coriander)	3,58,075	3,32,238	2,54,300	2,60,720	2,73,400	2,90,961	70,731	60,808	59,522	60,572	71,436	65,864
Basmati rice -vegetable pea (4 rows vegetable pea +2 rows coriander)	3,04,956	2,87,363	2,08,075	2,12,570	2,34,935	2,46,357	73,456	63,953	61,112	62,162	70,526	67,069
Basmati rice -potato	2,67,939	2,61,634	1,78,297	1,82,541	2,02,390	2,15,108	98,640	92,380	90,096	91,146	1,00,737	96,486
Mean	2,87,632	2,73,394	2,01,146	2,04,756	2,22,128	2,18,350	79,998	70,351	67,499	68,024	78,353	81,001
Raipur												
Soybean-Maize	3,41,767	3,65,936	2,48,975	2,65,825	1,95,003	2,69,920	94,430	91,433	74,166	81,540	86,549	86,591
Soybean-Pea	2,24,328	2,67,311	1,49,233	1,61,859	1,37,759	1,79,224	76,587	73,528	59,863	66,833	68,075	69,902
Soybean-Chilli	2,74,214	2,93,025	2,15,521	2,26,375	2,09,968	2,39,074	85,160	81,207	70,043	77,474	75,942	78,648
Soybean-Onion	2,32,362	2,51,238	2,07,137	2,16,867	1,62,320	2,07,027	84,018	78,451	71,051	76,725	74,639	77,667
Mean	2,68,168	2,94,378	2,05,217	2,17,732	1,76,263	1,81,111	85,049	81,155	68,781	75,643	76,301	82,283
Ranchi												
Rice -wheat	1,42,697	1,44,401	1,09,663	90,598	1,14,494	1,19,329	76,928	68,915	52,825	49,472	70,894	63,980
Rice -lentil	1,07,041	1,07,441	77,480	65,411	86,293	88,845	53,478	49,268	42,733	40,372	50,786	47,457
Rice -potato	1,98,180	1,92,616	1,24,687	1,05,224	1,41,173	1,49,558	1,04,578	95,622	80,862	77,482	98,646	91,651
Rice -linseed	1,01,728	1,03,988	68,002	60,002	75,696	80,361	53,919	48,756	39,134	37,446	50,214	45,998
Mean	1,37,412	1,37,112	94,958	80,309	1,04,414	1,02,936	72,226	65,640	53,889	51,193	67,635	63,047
Umiam												
Vegetable-vegetable systems on raised bed												
Broccoli -carrot	6,18,900	5,50,260	4,76,200	-	5,08,650	5,38,503	2,36,034	2,12,706	1,78,660	-	1,92,883	2,05,071
Broccoli - potato	5,20,920	4,69,440	4,03,400	-	4,25,300	4,54,765	2,71,566	2,47,050	2,16,244	-	2,36,192	2,42,763

Locations/Treatments	Gross returns (Rs/ha)						Cost of cultivation (Rs/ha)					
	Organic			Inorganic			Organic			Inorganic		
	100% organic	75% organic + innovative organic practices	50% organic + 50% inorganic	100% Inorganic	State recommendation	50% organic + 50% inorganic	100% organic	75% organic + innovative organic practices	50% organic + 50% inorganic	100% Inorganic	State recommendation	50% organic + 50% inorganic
Broccoli - french bean	5,99,220	5,30,340	4,65,750	-	-	4,91,600	-	-	-	1,62,411	-	1,81,807
Broccoli - tomato	6,58,140	5,79,420	4,99,300	-	-	5,36,850	-	-	-	1,91,188	-	2,08,868
Mean	5,99,295	5,32,365	4,61,163			4,90,600				1,87,126		2,04,938
Centres started from 2015-16												
Ajmer												
Green gram - fennel	-	-	-	-	-	-	-	-	-	43,017	53,017	62,517
Green gram - coriander	-	-	-	-	-	-	-	-	-	40,821	50,821	54,193
Cluster bean - fennel	-	-	-	-	-	-	-	-	-	43,017	53,017	62,517
Cluster bean - coriander	-	-	-	-	-	-	-	-	-	40,821	50,821	54,193
Mean	-	-	-	-	-	-	-	-	-	41,919	51,919	58,355
Narendrapur												
Basmati rice-broccoli-Sesbania green manure	2,52,744	2,47,191	1,92,306	1,88,519	1,88,519	2,04,130	2,08,470	2,15,560	2,15,560	1,00,661	1,00,661	1,10,255
Paddy - mustard- green-gram	2,50,358	2,46,837	1,78,960	1,78,728	1,78,728	1,97,513	1,89,555	2,06,992	2,06,992	90,372	90,372	95,708
Paddy - capsicum - green-gram	3,82,249	3,71,374	2,75,736	2,88,367	2,88,367	2,97,099	3,06,705	3,20,255	3,20,255	1,40,136	1,40,136	1,50,333
Paddy - french bean - sesame	6,44,688	6,41,878	5,06,852	5,12,124	5,12,124	5,36,951	5,13,116	5,59,268	5,59,268	1,49,854	1,49,854	1,60,148
Mean	3,82,510	3,76,820	2,88,464	2,91,935	2,91,935	3,08,923	3,04,462			1,20,256	1,20,256	1,29,111
Sardar Krushinagar												
Groundnut- wheat- green gram	2,38,839	2,47,192	2,23,862	2,45,251	2,45,251	2,22,226	2,24,178	2,33,591	2,33,591	96,734	1,41,734	1,14,547
Greengram- cumin- vegetable cowpea	2,16,824	2,15,310	2,54,689	2,93,766	2,93,766	2,45,140	2,52,042	2,46,295	2,46,295	86,798	1,31,798	93,886
Greengram-fennel- fennel cont.	1,11,841	1,14,181	1,04,521	1,14,807	1,14,807	99,653	1,01,929	1,07,822	1,07,822	60,826	90,826	74,257
Mean	1,89,168	1,92,228	1,94,357	2,17,941	2,17,941	1,89,006	1,92,716			81,453	1,21,453	94,230

Locations/Treatments	Gross returns (Rs/ha)					Cost of cultivation (Rs/ha)				
	Organic		Inorganic		Mean	Organic		Inorganic		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation		100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation	
Udaipur										
	1,79,478	1,96,597	2,28,243	2,38,366	2,10,668	1,02,896	96,943	55,007	65,007	81,618
	1,47,910	1,57,950	1,83,266	1,83,764	1,68,849	69,926	70,002	44,820	54,865	60,112
	1,28,707	1,38,752	1,72,558	1,78,535	1,53,561	1,02,406	1,01,285	72,366	82,410	90,125
	86,402	91,981	1,02,677	1,05,111	94,450	58,490	61,466	43,824	53,914	53,956
Mean	1,35,624	1,46,320	1,71,686	1,76,444		83,430	82,424	54,004	64,049	76,066

Table 7.2.24: Influence organic, inorganic and integrated production systems on net return and return per rupee invested of different crops and cropping system at different locations

Locations/Treatments	Net returns (Rs/ha)					Net return per rupee invested (NRPRI)				
	Organic		Inorganic		Mean	Organic		Inorganic		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation		100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation	
Bajaura										
	1,22,504	88,039	-13,617	25,450	60,786	0.42	0.32	-0.08	0.08	0.21
	2,44,077	2,80,160	87,368	91,079	1,74,718	1.18	1.42	0.52	0.39	0.89
	2,66,337	2,98,937	99,531	1,78,920	2,28,706	1.04	1.20	0.46	0.61	0.90

Locations/Treatments	Net returns (Rs/ha)					Net return per rupee invested (NRPRI)									
	Organic	Inorganic	Integrated			Mean	Organic				Inorganic		Integrated		Mean
			100% Inorganic	State recommendation	50% organic + 50% inorganic		75% organic + 25% inorganic	100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic		
Lady finger-Pea	1,29,152	1,45,179	41,751	54,151	1,22,651	1,06,299	99,864	0.80	0.93	0.29	0.27	0.76	0.64	0.61	
Mean	1,90,517	2,03,079	47,508	87,400	1,70,125	1,47,481		0.86	0.97	0.30	0.34	0.80	0.68		
Bhopal															
Soybean- wheat	-	-	-	-	-	-	62,284	-	-	-	-	-	-	1.32	
Soybean- Mustard	-	-	-	-	-	-	59,540	-	-	-	-	-	-	1.33	
Soybean- Chickpea	-	-	-	-	-	-	73,953	-	-	-	-	-	-	1.64	
Soybean- Linseed	-	-	-	-	-	-	57,274	-	-	-	-	-	-	1.27	
Nutrient Sources	90,671	84,458	48,020	46,507	52,520	60,046		2.01	1.89	1.05	0.98	1.17	1.33		
Calicut															
Ginger	5,63,004	5,75,654	2,80,900	-	7,27,466	5,91,466	5,47,698	3.06	3.33	1.94	-	4.66	3.66	3.33	
Turmeric	6,43,004	5,84,054	5,47,965	-	6,76,799	6,42,155	6,18,795	3.59	3.47	3.61	-	4.82	3.80	3.86	
Black pepper (Kg/vine)															
Coimbatore															
Maize - cotton - green manure	57,756	82,847	96,160	87,602	96,049	88,844	84,876	1.58	1.91	2.37	2.12	2.17	1.97	2.02	
Chillies - sunflower - green manure	53,005	66,245	85,950	85,473	84,653	90,125	77,575	1.70	1.95	2.67	2.41	2.49	2.40	2.27	
Beetroot - maize - green manure	1,55,430	1,58,543	1,60,542	1,62,430	1,92,407	2,02,920	1,72,045	2.40	2.58	2.93	2.75	3.02	2.91	2.76	
Mean	88,730	1,02,545	1,14,217	1,11,835	1,24,370	1,27,296		1.89	2.15	2.66	2.43	2.56	2.43		
Dharwad															
Cowpea-safflower	-21,617	-7,396	-7,434	-19,824	-14,199	-22,948	-15,570	0.54	0.82	0.76	0.52	0.61	0.47	0.62	
Pigeon pea (sole)	9,814	5,738	7,450	5,824	4,165	-1,436	5,259	1.32	1.21	1.36	1.22	1.17	0.95	1.21	
Sorghum-green gram	-13,531	-11,866	-8,756	-14,668	-7,329	-15,797	-11,991	0.72	0.73	0.71	0.64	0.80	0.64	0.71	
Groundnut +hybrid cotton (2:1)	9,663	35,480	24,878	27,075	20,117	19,165	22,730	1.17	1.71	1.74	1.56	1.53	1.42	1.52	

Locations/Treatments	Net returns (Rs/ha)				Net return per rupee invested (NRPRI)										
	Organic	Inorganic	Integrated			Mean	Organic				Inorganic		Integrated		Mean
			100% organic	75% organic + innovative organic practices	100% Inorganic		State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic	100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation	50% organic + 50% inorganic	
Maize-Chickpea	34,143	24,082	38,277	22,801	32,444	20,381	28,688	1.79	1.62	1.74	2.67	1.74	2.14	1.65	1.93
Mean	3,694	9,208	10,883	4,242	7,040	-127		1.11	1.22	1.14	1.45	1.14	1.25	1.03	
Jabalpur															
Basmati rice - wheat (durum) - green manure	81,754	70,184	1,09,103	71,119	88,907	72,437	82,251	1.78	1.74	2.02	2.49	2.02	1.97	1.71	1.95
Basmati rice - chick-pea - maize fodder	47,140	27,505	68,116	47,026	63,255	26,103	46,524	1.44	1.27	1.67	1.86	1.67	1.68	1.26	1.53
Basmati rice - ber-seem (fodder and seed)	77,654	67,966	1,14,049	79,586	86,522	64,773	81,758	1.8	1.75	2.18	2.64	2.18	2.09	1.73	2.03
Basmati rice - vegetable pea-sorghum (fodder)	89,045	70,844	1,15,771	1,02,182	93,025	73,272	90,690	1.83	1.69	2.47	2.46	2.47	2.02	1.74	2.04
Mean	73,898	59,125	1,01,760	74,978	82,927	59,146		1.71	1.61	2.09	2.36	2.09	1.94	1.61	
Karjat															
Rice-brinjal	6,97,934	6,32,947	6,61,482	4,35,230	5,58,633	5,09,961	5,82,698	3.17	3.15	2.93	3.84	2.93	3.01	2.72	3.14
Rice-chickpea	85,590	77,053	66,946	60,040	64,516	54,504	68,108	1.67	1.66	1.65	1.68	1.65	1.57	1.46	1.62
Rice-field bean	91,263	77,390	88,343	61,497	61,629	44,221	70,724	1.69	1.63	1.62	1.79	1.62	1.52	1.36	1.60
Rice-onion (White)	5,03,240	3,26,881	3,78,022	2,73,232	4,26,870	2,75,951	3,64,033	3.21	2.59	2.81	3.42	2.81	3.22	2.34	2.93
Mean	3,44,507	2,78,568	2,98,698	2,07,500	2,77,912	2,21,159		2.44	2.26	2.25	2.68	2.25	2.33	1.97	
Ludhiana															
Basmati rice-chick-pea-GM	34,173	32,507	21,940	22,910	24,607	24,711	26,808	1.38	1.36	1.30	1.29	1.30	1.32	1.32	1.33
Basmati rice-wheat-GM	1,44,057	1,47,270	1,27,679	1,25,228	1,25,850	1,24,095	1,32,363	2.66	2.74	2.78	2.82	2.78	2.74	2.78	2.75
Cluster bean-wheat-summer moong	1,39,275	1,43,261	97,244	90,438	1,07,474	1,13,971	1,15,277	2.39	2.47	2.18	2.26	2.18	2.39	2.54	2.37
Soybean -wheat	1,09,588	1,03,804	95,524	91,613	98,342	1,03,874	1,00,458	2.38	2.34	2.63	2.69	2.63	2.66	2.84	2.59

Locations/Treatments	Net returns (Rs/ha)					Net return per rupee invested (NRPRI)				
	Organic	Inorganic	Integrated			Mean	Organic			
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic	100% organic	75% organic + innovative organic practices	100% Inorganic	State recommendation
Mean	1,06,773	1,06,711	85,597	82,547	89,068	91,663	2,20	2,23	2,27	2,22
Modipuram										
Basmati rice- wheat - sesbania green manure	82,163	76,500	72,116	74,197	78,803	79,483	-	-	-	-
Rice- barley (malt) - green gram	90,083	88,116	81,227	80,961	80,146	86,160	-	-	-	-
Maize(popcorn)- potato -okra + sesbania green manure	1,27,327	1,20,791	1,19,397	1,22,401	1,15,940	1,19,751	-	-	-	-
Maize(sweet corn)- mustard- sesbania green manure	1,27,782	1,27,729	1,28,395	1,19,099	1,26,868	1,35,472	-	-	-	-
Mean	1,06,839	1,03,284	1,00,284	99,165	1,00,439	1,05,217	-	-	-	-
Pantnagar										
Basmati rice- wheat	1,42,393	1,48,081	1,04,643	1,04,975	1,07,076	1,03,513	1,85	2,30	1,77	1,80
Basmati rice -chick-pea (4rows+2rows coriander)	2,87,344	2,71,430	1,94,778	2,00,148	2,01,964	1,94,916	4,06	4,46	3,27	3,30
Basmati rice -vegetable pea (4 rows vegetable pea +2 rows coriander)	2,31,500	2,23,410	1,46,963	1,50,408	1,64,409	1,59,036	3,15	3,49	2,40	2,42
Basmati rice -potato	1,69,299	1,69,254	88,201	91,395	1,01,653	91,928	1,72	1,83	0,98	1,00
Mean	2,07,634	2,03,043	1,33,646	1,36,732	1,43,775	1,37,348	2,69	3,02	2,11	2,13
Raipur										
Soybean-maize	2,47,337	2,74,503	1,74,809	1,84,286	1,08,454	1,10,589	3,62	4,00	3,36	3,26
Soybean- garden pea	1,47,742	1,93,782	89,371	95,026	69,684	60,326	2,93	3,64	2,49	2,42
Soybean-chilli	1,89,054	2,11,818	1,45,478	1,48,902	1,34,027	1,33,277	2,22	3,61	3,08	2,92

Locations/Treatments	Net returns (Rs/ha)					Net return per rupee invested (NRPRI)								
	Organic	Inorganic	Integrated			Mean	Organic				Inorganic		Integrated	Mean
			100%	75%	100%		State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic	100%	75% organic + innovative organic practices	100%		
Soybean-onion	1,48,344	1,72,788	1,36,086	1,40,142	87,681	91,123	1,29,361	2.77	3.20	2.92	2.83	2.17	2.12	2.67
Mean	1,83,119	2,13,223	1,36,436	1,42,089	99,962	98,829		2.89	3.61	2.96	2.86	2.30	2.19	
Ranchi														
Rice-wheat	65,769	75,486	56,838	41,126	43,600	49,274	55,349	1.17	0.91	0.93	1.20	1.63	1.32	1.19
Rice - lentil	53,563	58,173	34,747	25,039	35,507	41,300	41,388	1.00	0.85	1.23	1.61	1.43	1.16	1.21
Rice - potato	93,602	96,994	43,825	27,742	42,527	42,754	57,907	1.12	0.99	1.85	2.79	2.32	2.17	1.87
Rice- linseed	47,809	55,232	28,868	22,556	25,482	26,231	34,363	1.13	0.88	1.36	1.66	1.97	1.77	1.46
Mean	65,186	71,471	41,070	29,116	36,779	39,890		1.10	0.91	1.34	1.82	1.84	1.61	
Umiam														
Vegetable-vegetable systems on raised bed														
Broccoli -carrot	3,82,866	3,37,554	2,97,540	-	3,15,767	-	3,33,432	1.62	1.59	1.67	-	1.64	-	1.63
Broccoli - potato	2,49,354	2,22,390	1,87,156	-	1,89,108	-	2,12,002	0.92	0.90	0.87	-	0.80	-	0.87
Broccoli -french bean	3,83,598	3,35,244	3,03,339	-	3,09,793	-	3,32,994	1.78	1.71	1.87	-	1.70	-	1.77
Broccoli -tomato	4,13,250	3,58,182	3,08,112	-	3,27,982	-	3,51,882	1.69	1.62	1.61	-	1.57	-	1.62
Mean	3,57,267	3,13,343	2,74,037	-	2,85,663	-		1.50	1.46	1.51	-	1.43	-	
Centres started from 2016-17														
Ajmer														
Green gram - fennel	89,317	1,24,088	1,56,333	1,63,924	1,47,307	1,54,361	1,39,222	1.09	1.77	3.63	3.09	2.36	2.14	2.35
Green gram - coriander	10,945	19,371	38,359	37,818	22,470	34,900	27,310	0.16	0.33	0.94	0.74	0.41	0.57	0.53
Cluster bean - fennel	1,11,168	1,20,022	1,40,139	1,61,206	1,40,288	1,52,434	1,37,543	1.35	1.71	3.26	3.04	2.24	2.11	2.29
Cluster bean - coriander	24,715	40,464	52,380	52,152	44,360	49,084	43,859	0.36	0.68	1.28	1.03	0.82	0.81	0.83
Mean	59,036	75,986	96,803	1,03,775	88,606	97,695		0.74	1.12	2.28	1.98	1.46	1.41	
Gangtok		(×10³ ₹/ha)												

Locations/Treatments	Net returns (Rs/ha)					Net return per rupee invested (NRPRI)								
	Organic	Inorganic	Integrated			Mean	Organic				Inorganic		Integrated	Mean
			100%	75%	100%		State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic	100%	State recommendation			
100% organic	75% organic + innovative organic practices	100% Inorganic	75% organic + 25% inorganic	50% organic + 50% inorganic	100% Inorganic	75% organic + innovative organic practices	100% Inorganic	75% organic + innovative organic practices	100% Inorganic	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic		
Maize + ginger (1:1)- french bean	-	-	-	-	-	-	-	-	-	-	-	-	3.15	
Maize + soybean (1:1) - buckwheat	-	-	-	-	-	-	-	-	-	-	-	-	2.44	
Maize + turmeric (1:1) - rajmash	-	-	-	-	-	-	-	-	-	-	-	-	3.45	
Maize + pigeon pea (2:1)	-	-	-	-	-	-	-	-	-	-	-	-	2.66	
Mean	266.7	216.2		70.2	169.5			3.69	3.21		1.94	2.88		
Narendrapur														
Basmati rice- brocoli - sesbania green manure	1,27,794	1,31,964	91,645	87,858	93,875	90,127	1,03,877	1.02	1.15	0.91	0.87	0.85	0.76	0.93
Paddy- mustard- green gram	1,43,398	1,48,527	88,588	88,356	1,01,805	87,721	1,09,732	1.34	1.51	0.98	0.98	1.06	0.86	1.12
Paddy- capsicum- green gram	2,06,236	2,11,461	1,35,600	1,48,231	1,46,767	1,43,032	1,65,221	1.17	1.32	0.97	1.06	0.98	0.87	1.06
Paddy- french bean - sesame	4,49,520	4,67,984	3,56,999	3,62,270	3,76,804	3,32,890	3,91,078	2.30	2.69	2.38	2.42	2.35	1.85	2.33
Mean	2,31,737	2,39,984	1,68,208	1,71,679	1,79,813	1,63,443		1.46	1.67	1.31	1.33	1.31	1.09	
Sardar Krushinagar														
Groundnut- wheat- green gram	1,15,765	1,11,204	1,21,856	90,575	1,12,833	98,000	1,08,372	0.80	1.04	1.31	0.73	0.94	0.82	0.94
Greengram- cumin- vegetable cowpea	1,10,878	1,19,065	1,55,386	1,38,012	1,84,933	1,52,234	1,43,418	1.15	1.25	1.93	1.23	1.61	1.59	1.46
Greengram-fennel- fennel cont.	23,402	29,250	35,496	18,223	32,537	17,922	26,138	0.28	0.44	0.72	0.26	0.34	0.26	0.38
Mean	83,348	86,506	1,04,246	82,270	1,10,101	89,385		0.74	0.91	1.32	0.74	0.96	0.89	

Locations/Treatments	Net returns (Rs/ha)				Net return per rupee invested (NRPRI)									
	Organic	Inorganic	Integrated			Mean	Organic			Inorganic	Integrated		Mean	
			100%	75%	100%		State recommendation	50% organic + 50% inorganic	75% organic + innovative organic practices		100% Inorganic	State recommendation + 50% inorganic		75% organic + 25% inorganic
Thiruvananthapuram														
Cassava-veg. cowpea	1,96,507	2,54,398	3,78,060	2,22,744	2,40,623	1,55,319	2,41,275	1.59	1.78	3.00	2.09	1.91	1.46	1.97
Cassava-groundnut	5,71,362	4,74,025	5,29,130	4,10,485	3,94,363	4,39,067	4,69,739	3.52	2.92	3.94	3.23	2.64	2.69	3.16
Taro-black gram	-1,90,605	-1,16,329	-1,71,862	-1,53,037	-1,45,839	-2,98,864	-1,79,423	0.62	0.26	0.18	0.21	0.37	0.22	0.31
Taro-greengram	-1,65,443	-3,21,389	-2,01,455	-2,05,366	-2,16,289	-3,33,645	-2,40,598	0.58	0.67	0.34	0.45	0.58	0.31	0.49
Mean								1.58	1.41	1.86	1.49	1.37	1.17	
Udaipur														
Maize + blackgram (2:2) - durum Wheat - sesbania (GM)	95,727	1,24,566	1,73,236	1,73,359	1,22,698	1,28,772	1,36,393	0.93	1.28	3.15	2.67	1.55	1.42	1.83
Blackgram - wheat (Triticum aestivum)	97,480	1,09,934	1,38,446	1,28,899	1,19,270	99,874	1,15,651	1.39	1.57	3.09	2.35	2.08	1.57	2.01
Sweet corn + blackgram (2:2) - chickpea	32,875	46,835	1,00,192	96,125	68,565	51,967	66,093	0.32	0.46	1.38	1.17	0.78	0.55	0.78
Soybean - fenugreek	37,020	41,148	58,853	51,197	46,403	28,088	43,785	0.63	0.67	1.34	0.95	0.91	0.51	0.84
Mean	65,776	80,621	1,17,682	1,12,395	89,234	77,175		0.82	1.00	2.24	1.78	1.33	1.01	

7.3 Evaluation of response of different varieties of major crops for Organic Farming

Objectives

- To evaluate the response of varied duration and nutrient requiring varieties of major crops to organic production system
- To identify the suitable varieties of crops for organic management practices

Three to four groups of varieties based on crop duration, nutrient and water requirement and insect/disease tolerance was selected for evaluation. Two major varieties grown by the farmers in the region was also included. About 10-12 different varieties/ hybrids, which are popular in farmers or recommended by institutions were evaluated for potential cropping system of organic farming in 3 replications in RBD having the minimum Plot size 20 m². All the centers have taken up this experiment as it is especially important to identify the varieties which form the core of organic farming package.

Year of start: 2013-14

Locations: All the 20 centers in different ecosystem as mentioned in section 7.1 have conducted the

experiments including 7 new centers started experimentation from 2015-16. Almora and Narendrapur not conducted the experiments.

Results

Bajaura (Table 7.3.1.1 – 7.3.1.4)

Four varieties and two hybrids of okra in *kharif*, seven varieties of cauliflower in *rabi*, eight varieties pea and twelve varieties of tomato in summer season were evaluated for their performance and suitability under organic conditions.

Okra (Table 7.3.1.1): Six varieties of okra including two hybrids were evaluated during *kharif* for their suitability under organic conditions. Significant differences among the varieties for the entire traits for okra except plant height were observed. Best performing variety i.e., Chameli-015 recorded significantly higher fruit yield (5620 kg/ha) owing to higher number of fruits/plant (20.0), plant population (86.42 '1000/ha), net returns (Rs. 61097/ha) and B:C ratio (0.77) followed by Indranil. The number of fruits per plant were found maximum and equal both in hybrid Chameli-015 and Indranil (20). The variety Perkins Long Green had taken maximum number of days to harvest (58.0 days) along with longest fruit length (12.6 cm).

Table 7.3.1.1: Yields attributes and yield of okra in under organic management at Bajaura

Varieties	Plant height (cm)	Days taken to Harvest	No. of fruits/ plant	Fruit length (cm)	Fruit yield (kg/ha)	Net Returns (RS./ha)	B:C ratio
Perkins Long Green	169.3	58.0	15.0	12.6	4560	43680	0.62
Pusa Makhmali	177.6	56.0	17.6	12.2	4310	37347	0.53
Palam Komal	184.3	52.6	15.6	11.8	3940	28097	0.40
P-8 (check)	176.3	56.6	15.6	11.7	4170	33930	0.48
Indranil*	171.0	24.0	20.0	11.9	5250	51847	0.65
Chameli-015*	178.0	57.0	20.0	12.5	5620	61097	0.77
CD (P=0.05)	NS	1.72	2.75	0.53	387	9680	0.13

*Hybrid



Best performing Okra variety Chameli-015 at Bajaura

Pea (Table 7.3.1.2): Five varieties and three hybrids of pea were evaluated for their performance under organic conditions during *rabi*. Significant differences were observed among the pea varieties for all traits except TSS. Ten plus recorded tallest plant (56.3 cm) and gave the highest pod yield (9810 kg/ha) with pods/plant (27.3), it gave maximum net

return (Rs. 1,72,271/ha) followed by Nirali yield (9120 kg/ha), nos. of pod/plant (24.5) and net return of Rs. 1,55,047/ha. GC 477 produced the lowest yield (4310 kg/ha) with lower number of seeds/pods. Days taken to flowering also more in Ten plus (112.0) followed by Nirali (110.6 days), NP-20 (109.0days), but these were found statistically at par to each other.

Table 7.3.1.2: Yields attributes and yield of vegetable pea (*rabi*) in tomato-cauliflower-pea system under organic management at Bajaura

Varieties	Plant height (cm)	Pod length (cm)	No. of pods plant ⁻¹	No. of seeds pod ⁻¹	Days taken to flowering	Pod yield (kg/ha)	TSS (°Brix)	Net Return (Rs/ha)	B:C
GC 477	39.8	5.8	20.6	6.0	107.3	4310	15.0	45609	0.73
Pb-89	53.0	6.8	22.6	7.3	93.3	7720	15.3	130812	2.10
Azad P-1	54.6	6.7	20.0	6.7	90.6	5560	15.3	76873	1.24
Lincon	55.2	6.7	21.6	6.0	100.6	5540	15.6	76314	1.23
Palam Triloki	54.5	6.7	23.0	7.3	90.6	8840	15.3	158902	2.55
Nirali*	55.7	6.8	24.5	7.3	110.6	9120	15.6	155047	2.12
NP-20	53.9	7.0	23.0	7.7	109.0	8670	15.3	143677	1.97
Ten Plus	56.3	6.9	27.3	8.0	112.0	9810	15.6	172271	2.36
CD (P=0.05)	4.34	0.35	3.30	1.12	8.46	555	NS	13912	0.21

*Hybrid



Best performing variety Ten Plus under organic farming at Bajaura

Cauliflower (Table 7.3.1.3): Two varieties and five hybrids of cauliflower were evaluated for their performance under organic conditions during *rabi*. Significant differences were observed among the varieties/hybrids for the different traits. Though higher curds size was obtained in Chandra mukhi (252.2 cm²) but significantly higher curd weight (635 g), marketable curd (82.8%), curd yield (11830 kg/

ha) resulted in higher net return of Rs. 1,94,910/ha and B:C ratio (1.736) was obtained in US-178 among the varieties followed by Chandramukhi, curd yield (11360 kg/ha), curd weight (631 g), net return (Rs. 1,79,819/ha) and B:C ratio (1.736). Variety KT-25 recorded lower yield (6830 kg/ha) resulting in lower number of marketable curd (72.1%) and curd size (200.4 g).

Table 7.3.1.3: Yields attributes and yield of cauliflower (*rabi*) under organic farming at Bajaura

Variety/ hybrid	Marketable curd (%)	Curd weight (g)	Curd size (cm ²)	Curd yield (kg/ha)	Biomass (kg/ha)	Net Returns (Rs/ha)	B:C ratio
PSBK-1	74.2	424	207.8	8960	18810	134290	1.49
Sonaxi	81.4	532	249.8	9640	20020	142066	1.44
Madhuri	78.5	526	241.0	9580	18390	140638	1.42
KT-25	72.1	442	200.4	6830	18140	81179	0.90
US-178	82.8	635	248.2	11830	20790	194910	1.93
Chandramukhi	80.7	631	252.2	11360	20580	179819	1.73
71 No.	78.5	415	224.3	8980	18100	125472	1.26
CD (P=0.05)	0.23	14.16	6.48	1400	700	35190	0.36

*Hybrid



Best performing variety US-178 under organic farming at Bajaura

Tomato (Table 7.3.1.4): Seven hybrids and five varieties of tomato were evaluated during summer under organic management. Significant differences were observed among the tomato varieties/hybrids for all variables. Though tallest plant of tomato was recorded with Heem Sohna and Yash 100.1 and 100.2 cm respectively, but significantly fruit size (30.1 cm²), number of fruits/plant (42.6) were higher with RK-123. Fruit yield difference was recorded among the

tomato varieties ranged from 3350 to 13850 kg/ha. Mar Globe showed lowest yield while R K-123 had highest fruit yield with higher numbers of fruits/plant. TSS (°Brix) in term of quality varied ranging from 3.6 to 4.5. Mar Globe recorded lowest while Yash recorded highest TSS content (°Brix). Variety RK-123 also gave the maximum return of Rs. 2,40,944/ha and B:C ratio 2.259 followed by red gold and Heem sohna.



Table 7.3.1.4: Yields attributes and yield of tomato in tomato-pea-tomato system under organic management at Bajaura

Varieties/ hybrids	Plant height (cm)	Nos. of fruits plant ⁻¹	Fruit size (cm ²)	Days taken to flowering	Yield (kg/ ha)	TSS (°Brix)	Net return (Rs./ha)	B:C ratio
Yash*	100.2	38.0	24.6	39	10140	4.5	148282	1.41
Naveen 2000*	99.5	33.3	21.5	37	11060	4.0	171163	1.62
Manisha*	86.5	35.0	23.7	45	9670	4.5	136524	1.29
Red Gold*	88.5	39.6	26.6	39	12230	4.3	200457	1.90
Hybrid 7730*	96.6	35.3	20.8	37	12130	3.7	197885	1.88
Roma	66.6	24.0	19.0	48	6110	3.6	54351	0.55
Sioux	84.2	22.0	18.7	38	4310	3.7	9157	0.09
Best of All	77.8	22.6	11.9	39	3650	4.3	-7347	-0.07
Palam Pink	62.6	22.3	24.7	38	4460	3.8	12963	0.13
Mar Globe	90.7	19.3	25.3	39	3340	3.6	-14891	-0.15
RK-123*	93.1	42.6	30.1	40	13850	4.3	240944	2.29
Heem Sohna*	100.1	39.6	24.6	42	12580	4.5	209277	1.99
CD (P=0.05)	0.59	2.2	2.50	1.28	840	0.40	20975	0.20

*Hybrids



Best performing variety (RK 123) for organic farming at Bajaura

Bhopal (Table 7.3.2.1-7.3.2.4)

Twelve varieties of each soybean and maize in *kharif* and wheat and chickpea in *rabi* including two major varieties grown by the farmers in the region were evaluated in soybean-wheat and maize-chickpea cropping systems.

Performance of *kharif* crops

Soybean (Table 7.3.2.1): Soybean variety JS-97-52 was significantly tallest (54.3 cm) but among the varieties, RVS-2002-4 resulted in significantly higher seed

yield (1890 kg/ha) owing to higher pods/plant (49.9) and numbers of seeds/pod (3.3). NRC-37 recorded lower soybean yield (1320 kg/ha) with least pods/plant (42.6) and biomass (5137kg/ha).

Nutritional quality constituents such as protein, oil and methionine, content was determined in seeds of different varieties of soybean and significant variation was also observed for oil and Methionine content. The percentage of protein among different varieties of soybean seeds was being in the range from 36.21 to 37.35% however, 7.72% more oil was

recorded in RVS-2002-7 compared to JS 20-34 which was lowest in oil content. Significantly higher

methionine (1.77 g/16 g N) was observed with RVS-2002-7 and RVS-2002-6 (1.77 g/16 g N).

Table 7.3.2.1: Yield attributes yields and quality of soybean under organic management at Bhopal

Variety	Plant height (cm)	Pods/Plant	Seeds/Pod	Seed yield (kg/ha)	Total Biomass (kg/ha)	Protein (%)	Oil (%)	Methionine (g/16 g N)
JS-335	45.1	45.9	2.6	1547	5183	37.2	19.7	1.74
JS-93-05	40.3	43.1	2.5	1513	5283	37.4	19.4	1.73
JS-95-60	34.7	43.9	3.1	1540	5437	37.0	19.0	1.71
JS-20-41	48.7	49.5	3.3	1520	5083	36.3	19.8	1.73
NRC-7	41.0	45.5	2.9	1523	5167	36.2	19.2	1.70
NRC-37	57.3	42.6	2.7	1320	5137	36.9	19.0	1.71
JS-20-29	49.7	43.5	3.1	1500	5287	37.3	19.8	1.70
RVS-2002-4	42.7	49.9	3.3	1890	6343	36.6	19.8	1.76
RVS-2002-6	46.4	48.3	2.6	1773	6297	36.5	19.8	1.77
RVS-2002-7	48.9	44.1	2.7	1623	5887	36.5	20.1	1.77
JS-97-52	54.3	49.3	3.3	1777	6140	36.5	19.1	1.71
JS-20-34	40.7	45.3	2.7	1663	5987	36.7	18.7	1.75
CD (P= 0.05)	8	NS	0.33	121	545	NS	0.41	0.026

Maize (Table 7.3.2.2): Among the maize varieties grown under similar nutrient source and doses, Kanchan was outperformed in yield (3920 kg/ha) followed by Proagro 4212, JM-8, Pratap-6 and Pratap-5 which were on par to each other. Kanchan was the leading variety in cobs/plant (1.4), rows/cob (12.8), seed/row (20.1) and biomass yield (8273

kg/ha). Nutritional quality such as protein, ash and tryptophan content were determined in grains of different varieties of maize and differ significantly among various varieties of maize for protein and tryptophan content except ash. The higher values of protein concentration recorded in Proagro-4212 (9.91%) followed by Kanchan and CPBG 4202.

Table 7.3.2.2: Yield attributes, yield and quality of different maize varieties/hybrids under organic management at Bhopal

Variety	Plant height (cm)	Cobs/plant	Rows/cob	Seeds/row	Seed yield (kg/ha)	Biomass (kg/ha)	Harvest index (%)	Protein (%)	Tryptophan (g/16 g N)
Kanchan	162	1.4	12.8	20.1	3920	8273	47.4	9.91	0.90
Pratap 5	179	1.4	11.4	17.3	3297	7180	45.9	9.49	0.88
Arawali	154	1.2	11.4	18.1	2920	6533	44.7	9.89	0.78
Sona 222	160	1.4	11.1	17.9	3147	6383	49.3	9.71	0.86
Pratap 6	168	1.2	11.5	17.5	3357	7707	43.6	9.36	0.79
JM 216	164	1.3	10.7	17.5	3273	7393	44.3	9.79	0.77
Popcorn 1	114	1.0	10.2	15.2	2483	5130	48.4	9.80	0.76
JM 8	163	1.2	10.6	16.5	3570	7640	46.7	9.83	0.86
JM 12	168	1.2	10.8	16.2	3187	7457	42.7	9.44	0.82
Proagro 4412	171	1.2	10.8	17.9	3880	8060	48.1	9.99	0.89

Variety	Plant height (cm)	Cobs/plant	Rows/cob	Seeds/row	Seed yield (kg/ha)	Biomass (kg/ha)	Harvest index (%)	Protein (%)	Tryptophan (g/16 g N)
Sweet Corn	115	1.1	10.1	15.4	2443	4967	49.2	9.30	0.75
CPBG 4202	149	1.3	11.1	17.4	3243	7803	41.6	9.90	0.81
CD (P= 0.05)	20	NS	NS	NS	603	901	-	0.29	0.058



Best preforming variety soybean (RVS-2002-4) and maize (Kanchan) under organic conditions at Bhopal

Performance of rabi crops

Wheat (Table 7.3.2.3): Among the wheat varieties, GW-366 significantly outperformed in number of spikes/meter row length (101.0), seeds/spike (77.4)

resulted in higher grain and biomass yield (4167 and 8847 kg/ha) and harvest index (47.0%) followed by HI-8498 and Malwa shakti in term of yield. Lok-1 produced lower yield (2923 kg/ha) with total biomass (6593 kg/ha).

Table 7.3.2.3: Response of wheat varieties for yield attributes and yields in soybean-wheat system under organic management at Bhopal

Variety	Spikes/meter length	Seeds/spike	Grain Yield (kg/ha)	Biomass (kg/ha)	Harvest Index (%)
C-306	90.3	64.6	3240	7150	45
HI-8663	95.0	71.9	3507	7960	44
HI-1544	95.3	69.1	3387	7460	45
Malwashakti	100.0	73.0	3707	8220	45
GW-322	99.3	71.8	3527	7820	45
GW-366	101.0	77.4	4167	8847	47
HI-1531	92.7	69.6	3143	7480	42
HI-8498	100.7	76.9	3733	8620	43
HI-1500	98.3	67.9	3317	7863	42
1202	97.3	71.2	3220	7373	44
HD-932	94.0	74.6	3227	7717	42
LOK-1	91.7	66.2	2923	6593	44
CD (P= 0.05)	7	5	290	417	

Chickpea (Table 7.3.2.4): Among the varieties, JG 130 recorded significantly higher seed yield (1962 kg/ha), correspondingly higher biomass yield of 5493 kg/ha, seeds/pod (2.0) and pod/plant (99.1) followed by JG-

63 (1880 kg/ha) and RVG-202 (1840 kg/ha) in term of yield. Rest of varieties were ranged from 1345 to 1793 kg/ha on yield basis.

Table 7.3.2.4: Yield indices and yield of different chickpea varieties/hybrids under organic management at Bhopal

Treatment	Pods/plant	Seed/pod	Grain yield (Kg/ha)	Total Biomass (Kg/ha)	Harvest Index (%)
RVG-202	97.3	1.9	1840	4933	37.3
JG-16	94.0	1.7	1660	4457	37.2
JGK-3	82.0	1.8	1345	3623	37.1
RVG-203	95.2	1.9	1747	4560	38.3
JG-11	95.4	1.7	1540	4577	33.6
JG-6	90.9	1.8	1437	4407	32.6
JG-130	99.1	2.0	1962	5493	35.7
JG-315	91.3	1.8	1793	4863	36.9
JG-63	98.1	1.6	1880	4880	38.5
JG-74	95.3	1.7	1737	4860	35.7
VIRAT	90.3	1.7	1643	4413	37.2
UJJWALA	84.7	1.7	1600	4463	35.8
CD (P=0.05)	4.2	NS	122	519	

Calicut (Table 7.3.3.1)

Three varieties of ginger, twelve varieties of turmeric and two varieties of black pepper were evaluated under organic management. All three varieties of ginger outperformed better under organic condition whereas, Rajetha recorded maximum rhizome yield (26200 kg/ha) which only 200 kg higher to Mahima and 600 kg more to Varda. Varda recorded maximum oil and oleoresin content under both management practice. Among the 12 varieties of turmeric,

maximum yield was recorded by Pragati (48600 kg/ha) followed by Sudarshana (44000 kg/ha). Variation in other turmeric varieties was recorded in range from 16200 kg/ha (Prathibha) to 39000 kg/ha (Suvarna). In term of quality of turmeric, Kanthi recorded maximum oil content (6.0%) followed by Prabha (5.8%) and the least oil content was noticed in Sudarsana (4.8%). Prabha recorded maximum oleoresin and curcumin content of 17.1 and 6.46% among the turmeric varieties.

Table 7.3.3.1 Response of different production systems on yield and quality of ginger at Calicut

Varieties	Yield (kg/ha)		Oil content (%)		Oleoresin content (%)	
	Organic	Inorganic	Organic	Inorganic	Organic	Inorganic
Varada	25600	13800	1.8	1.9	4.8	5.2
Mahima	26000	14200	1.6	1.8	4.8	4.9
Rejatha	26200	14200	1.6	1.9	4.5	4.7
Mean	25933	14067	1.7	1.9	4.7	4.9



Table 7.3.3.2. Response of different management systems on yield and quality of turmeric under organic conditions at Calicut

Varieties	Yield (kg/ha)		Oil content (%)		Oleoresin content (%)		Curcumin (%)	
	Organic	Inorganic	Organic	Inorganic	Organic	Inorganic	Organic	Inorganic
Prathibha	16200	44800	5.8	6.4	16.3	16.7	5.67	6.49
Alleppey Supreme	17600	18800	5.6	6.0	16.6	15.8	6.29	6.24
Varna	35200	25200	5.2	6.0	13.2	12.7	3.26	3.11
Sobha	34200	28600	5.0	5.4	12.9	12.6	3.01	3.18
Sona	33600	31000	5.2	5.6	11.6	12.1	3.39	3.29
Kanthi	35200	31200	6.0	5.8	12.9	12.8	3.70	3.55
Suvarna	39000	30400	5.6	5.6	12.6	13.6	4.05	4.02
Suguna	24000	19000	5.6	5.2	16.4	16.6	6.28	6.05
Sudarsana	44000	40800	4.8	5.4	15.8	16.4	6.12	6.23
Kedaram	31200	22600	5.2	5.4	16.1	16.1	6.21	6.13
Prabha	28400	20400	5.2	5.4	17.1	16.4	6.46	6.13
Pragati	48600	39000	5.4	5.2	16.4	16.6	6.34	6.14
Mean	32267	29317	5.4	5.6	14.8	14.9	5.1	5.0

Coimbatore (Table 7.3.4.1 – 7.3.4.4)

Twelve rice varieties were evaluated for their performance of suitability under organic production system

Rice (Table 7.3.4.1)

All the traits showed significant difference in rice varieties studied under organic condition. Variation in productive tillers (numbers/hill) recorded between 11 to 22.4. Kitchili Samba had the maximum productive tillers (22.4 numbers/hill) while Mappillai

samba and Mappillai samba had least numbers of productive tillers / hill (11). Thousand grains weight among the varieties varied from 12.4 to 24.3 g. Least thousand grains weight (12.4 g) was observed in Jeeraga Samba while heaviest grains (21.1 g) was produced by Mapillai Samba. Significant grain yield difference was observed among the rice varieties. Difference in grain yield among the varieties ranged from 2660 to 5770 kg/ha. Mappillai samba showed lowest grain yield (2660 kg/ha) while CO (R) 48 had highest grain yield (5770 kg/ha).

Table 7.3.4.1: Performance of rice varieties under organic condition at Coimbatore

Varieties	Productive tillers hill ⁻¹	No. of filled grains panicle ⁻¹	1000 grains weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index
Bhavani	13.6	148.6	22.8	4280	6540	0.40
IW Ponni	15.8	204.3	16.1	4400	8280	0.35
Mappillai Samba	11.0	162.9	24.3	4960	12720	0.28
Kitchili Samba	22.4	148.5	18.5	4640	9950	0.32
IR 20	15.5	174.3	18.3	4090	7680	0.35
CO 43	13.2	181.6	20.1	3520	6100	0.37
CO(R) 48	12.0	213.7	19.4	5770	10150	0.36
CO(R) 51	16.1	144.4	16.8	4370	6140	0.42

Varieties	Productive tillers hill ⁻¹	No. of filled grainspanicle ⁻¹	1000 grains weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index
CB-05022	14.6	202.2	18.9	5390	9730	0.36
KDML-105	11.0	80.6	23.8	2660	4620	0.37
Red Kavuni	11.3	190.5	23.6	3870	8590	0.31
Jeeraga Samba	14.5	251.1	12.4	3620	8740	0.29
CD (P=0.05)	4.56	16.22	0.65	560	1000	-

Quality parameters (Table 7.3.4.2): Physical quality parameter such as kernel length, kernel breadth, length breadth ratio, hulling percentage and milling percentage were estimated at post-harvest stage. Among the varieties, CO-51 obtained higher hulling percentage (81.5%) while KDML-105 registered lower hulling percentage (70.3%) however milling (86.2%) was higher in Jeeraga samba and least had Mappillai Samba. With regard to cooking characters, KDML-105 followed by Mapillai Samba obtained higher kernel length before and after cooking while, Jeeraga samba recorded least Kernel length

before and after cooking. Among the different rice varieties, the linear elongation ratio ranged (LER) from 1.45 to 1.93. The highest linear elongation ratio of 1.93 was recorded in Kitchidi samba followed by CO 51 and Mappillai samba (1.86). The lowest LER of 1.45 was recorded in organic culture CB05022. The highest volume expansion ratio of 4.7 was recorded in Bhavani followed by Improved white ponni (4.6) and IR 20 (4.5). The lowest VER of 3.4 was recorded in Red kavuni medicinal rice variety. The breadthwise expansion ratio was highest in CO 51 (1.73) while lowest (1.25) was in CO-43.

Table 7.3.4.2: Physical parameters of rice varieties under organic farming at Coimbatore

Treatments	Hulling (%)	Milling (%)	Kernel length (mm)		Kernel breadth (mm)		Linear Elongation ratio (LER)	Volume Expansion Ratio	Breadth wise expansion ratio
			Before cooking	After cooking	before cooking	After cooking			
Bhavani	79.2	84.2	5.1	9.1	1.8	2.1	1.71	4.7	1.34
I White Ponni	73.6	78.1	5.3	9.3	1.7	2.4	1.62	4.6	1.51
Mappillai Samba	80.1	73.5	5.4	10.0	2.6	2.5	1.86	3.9	1.45
Kitchili Samba	78.6	81.0	5.3	10.2	1.7	2.6	1.93	3.8	1.33
IR 20	78.5	78.5	5.0	8.3	1.8	1.6	1.62	4.5	1.34
CO 43	80.7	72.3	4.7	8.4	2.0	1.9	1.78	3.8	1.25
CO(R) 48	78.9	79.4	4.8	8.2	1.9	2.8	1.67	3.8	1.62
CO(R) 51	81.5	75.8	4.7	8.7	1.7	2.9	1.88	3.7	1.73
CB 05022	78.9	82.3	5.4	7.9	2.1	2.7	1.45	3.6	1.26
KDML 105	70.3	85.4	6.1	10.5	2.2	2.6	1.66	3.8	1.31
Red Kavuni	74.1	81.9	4.6	8.1	2.1	2.5	1.68	3.4	1.66
Jeeraga Samba	72.2	86.2	3.7	6.6	1.7	2.3	1.77	3.8	1.71

Dharwad (Table 7.3.5.1 – 7.3.5.3)

Evaluation of response of different varieties of chickpea and wheat for organic farming under rainfed farming situation during *rabi* season

Chickpea (Table 7.3.5.1): Significant differences of chickpea varieties for all the variables were observed. Among the chickpea varieties, A1 recorded maximum yield of 2857 kg/ha which on par with



JAKI 9218 (2843 kg/ha) than other, whereas BGD-103 produced lower yield of 2016 kg/ha under organic

condition. The difference from the lower and higher yielded variety found to be 41.7%.

Table 7.3.5.1: Yield attributes of chickpea cultivars under rainfed farming situation at Dharwad

Sorghum cultivars	Plant height (cm)	No. of pods/plant	Seed weight (g/plant)	1000-grains weight (g)	Grain yield (kg/ha)	Stover yield (kg/ha)	Harvest Index
A 1	43.4	54.2	17.6	251.8	2857	1318	0.684
MABC 27	47.2	60.7	20.7	378.6	2056	1052	0.664
MABC 37	45.1	60.9	17.9	386.2	2334	1388	0.628
BGD 103	42.1	69.2	23.7	333.0	2016	1287	0.611
JAKI 9218	45.2	59.6	18.1	260.1	2843	1109	0.721
Mean	44.6	60.9	19.6	321.9	2421	1231	0.662
CD (P=0.05)	3.2	5.8	1.5	12.8	297	246	0.05

Wheat (Table 7.3.5.2): Organic production practices involving the application of organic sources, Bijaga yellow recorded tallest variety (49.4 cm). 1000-grains weight (44.0g) was recorded in DWR 2006 (DW)

however, higher grain yield of wheat (1945 kg/ha) was recorded with UAS 347 (BW) produced 60.1% higher yield over least yielded cultivars JAKI 9218 (11215 kg/ha).

Table 7.3.5.2: Yield attributes and yields of wheat cultivars under rainfed farming situation at Dharwad

Sorghum cultivars	Plant height (cm) at harvest	1000-grains weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest Index
BIJAGA YELLOW (DW)	49.4	42.1	1271	1468	0.46
UAS 446 (DW)	46.5	36.1	1568	1546	0.49
DWR 2006 (DW)	48.6	44.0	1890	1597	0.64
UAS 347 (BW)	36.2	37.1	1945	1580	0.55
NIAW 1415 (BW)	34.5	31.3	1215	1471	0.45
Mean	43.0	38.1	1578	1532	0.52
CD (P=0.05)	2.7	1.8	407	485	0.036

Changes in soil chemical properties (Table 7.3.5.3)

The results showed in table that soil chemical properties did not differ significantly due to varieties. Variation in organic carbon recorded between 0.48 – 0.62 g/kg. JAKI 9218 had the maximum soil organic

carbon in the soil (0.62 g/kg) while BGD-103 had least organic carbon in the soil (0.48 g/kg). Available nitrogen and phosphorus among the varieties recorded higher in MABC-27, whereas available phosphorus in the soil was higher in JAKI 9218.

Table 7.3.5.3: Soil chemical properties after cropping cycle under rainfed farming situation at Dharwad

Sorghum cultivars	Soil pH	Electrical conductivity (d Sm ⁻¹)	Organic carbon (g kg ⁻¹)	Available nitrogen (kg ha ⁻¹)	Available phosphorus (kg ha ⁻¹)	Available Potassium (kg ha ⁻¹)
A 1	7.15	0.21	0.61	284	45.72	315
MABC 27	7.05	0.20	0.50	319	35.42	369
MABC 37	7.04	0.23	0.60	302	42.21	328



Sorghum cultivars	Soil pH	Electrical conductivity (d Sm ⁻¹)	Organic carbon (g kg ⁻¹)	Available nitrogen (kg ha ⁻¹)	Available phosphorus (kg ha ⁻¹)	Available Potassium (kg ha ⁻¹)
BGD 103	6.99	0.21	0.48	284	46.95	302
JAKI 9218	7.04	0.22	0.62	256	61.83	342
Mean	7.06	0.21	0.56	289	46.43	331
CD (P=0.05)	NS	NS	NS	NS	NS	NS

Jabalpur (Table 7.3.6.1-7.3.6.5)

Twelve varieties of rice and wheat in system mode were evaluated for their performance and suitability under organic nutrient management.

Rice (Table 7.3.6.1): Significant difference among the varieties for yield and yield attributing characters were observed. PS-3 and IR-36 was the leading varieties in all the traits but statistically on par with

each other however, significantly different from rest of varieties. Maximum Plant height (75.1 cm), effective tillers/hill (13.2 nos.), panicle length (26.1 cm), grains/panicle (68.7 nos.) resulted in highest grain yield 4277 kg/ha in PS-3 rice variety followed by IR-36 in term of yield (4040 kg/ha). Sterility percentage also found to be least 6.6% in PS-3. Lowest yield was recorded in BVD-109 (2083 kg/ha).

Table 7.3.6.1: Yield attributes and yield of rice varieties under organic farming at Jabalpur

Rice varieties	Plant height (cm)	Effective tillers / hill	Panicle length (cm)	Grains/panicle	1000-grains weight (g)	sterility (%)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index (%)
PS 5	73.9	13.0	24.8	67.1	22.07	8.3	3799	4269	33.7
Shehdri	63.1	11.9	21.1	54.0	24.97	20.7	2132	3462	32.6
PS 4	72.5	12.5	24.5	60.1	22.00	12.6	2868	4197	33.2
BVD 109	66.0	12.3	21.7	54.8	24.00	19.3	2083	3896	33.3
JR - 201	73.9	13.1	25.1	68.1	23.00	6.9	2096	4703	32.8
Danteshwari	67.6	12.3	21.7	57.3	23.27	18.4	2414	4412	33.0
Madhuri	63.0	11.5	20.9	53.3	24.00	23.5	3676	5219	33.7
IR 36	70.4	12.4	24.0	58.6	23.87	13.2	4040	4779	33.7
MTU 1010	61.3	11.4	19.7	53.1	24.67	26.6	2341	3968	32.9
IR 64	73.0	12.7	24.7	65.0	24.00	9.7	3775	4187	33.2
Pusa 1	64.5	11.9	21.3	54.2	22.13	20.5	2806	3748	33.2
PS 3	75.1	13.2	26.1	68.7	23.00	6.6	4277	4478	33.3
CD (P=0.5 %)	5.64	2.99	3.45	2.36	1.11	-	438	811	-

Wheat (Table 7.3.6.2): Among the wheat varieties, all the parameters showed significant differences. Plant height recorded in range from 80.0 cm to 83.1 cm whereas tallest plant was recorded for HI 1418 and smallest was for JW 17. Variation in effective tillers/m² (nos.) was 495 -527. 1000 grains-weight recorded superior in HW-2004 (50.6g) while minimum

being with HI-2967 among the wheat varieties. Significantly higher wheat yield was recorded with HI 1500 (3885 kg/ha) and found to be on par with HI 1418 (3689 kg/ha) and C 306 (3554 kg/ha). JW3020 recorded minimum grain and straw yield of wheat (2218 and 3462 kg/ha).


Table 7.3.6.2: Yield attributes and yield of wheat varieties under organic farming at Jabalpur

Wheat varieties	Plant height (cm)	Effective tillers /m ²	Spike length (cm)	Grains/spike	Test weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index
JW 17	80.0	520	11.1	44.9	49.6	3162	4269	42.6
JW 3020	82.4	508	9.6	43.3	49.5	2218	3462	39.1
JW 3173	81.6	506	11.0	38.7	46.6	3051	4197	42.1
JW 3269	81.3	499	9.3	38.4	48.1	3333	3896	46.1
JW 3288	80.8	502	10.7	40.7	49.3	3395	4703	41.9
HI 1531	81.5	527	12.0	41.4	46.7	3076	4412	41.1
HI 1500	82.1	509	10.6	47.6	49.2	3885	5219	42.7
C 306	80.6	509	12.2	44.8	47.4	3554	4779	42.7
HD 2004	82.0	518	11.6	48.9	50.6	2855	3968	41.9
HI 2987	81.5	502	9.8	41.4	46.5	3542	4187	45.8
HD 4672	80.7	495	10.0	42.2	49.3	2953	3748	44.1
HI 1418	83.1	500	11.0	41.3	48.4	3689	4478	45.2
CD (P=0.5)	1.09	7.34	0.81	3.67	0.54	287	241	-

Rice equivalent yield and economics of different varieties of rice and wheat varieties in rice-wheat system (Table 7.3.6.3): The system productivity in term of rice equivalent yield (REY), net return (Rs/ha/year) and B:C ratio of rice-wheat cropping systems under organic management recorded maximum with rice (PS-3) – wheat (HI-1418) system of 8404

kg/ha (REY), Rs. 1,04,083/ha (NR), and 1.98 (B:C ratio) followed by rice (IR-36) - wheat (C-306) system of 8060 kg/ha (REY), Rs. 95,479/ha/year (NR) and 1.90 (B:C ratio). Shehdri (rice)-JW-3020 (wheat) system recorded minimum rice equivalent yield of 4676 kg/ha with lowest net return of Rs. 10,882/ha/yr.

Table 7.3.6.3: Rice equivalent yield and economics of rice - wheat systems under organic farming at Jabalpur

Rice (Kharif)	Wheat (Rabi)	REY (Kg/ha/yr.)	Gross return (Rs/ha)	Cost of cultivation (Rs/ha)	Net Return (Rs/ha)	B:C Ratio
PS 5	JW 17	7393	184821	106012	78809	1.74
Shehdri	JW 3020	4676	116894	106012	10882	1.10
PS 4	JW-3173	6287	157173	106012	51161	1.48
BVD 109	JW 3269	5650	141256	106012	35244	1.33
JR - 201	JW 3288	5820	145488	106012	39476	1.37
Dhanteshwari	HI 1531	5846	146160	106012	40148	1.38
Madhuri	HI 1500	8010	200257	106012	94245	1.89
IR 36	C 306	8060	201491	106012	95479	1.90
MTU 1010	HW 2004	5521	138018	106012	32006	1.30
IR 64	HI 2987	7698	192458	106012	86446	1.82
Pusa 1	HD 4672	6080	151997	106012	45985	1.43
PS 3	HI 1418	8404	210095	106012	104083	1.98

Effect of different varieties of rice and wheat on soil chemical and microbial properties (Table 7.3.6.4 & 7.3.6.5): Response on soil properties was observed among the rice and wheat after completion of rice-wheat cropping cycle. The soil of the field was sandy clay loam in texture and neutral in reaction at 30 cm depth. At the end of cropping cycle, no remarkable changes the soil properties were observed under all the treatment in rice-wheat system. Maximum organic carbon content (7.74 g/kg) in the soil was found to be with rice (PS-4) - wheat (JW-3173) and PS 3 - HI 1418 in the system and lowest was with PS-5 - JW-17 of 7.32 g/kg in the system. Variation in pH was from 7.26 to 7.38 and neutral in reaction and for EC

it was in range from 0.35 to 0.37 (dm/m). Biological properties of soil viz. fungi, AZB and ACT were also not enhanced much among different varieties of rice and wheat. Among the varieties grown in *kharif* and *rabi* in rice-wheat system, higher fungi (43.22×10^4 /g cfu) and azotobacter (31.75×10^6 /g cfu) was recorded in rice (IR 64) - wheat (HI 2987). Bacteria and phosphate solubilizing bacteria was found to be higher in rice (PS-5) - wheat (JW 17) of 55.04 and 20.24×10^6 /g cfu. Cropping system rice (BVD-109) - wheat (JW-3269) retained higher actinomycetes (21.46×10^6 /g cfu) closely followed by rice (IR-64)-wheat (HD-2967) of 20.55×10^6 /g cfu.

Table 7.3.6.4: Effect of different varieties of rice and wheat on soil properties at the end of cropping cycle in Jabalpur

Rice (Kharif)	Wheat (Rabi)	pH	EC (dS/m)	OC (%)	Available nutrients (kg/ha)		
					N	P	K
PS 5	JW 17	7.26	0.35	7.32	281.6	12.98	326
Shehdri	JW 3020	7.26	0.35	7.44	279.5	13.48	318
PS 4	JW 3173	7.31	0.35	7.74	280.9	14.90	327
BVD 109	JW 3269	7.30	0.36	7.63	278.5	13.73	326
JR - 201	JW 3288	7.28	0.35	7.73	282.2	13.85	310
Dhanteshwari	HI 1531	7.32	0.35	7.63	279.6	13.41	331
Madhuri	HI 1500	7.26	0.37	7.44	269.7	12.92	319
IR 36	C 306	7.38	0.37	7.54	284.2	13.85	308
MTU 1010	HW 2004	7.29	0.36	7.53	285.6	13.82	330
IR 64	HI 2987	7.28	0.37	7.54	278.6	13.58	322
Pusa 1	HD 4672	7.29	0.36	7.63	276.6	13.74	319
PS 3	HI 1418	7.26	0.35	7.74	280.1	13.13	320

Table 7.3.6.6: Effect of microbial changes in soil under different varieties of rice and wheat at Jabalpur

Rice (Kharif)	Wheat (Rabi)	Fungi (10^4 /g)	Bacteria (10^6 /g)	AZB (10^6 /g)	PSB (10^6 /g)	ACT (10^6 /g)
PS 5	JW 17	42.4	55.0	28.7	20.2	20.5
Shehdri	JW 3020	40.0	51.9	30.3	19.4	19.3
PS 4	JW 3173	37.5	53.9	30.6	19.8	20.2
BVD 109	JW 3269	41.1	54.9	28.2	19.4	21.5
JR - 201	JW 3288	41.2	53.0	31.3	20.3	20.8
Dhanteshwari	HI 1531	40.2	52.0	29.3	19.9	20.5
Madhuri	HI 1500	38.7	53.6	30.2	19.0	19.5



Rice (Kharif)	Wheat (Rabi)	Fungi (10 ⁴ /g)	Bacteria (10 ⁶ /g)	AZB (10 ⁶ /g)	PSB (10 ⁶ /g)	ACT (10 ⁶ /g)
IR 36	C 306	41.0	53.1	30.0	19.7	20.4
MTU 1010	HW 2004	41.6	53.1	30.3	18.5	27.3
IR 64	HI 2987	43.2	53.8	31.8	19.7	20.6
Pusa 1	HD 4672	37.7	51.1	29.8	19.7	20.2
PS 3	HI 1418	39.2	53.3	29.5	19.0	19.9

Karjat (Table 7.3.7.1 – 7.3.7.4).

Fifteen varieties of rice including early, mid-late and late maturity category (4 varieties in each) and 3 popular varieties grown by the farmers in the region during *kharif* and 15 varieties of groundnut during *rabi* hot weather were evaluated in the system mode under organic management.

Rice (Table 3.7.7.1): Among the rice varieties

grouped in four categories, rice variety Sahyadri-4 (early maturing), Sahyadri-3 (mid-late maturing), Sahyadri-5 (late maturing) and Jaya which is popular among farmers recorded significantly higher grain yield (6522, 6711, 6766 and 6039 kg/ha respectively) over rest of varieties but these are statistically on par to each other. Karjat 4 recorded lowest yielded (3938 kg/ha) among the rice varieties.

Table 3.7.7.1: performance of different rice varieties under organic management at Karjat

Duration	Rice varieties / hybrids	Grain Yield (kg/ha)	Straw Yield (kg/ha)
Early	Karjat - 4	3938	4485
	Karjat-7	4964	5589
	Ratnagiri-1	4704	5152
	Sahyadri-4	6522	7205
Mid-late	Karjat-5	6073	6803
	Karjat-6	4527	5095
	Palghar-1	4692	5576
	Sahyadri-3	6711	7264
Late	Ratnagiri-2	5472	6323
	Ratnagiri-3	5632	6537
	Karjat-8	4895	5543
	Sahyadri-5	6766	7535
Grown by farmers	Karjat-3	5836	6473
	Jaya	6039	6814
	Karjat-2	5267	5952
	CD(P=0.05)	483	590

Ground nut (Table 7.3.7.2): Significantly higher pods yield (3247 kg/ha) of groundnut recorded in TG-26 followed by Konkan Gaurav, TAG 24, Phule-6021 but these are statistically on par to each other. The

variation in other varieties of groundnut from 2113 to 2801 kg/ha. Kopergaon-1 produced lower yield among the varieties. Haulm weight (4190 kg/ha) was also recorded higher in TG-6 over rest of the varieties.

Table 7.3.7.2. performance of different groundnut varieties under organic management at Karjat

Groundnut varieties/hybrids	Yield dry pods (kg/ ha)	Haulm weight (kg/ ha)
Phule-6021	2956	4117
SB XI	2159	3279
Western-44	2327	3411
Western-66	2653	3529
TAG-24	2979	3896
TKG-Bold	2384	3544
Kopergaon-1	2113	3191
Phule Pragati (JL-24)	2202	3455
JL-220	2175	3396
JL-776	2801	3793
JL-501	2625	3661
TG-37 A	2444	3749
TG-26	3247	4190
Konkan Gaurav	3095	4058
RHRG-6083	2537	3397
CD(P=0.05)	174	475

System equivalent yield and economics (Table 7.3.7.3): Significantly higher rice equivalent yield (REY 28666 kg/ha), net return (Rs. 3,01,655/ha) and benefit cost ratio (2.85) were recorded with variety Karjat-3 (rice) in *kharif* and TG-26 (groundnut) in *rabi* compared to other varieties evaluated in the

system and were statistically on par with Jaya (rice) - Konkan Gaurav (groundnut). Lowest system equivalent yield and net return was recorded in rice (palghar-1) - groundnut (kopergaon-1) of 20155 kg/ha and Rs. 1,63,773/ha respectively.

Table 7.3.7.3. System equivalent yield and economics of different rice and groundnut varieties under organic management at Karjat

Rice	Groundnut	System's equivalent yield (kg/ha)	Gross returns (Rs. /ha)	Net returns (Rs. /ha)	B:C ratio
Karjat - 4	Phule-6021	24404	395341	232606	2.43
Karjat-7	SB XI	20786	336728	173993	2.07
Ratnagiri-1	Western-44	21309	345209	182474	2.12
Sahyadri-4	Western-66	26034	421744	259009	2.59
Karjat-5	TAG-24	27305	442333	279598	2.72
Karjat-6	TKG-Bold	21602	349959	187224	2.15
Palghar-1	Kopergaon-1	20155	326508	163773	2.01
Sahyadri-3	Phule Pragati (JL-24)	23478	380348	217613	2.34
Ratnagiri-2	JL-220	21471	347838	185103	2.14
Ratnagiri-3	JL-776	25622	415073	252338	2.55
Karjat-8	JL-501	23630	382800	220065	2.35



Rice	Groundnut	System's equivalent yield (kg/ha)	Gross returns (Rs. /ha)	Net returns (Rs. /ha)	B:C ratio
Sahyadri-5	TG-37 A	25130	407107	244372	2.50
Karjat-3	TG-26	28666	464390	301655	2.85
Jaya	Konkan Gaurav	28007	453718	290983	2.79
Karjat-2	RHRG-6083	23563	381719	218984	2.35
CD (P=0.05)		13.89	22500	22500	0.14

Soil chemical properties: The soil chemical properties measured after completion of rice - groundnut system, soil pH and EC were not influenced significantly due to varietal sequences of rice and groundnut. Maximum organic carbon content (1.31 %), available N (287.58 Kg ha⁻¹), available P₂O₅ (22.97 Kg ha⁻¹) and available K₂O (418.88 Kg ha⁻¹)

¹) were observed with 'Jaya (rice)- Konkan Gaurav' (groundnut) varietal sequence as compared to other sequences followed by 'Karjat-3 -TG 26', both are statistically at par to each other. Cropping system 'Palghar-1- Kopergaon-1' was observed as lowest in organic carbon (%), available N, P and K.

Table 7.3.7.4. Response of rice-groundnut system on physical and chemical properties of soil after end of cropping cycle at Karjat

Rice	Groundnut	Soil pH	Soil EC (dSm ⁻¹)	Organic carbon (%)	Available Nitrogen (Kg ha ⁻¹)	Available P ₂ O ₅ (Kg ha ⁻¹)	Available K ₂ O (Kg ha ⁻¹)
Karjat - 4	Phule-6021	6.89	0.39	1.27	265.85	19.36	380.80
Karjat-7	SB XI	6.88	0.40	1.25	261.67	19.10	378.56
Ratnagiri-1	Western-44	6.84	0.40	1.22	253.31	18.58	373.18
Sahyadri-4	Western-66	6.79	0.40	1.24	257.49	18.84	374.98
Karjat-5	TAG-24	6.76	0.39	1.21	257.49	18.32	366.02
Karjat-6	TKG-Bold	6.79	0.40	1.18	253.31	17.81	361.09
Palghar-1	Kopergaon-1	6.63	0.41	1.16	244.95	18.07	354.82
Sahyadri-3	Phule Pragati (JL-24)	6.74	0.40	1.30	270.03	19.87	396.93
Ratnagiri-2	JL-220	6.74	0.40	1.29	265.85	19.62	391.55
Ratnagiri-3	JL-776	6.83	0.39	1.30	282.57	21.42	412.16
Karjat-8	JL-501	6.85	0.41	1.18	253.31	18.07	364.22
Sahyadri-5	TG-37 A	6.77	0.41	1.27	278.39	20.13	396.03
Karjat-3	TG-26	6.70	0.41	1.30	283.40	21.94	415.30
Jaya	Konkan Gaurav	6.76	0.41	1.31	287.58	22.97	418.88
Karjat-2	RHRG-6083	6.70	0.40	1.29	282.57	21.68	409.47
CD (P=0.05)		NS	NS	0.05	9.28	1.17	8.49

Ludhiana (Table 7.3.8.1-7.3.8.2).

Twelve varieties of rice and eight varieties of wheat were evaluated in rice-wheat system for their suitability under organic management. All the varieties of rice and wheat were grown under similar

nutrient source and doses.

Basmati rice (Table 7.3.8.1): Among the varieties, CSR 30 attained the highest plant height (147.0 cm) was significantly higher than the other varieties. The lowest plant length among all varieties was

achieved by Pusa basmati-1509 (102.cm). The highest number of effective tillers per m² (408) was observed in Pb basmati-4 which was higher than PB-5, PB-2 and CSR-30 but was at par with the other varieties. Thousand grains weight varied from 25.2 to 29.8 g. Thousand grains weight (29.8 g) was the highest in Pusa-basmati-1121, however the differences among all the varieties were non-significant. Basmati rice

grain yields varied from 2940 – 5130 kg/ha with a maximum percent variation of 74.5%. Basmati variety Pb basmati-4 gave the highest grain yield (5130 kg/ha) which was significantly higher than Pb-basmati 5, Pb-basmati 3, BR3 and Pb-basmati 2 but was at par with all the other varieties. The lowest grain yield (2940 kg/ha) was given by CSR-13. Though the straw yield was the highest.

Table 7.3.8.1: Performance of basmati rice varieties under organic management in rice-wheat system at Ludhiana

Rice varieties	Plant height (cm)	Effective tillers/m ²	Panicle length (cm)	Grains/panicle	1000 grain weight (g)	Yield (kg/ha)	Straw yield (kg/ha)
Punjab Basmati 5	114.6	324	25.1	59.5	26.1	3770	63.7
Punjab Basmati 3	109.0	372	23.9	64.4	25.3	4210	57.3
Punjab Basmati 2	135.5	300	25.3	67.8	25.6	3360	50.6
Punjab Basmati 4	102.5	408	21.2	59.5	27.3	5130	61.6
CSR 30	147.0	322	25.4	67.8	25.2	2940	71.8
Pusa Basmati 1121	124.8	366	25.0	68.4	29.8	4470	63.3
Pusa Basmati 1509	102.0	371	25.1	68.9	29.1	4520	62.1
RYT 3649	123.5	385	23.8	67.1	27.8	4720	53.3
RYT 3677	112.9	377	23.8	73.8	26.2	5090	58.3
RYT 3517	130.0	383	27.4	63.7	29.4	4810	64.2
CD (P=0.05)	6.6	63	2.5	NS	NS	8.7	NS

Wheat (Table 7.3.8.2): Significant differences were found among the varieties for all the parameters except ear length. The variation for plant height was observed from 88.4 to 152.8 cm, variety C306 attained tallest plant while Unnat PBW-550 been smallest. The variation for number of effective tillers meter⁻² was noted from 336 as lowest and 426 as highest and found to be significant among the varieties. The number of grains/panicle was highest (54.3) in PBW 1 Zn (bio-fortified variety) which was statistically at par with BWL 3498 and Unnat PBW 550 but was significantly higher than all the other varieties. The lowest number of grains / panicle (39.8) was observed

in BWL 3504. The highest thousand grains weight (57.5 g) was observed in PBW 175 and significantly higher to all the other wheat varieties. The lowest thousand-grain weight was observed in C-306 (43.2 g). Wheat grain yield varied from 3600 - 5920 kg/ha among different varieties and the maximum variation was of 64.4%. Significantly higher grain yield of wheat (5920 kg/ha) was observed in PBW 1 Zn than the other varieties which were statistically at par with Unnat PBW 550, BWL 3498 and PBW 175. The lowest grain yield was recorded with C-306 (3600 kg/ha) but produced maximum straw yield (11240 kg/ha).

Table 7.3.8.2: Performance of wheat varieties under organic management in rice-wheat system at Ludhiana

Wheat varieties	Plant height(cm)	Effective tillers/m ²	Ear length (cm)	Grains/ear	1000-grains weight (g)	Yield (kg/ha)	Straw yield (kg/ha)
PBW 660	110.3	339	10.0	44.2	51.8	4590	9640
BWL 3504	117.6	380	10.5	39.8	56.5	4830	9490



Wheat varieties	Plant height(cm)	Effective tillers/m ²	Ear length (cm)	Grains/ear	1000-grains weight (g)	Yield (kg/ha)	Straw yield (kg/ha)
PBW 175	103.4	375	9.9	41.7	57.5	5340	9640
BWL 3498	117.4	360	9.2	50.2	53.3	5530	10820
BWL 3500	104.9	339	9.7	47.4	51.4	4990	8590
C 306	152.8	426	10.0	46.2	43.2	3600	11240
PBW 1 Zn	111.3	356	9.8	54.3	52.4	5920	10060
Unnat PBW 550	88.4	336	9.8	51.2	51.7	5450	8030
CD (P=0.05)	5.5	49.0	NS	6.1	3.8	640	12.8

Modipuram (Table 7.3.9.1 and 7.3.9.2)

Twelve promising varieties of maize and mustard in maize-mustard system were evaluated with similar nutrient source and doses under organic condition.

Maize (Table 7.3.9.1): PMH-1 was the tallest variety with plant length (278.0 cm) followed by Vivek QPM-9 (247.0 cm). The lowest plant height among all varieties was achieved by Vivek hybrid-9 (177.0 cm). Cob length among the varieties ranged between 14.6 and 20 cm. Least cob length (14.6) was noted for PMH-4 while highest cob length (20 cm) was recorded for HQPM-1 followed by PMH-1 and VMH-39. Grains

row/cob and number of grains/row was observed in range from 11.5 -16.3 and 25.8 – 35.5 respectively. Grain yield of maize was significantly varied among the varieties of maize from 10000-15000 kg/ha and higher grain yield was found to be in Vivek QPM-9 (15000 kg/ha) followed by PMH-1 (14000 kg/ha) while lowest yield recorded in VMH 39 (10000 kg/ha). Cost of cultivation for all the varieties was same however, Vivek QPM -9 gave maximum gross return, net returns and benefit cost ratio of Rs. 1,50,000, Rs.1,08,575 ha⁻¹ and 2.62 respectively followed by PMH-1 and PMH 5.

Table 7.3.9.1: Yield attributes, yield and economics of maize in maize -mustard systems under organic farming at Modipuram

Maize varieties	Plant height (cm)	Dry matter/plant (g)	Cobs/plant	Cob length (cm)	Cob yield (kg/ha)	Gross return (Rs/ha/annum)	Cost of cultivation (Rs/ha/annum)	Net Returns (Rs/ha/annum)	B:C ratio
Prakash	234	18.9	12.9	33.2	13500	41425	135000	93575	2.26
VL Amber	202	18.6	11.5	31.1	12833	41425	128333	86908	2.10
PMH-1	278	19.8	13.6	28.8	14000	41425	140000	98575	2.38
PMH-3	232	16.7	12.4	25.8	11000	41425	110000	68575	1.66
PMH-4	219	14.6	12.6	32.0	12167	41425	121667	80242	1.94
PMH-5	228	16.2	15.2	28.2	13667	41425	136667	95242	2.30
HQPM-5	218	17.0	15.4	29.2	12000	41425	120000	78575	1.90
HQPM-1	213	20.0	15.3	28.5	10500	41425	105000	63575	1.53
PMH-2	221	18.5	16.3	30.5	12667	41425	126667	85242	2.06
VMH-39	204	19.4	15.3	35.5	10000	41425	100000	58575	1.41
Vivek hybrid-9	177	18.0	14.5	32.4	12333	41425	123333	81908	1.98
Vivek QPM-9	247	16.4	15.3	29.6	15000	41425	150000	108575	2.62
CD (P=0.05)	29.9	2.17	1.68	1.28	-	-	-	-	-



Overview of Maize and Mustard varietal trial

Mustard (Table 7.3.9.2): Among the varieties, maximum plant height was recorded with NRCDR-02 (180.0 cm) followed by Pusa mustard-26 and minimum was with Urvashi (145.0 cm). Number of branches per panicle among the varieties ranged between 3.7 to 4.8. Maximum nos. of branches (4.8) were recorded for Pusa mustard-26 while minimum (3.7) was recorded for RH-0406. Difference for nos. of siliqua among the varieties ranged from 90 in NRCHB-506 as least to 268 as highest in RGN-48 while, grains/siliqua was found in range from 10.5 in NRCHB-101 as minimum to 12.5 as highest in RGN

229. Among the mustard varieties, significantly higher seed yield was recorded with RGN-48 (1775 kg/ha) and it was statistically at par with Urvashi. Variety Pusa Mustard-25 gave minimum yield of 972 kg/ha. The yield difference from highest yielded variety was found to be 82.6% than lowest yielded variety. Cost of cultivation was found equal for all the varieties of mustard. Maximum gross return, net return and benefit cost ratio was recorded with RGN-48 (Rs. 71,000, 52,124/ha and 2.76 respectively) followed by Urvashi with Rs 52,057 as net return and 2.76 of BC ratio.

Table 7.3.9.2: Growth parameter, yield attributes, yield and economics of mustard in maize -mustard systems under organic farming at Modipuram

Mustard varieties	Plant height (cm)	Primary Branches/plant	No. of siliqua/plant	Grains/siliqua	Seed yield (kg/ha)	Bio-mass yield (kg/ha)	Cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net returned (Rs/ha)	Benefit cost ratio
DRMRIJ- 31	156	4.5	184	10.9	1298	6500	18876	51933	33057	1.75
NRCDR- 02	180	4.7	211	11.2	1408	7333	18876	56333	37457	1.98
NRCHB- 101	155	4.3	106	10.5	1290	7000	18876	51600	32724	1.73
NRCHB- 506	149	3.8	90	11.1	1220	5583	18876	48800	29924	1.59
Pusa Mustard-25 (NPJ-112)	156	3.7	129	11.9	972	5667	18876	38867	19991	1.06
Pusa Mustard-26 (NPJ-113)	162	4.8	139	11.3	1392	6500	18876	55667	36791	1.95
Pusa Tarak	154	4.5	131	11.8	1283	6333	18876	51333	32457	1.72
RH- 0406	150	3.7	113	11.4	1553	7167	18876	62133	43257	2.29

Mustard varieties	Plant height (cm)	Primary Branches/plant	No. of siliqua/plant	Grains/siliqua	Seed yield (kg/ha)	Bio-mass yield (kg/ha)	Cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net returned (Rs/ha)	Benefit cost ratio
RGN- 229	154	3.9	127	12.5	1475	7000	18876	59000	40124	2.13
RGN- 48	149	4.4	268	11.5	1775	7167	18876	71000	52124	2.76
Urvashi	145	3.9	168	12.3	1773	8333	18876	70933	52057	2.76
Pusa Bold	154	4.0	147	11.3	1352	7500	18876	54067	35191	1.86
CD (P=0.05)	7.55	0.44	40.35	N.S.	121.8	1220				

Pant Nagar (Tables 7.3.10.1 – 7.3.10.3)

Total fourteen varieties of rice including seven fine grain basmati rice and seven coarse grain varieties during *kharif* and fourteen varieties of wheat in *rabi* were evaluated under organic mode of cultivation.

Rice (Table 7.3.10.1): Significant variation was observed among the rice varieties for all the traits. Plant height of different rice varieties ranged from 118 to 168 cm. Taraori was recorded tallest varieties while Pusa-1509 been smallest. Highest number of effective tillers/m² was in Pusa Sugandha-5 (252) whereas, Taraori produced lowest effective tiller/m² (175). Among different varieties grain weight/panicle ranged from 1.29 to 1.84g. Significantly higher grain

weight/panicle was observed in Pant basmati-1 (1.84 g) being at par with Pant Sugandha-27, Pant basmati-2 and Pant Sugandha dhan-21. Though 1000-grains weight among rice varieties was found higher in Pant Sugandha Dhan-25 (25.3g) which being at par with Pant Sugandha dhan-15 & 21 (24.8 & 24.3 g respectively) but significantly higher grain yield of rice was observed in Pant Sugandha Dhan-17 (4141 kg/ha) which was at par with Pant basmati-1 (4136 kg/ha), Pant Sugandha-27 & 21 (4115 & 4108 kg/ha, respectively). Significantly higher straw yield recorded in Pant Basmati-1 (5318 kg/ha), followed by Pant Sugandha Dhan-17. Harvest index was significantly higher in Pant Sugandha Dhan-21 (0.467) as compared to others.

Table 7.3.10.1: Response for yield attributes and yield of rice varieties in rice-wheat system under organic management at Pantnagar

Rice varieties/hybrids	Plant height (cm)	Effective tillers/m ²	Grain weight/panicle(g)	1000-grains weight(g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest Index
Pant Basmati-2	152	242	1.82	21.1	3985	4671	0.460
Pusa Sugandha-4	136	234	1.77	23.7	3488	4762	0.423
Pant Sugandha Dhan-21	156	241	1.82	24.3	4108	4756	0.467
Pusa Basmati-1612	131	238	1.75	21.3	3881	4570	0.460
Pusa Basmati-1	121	227	1.65	20.4	3453	4057	0.460
Pusa Sugandha-5	127	252	1.72	23.4	3914	4915	0.443
Taraori	168	175	1.69	21.3	2687	5011	0.350
Pant Basmati-1	137	245	1.84	20.8	4136	5318	0.437
Type-3	163	230	1.29	21.5	2745	5075	0.353
Pusa-1509	118	238	1.53	21.7	3349	3974	0.457
Pant Sugandha Dhan-17	149	251	1.75	23.2	4141	5235	0.440
Pant Sugandha Dhan-15	150	240	1.55	24.8	3251	3860	0.457

Rice varieties/ hybrids	Plant height (cm)	Effective tillers/m ²	Grain weight/ panicle(g)	1000-grains weight(g)	Grain yield (kg/ ha)	Straw yield (kg/ha)	Harvest Index
Pant Sugandha Dhan-25	154	248	1.67	25.3	3444	4152	0.453
Pant Sugandha Dhan-27	126	248	1.83	24.0	4115	4742	0.466
CD (P=0.05)	6.44	20.4	0.24	0.89	473	485	0.03

Nutrient Uptake by Paddy (Table 7.3.10.2): Significant variation in N, P, K and S uptake were observed among different rice varieties under organic cultivation. The variation of nutrients uptake by the different varieties of rice found in range between 56.4 to 83.3 kg/ha for N, 17.9 – 25.8 kg/ha for P, 61.8 – 84.3 kg/ha for K and 12.0 – 17.9 kg/ha for S. Nitrogen uptake among rice varieties was found to be significantly higher in Pant Sugandha Dhan-27 (83.3 kg/ha) which was at par with Pant Basmati-2 (79.5 kg/ha), Pant Sugandha Dhan-21 (82.3 kg/ha) and Pant Sugandha Dhan-17 (81.2 kg/ha). P uptake was significantly higher in Pant Sugandha Dhan-17 (25.8 kg/ha) which was at par with Pant Basmati-2 (23.4 kg/ha), Pant

Sugandha Dhan-21 (25.0 kg/ha) and Pant Basmati-1 (23.4 kg/ha). K uptake was significantly higher in Pant Basmati-1 (84.3 kg/ha) which was found at par with Pant Sugandha Dhan-21 (76.8 kg/ha), Pusa Sugandha-5 (78.5 kg/ha), Pant Sugandha Dhan-17 (83.4 kg/ha) and Pant Sugandha Dhan-27 (78.0 kg/ha). Sulphur uptake among rice varieties was found to be significantly higher in Pusa Basmati-1612 (17.9 kg/ha) which was found at par with Pant Sugandha Dhan-21 (16.1 kg/ha), Pusa Sugandha-5 (16.6 kg/ha), Pant Basmati-1 (17.3 kg/ha), Pant Sugandha Dhan-17 (17.2 kg/ha), Pant Sugandha Dhan-25 (15.5 kg/ha) and Pant Sugandha Dhan-27 (15.8 kg/ha).

Table 7.3.10.2 : Total N, P, K and S uptake in different varieties of rice under organic mode of cultivation at Pant Nagar

Treatments	Nutrients Uptake (kg/ha)			
	N	P	K	S
Pant Basmati-2	79.5	23.4	75.2	14.8
Pusa Sugandha-4	73.6	22.1	74.6	14.0
Pant Sugandha Dhan-21	82.3	25.0	76.8	16.1
Pusa Basmati-1612	70.7	21.3	74.1	17.9
Pusa Basmati-1	60.1	20.3	64.1	14.0
Pusa Sugandha-5	71.0	20.8	78.5	16.6
Taraori	56.4	17.9	73.5	12.0
Pant Basmati-1	79.6	23.4	84.3	17.3
Type-3	69.9	20.1	74.5	13.6
Pusa-1509	66.6	19.1	65.8	14.3
Pant Sugandha Dhan-17	81.2	25.8	83.4	17.2
Pant Sugandha Dhan-15	67.5	19.1	61.8	14.2
Pant Sugandha Dhan-25	69.7	19.7	67.6	15.5
Pant Sugandha Dhan-27	83.3	22.9	78.0	15.8
CD (P=0.05)	7.41	3.48	8.27	2.89



Wheat (Table 7.3.10.3): Significant variation among the wheat varieties were observed for plant height, spike/m² and 1000-grains weight whereas grain yield, straw yield and harvest index found to be non-significant difference. Plant height at harvest of different wheat varieties ranged from 75 to 98 cm, tallest being in UP-1109, (98 cm) followed by UP- 2684 (96 cm) while smallest was recorded with DBW-17 (75 cm). Significant differences in spikes/m² of wheat varieties were in range from 237 to 316 and were found to be higher in HD-2967 (316 cm) which was at par with UP-2684 (309 cm), UP-2565

(307) and DPW-17 (305) while lower was in UP 2425 (237). Test weight (1000-grains weight) of different wheat varieties recorded in range from 38.9 to 52.0 g. Highest test weight of wheat variety was found in UP-2425 (52.0g) which was significantly higher than others however lower test weight been with DPW-62150 (38.9 g). Grain yield of different wheat varieties recorded in range from 3358 to 4040 kg/ha. Highest grain yield was noticed in HD-2967 (4040 kg/ha) which was closely followed by UP-2565 and UP- 2684 (4622 kg/ha). Least performing variety of wheat was UP-2425 under organic farming situation.

Table 7.3.10.3: Response for yield attributes and yields of wheat varieties in rice-wheat system under organic management at Pant Nagar

Wheat varieties/ hybrids	Plant height (cm)	spikes/m ²	1000-grains weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest Index
WH-1105	83	278	41.2	3586	3801	0.48
PBW-550	78	272	40.2	3358	3616	0.48
UP-2628	87	287	40.6	3560	3929	0.47
UP-1109	98	288	39.3	3737	3974	0.48
UP-2425	90	237	52.0	3358	3547	0.49
UP-2843	87	272	39.1	3485	3820	0.47
UP-2841	92	296	40.5	3838	4036	0.48
UP-2572	88	284	42.5	3674	3912	0.48
DPW-62150	86	272	38.9	3434	3642	0.48
UP-2565	90	307	43.2	3990	4398	0.47
HD-2967	90	316	40.0	4040	4674	0.46
UP-2684	96	309	39.6	3964	4215	0.48
DBW-17	75	305	39.5	3838	4035	0.48
UP-2784	91	301	43.8	3863	4065	0.48
CD (P=0.05)	7.33	40.18	3.13	NS	NS	NS

Nutrients uptake by wheat crop (Table 7.3.10.4): Among wheat varieties, higher uptake of nitrogen, phosphorus, potassium and sulphur was observed in HD-2967 (76.6, 18.8, 895.7 and 28.8 kg/ha,

respectively). N-uptake in HD-2967 variety was at par with UP-2565 (73.6 kg/ha) and UP 2684 (72.4 kg/ha). P uptake in UP-2572 was on par with HD-2684 (18.1 kg/ha) and UP-2841 (17.6 kg/ha).

Table 7.3.10.4: Total N, P, K and S uptake in different wheat varieties under organic mode of cultivation at Pant Nagar

Treatments	Nutrients Uptake (kg/ha)			
	N	P	K	S
V1-WH-1105	68.1	16.9	82.5	23.0
V2-PBW-550	62.1	15.2	77.3	20.2
V3-UP-2628	64.9	16.5	80.3	18.4
V4-UP-1109	67.6	15.9	82.0	21.8
V5-UP-2425	61.5	13.8	79.1	18.8
V6-UP-2843	63.6	15.9	77.6	22.0
V7-UP-2841	70.1	17.6	87.6	26.4
V8: UP-2572	67.7	17.5	79.0	24.4
V9: DPW-62150	62.1	14.4	77.8	23.9
V10: UP-2565	73.6	17.3	90.1	24.1
V11: HD-2967	76.6	18.8	95.7	28.8
V12: UP-2684	72.4	18.1	89.7	24.6
V13: DPW-17	69.0	17.2	85.8	26.4
V14: UP-2784	71.0	17.1	87.0	24.8
CD(p=0.05)	NS	2.67	NS	4.01



Best Performing varieties of rice and wheat under Organic farming at Pant Nagar

Raipur (Table 7.3.11.1 – 7.3.11.4)

Fifteen traditional /improved scented rice varieties and 15 popular chickpea varieties in the region were evaluated for their performance under organic management in rice-chickpea cropping system.

Rice (Table 7.3.11.1): Response of different traditional/improved scented rice varieties to organic farming indicate that the highest plant height was observed in traditional short grain scented rice variety

Gangabaru (169.0 cm) followed by Karigilas (168.0 cm) and Badshahbhog (166.0 cm). The number of tillers hill⁻¹ was significantly higher in Vishnubhog (10.0 hill⁻¹) over other varieties whereas the maximum no. of filled grains panicle⁻¹ was obtained in variety CR Sugandha Dhan-907 (261) which was significantly superior over rest of the rice varieties, however variety, C.G. Sugandhitbhog followed by Vishnubhog sel-01 were next in order and produced 231 and 216 filled grain panicle⁻¹ respectively. Other yield



attributing characters like panicle length (cm) was higher in C.G. Sugandhit Dhan (29.3cm) which was comparable with CR Sugandha Dhan-907 (29.1cm), Gopalbhog (28.4cm) and Badshahbhog (28.2cm) whereas the lowest length of panicle was recorded in Lalu 14 (23.3cm). As regards to test weight of the scented rice varieties, the highest test weight was achieved by Karigilas while the lowest test weight in Vishnubhog (16.59g). Grain yield of traditional/improved scented rice varieties was influenced significantly. The highest grain yield of scented rice

was recorded in CR Sugandha Dhan-907 (4603 kg/ha) followed by C.G. Sugandhitbhog (4389 kg/ha) which were significantly superior over rest of the varieties. These two varieties are short statured in nature. In case of tall traditional short grain aromatic rice varieties, Vishnubhog sel-01 gave the highest yield (4080 kg/ha) followed by Gopalbbhog (4023 kg/ha) and these varieties were statistically on par with Badsahbhog (3612 kg/ha), Dubraj sel-01 (3870 kg/ha) and Tarunbhog sel-01 (3983 kg/ha).

Table 7.3.11.1: Response of different traditional and improved scented varieties of rice under organic production system

Variety	Plant height at harvest (cm)	Tillers hill ⁻¹ at harvest	No. of filled grains/panicle	Panicle length (cm)	Test weight	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest Index
Badshah Bhog Sel.01	166	9.67	197	28.20	16.65	3612	10839	25.0
Gopapl Bhog	150	8.00	191	28.40	22.65	4023	10574	27.7
Vishanu Bhog Sel.01	163	10.00	216	27.67	16.59	4080	10909	27.3
C.G. Sugandhit Bhog	114	9.67	231	29.30	22.00	4389	9215	32.3
Shyamajeera	158	8.33	143	25.87	18.75	3169	9217	25.6
IndiraSugandhit dhan	117	8.67	181	26.83	23.19	3918	8475	31.6
Kubri mohar	153	9.33	164	25.27	19.89	3210	10190	24.0
Dubraj Sel.01	153	7.67	188	28.13	21.48	3870	10140	27.6
Lohandi	155	8.33	186	28.13	19.76	3653	9937	26.9
Gangabaru	169	8.20	153	24.93	16.67	3310	10632	23.7
Karigilas	168	8.33	169	26.37	40.20	3417	8791	28.0
Lalu 14	110	6.33	133	23.30	18.00	2213	7873	22.0
Tarun bhog Sel.01	155	9.00	178	23.80	18.23	3855	12806	23.1
Sugandhmati	127	8.67	193	27.97	23.36	3983	7740	34.1
CR Sugandha dhan 907	160	9.33	261	29.13	21.21	4603	11247	29.1
CD (P=0.05)	14.14	1.59	21.63	5.83		442	1475	1.7

Chickpea (Table 7.3.11.2): All the growth and yield parameters of different desi and kabuli chickpea varieties were influenced significantly. Variety Vaibhav (45.1cm) was tallest followed by RG-2003-38, RG-2009-01 and JG-130 which were statistically on par to each other while, smallest plant was recorded in Vijay (31.1 cm). Variation in number of branches plant⁻¹ at harvest were from 3.8 to 5.2 whereas Vaibhav had the maximum nos. of branches while Vijay had

minimum. Number of pods/plant was recorded in range from 27.5 (JG-16) as minimum to 44.5 (JG-130) as highest. As regards the 100-seeds weight it was higher in RG JG-226 (29.2 g) on par with PKV kabuli. Minimum test weight of chickpea was observed in Vishal (16 g). Seed yield of chickpea was also showed significant variation among varieties. Variation in seed yield in ranged from 1300 to 1711 kg/ha. Higher seed yield was obtained from JG-130 (1711 kg/ha)

which was statistically on par with all the chickpea varieties except Jaki, Vijay, PKV Kabuli, BGD-128 and JG-16 (1444, 1444, 1333, 1300 and 1300 kg/ha respectively). The harvest index was maximum in JG-14 (46.95) followed by Vaibhav (46.58). Net return

and B:C ratio was maximum in JG-130 (Rs 71111/ha & 2.83) followed by Vaibhav (Rs 69733/ha & 2.78) and RG 2009-16 (Rs 66222/ha & 2.64). variety JG-16 gave the minimum net return and B:C ratio

Table: 7.3.11.2 Response of different improved varieties of chickpea under organic production system at Raipur

Variety	Plant height at harvest (cm)	No. of branches at harvest	No. of pods/plant at harvest	No. of nodules/plant at 60DAS	100 seed weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest Index	Net return (Rs/ha)	B:C ratio
Vaibhav	45.1	5.2	42.5	56.3	27.2	1689	1944	46.6	69733	2.78
JG-226	38.8	4.5	39.0	50.3	29.2	1467	2000	42.3	57567	2.29
Jaki	38.8	4.8	35.2	60.7	25.6	1444	1833	44.2	56178	2.24
RG2009-01	41.8	5.0	35.3	53.0	22.1	1544	1989	44.6	61833	2.46
RG2009-16	34.0	4.8	40.3	57.2	21.8	1622	2100	43.6	66222	2.64
RG2003-28	42.9	4.7	39.8	51.3	23.7	1606	2106	43.2	65311	2.60
Vishal	37.6	4.5	35.2	62.3	16.0	1500	1789	45.7	59189	2.36
JG-16	39.8	4.2	27.5	44.8	18.4	1300	1578	45.2	47978	1.91
Vijay	31.1	3.8	36.0	39.0	20.0	1444	1922	42.9	56267	2.24
JG-11	37.8	4.7	42.3	48.0	22.1	1600	2147	42.7	65047	2.59
JG-14	34.2	4.5	39.3	54.5	22.8	1500	1689	46.9	59089	2.35
BGD-128	37.1	4.2	36.8	47.8	22.4	1300	1756	42.5	48156	1.92
Daftari-21	37.6	4.8	37.2	42.7	21.4	1589	2078	43.4	64367	2.56
PKV Kabuli	38.7	4.5	30.0	37.0	29.0	1333	1889	41.4	50122	2.00
JG-130	40.0	5.0	44.8	58.3	24.5	1711	2100	44.9	71111	2.83
CD (P=0.05)	3.31	0.76	8.49	9.31	1.65	248	427	4.3	13894	0.55

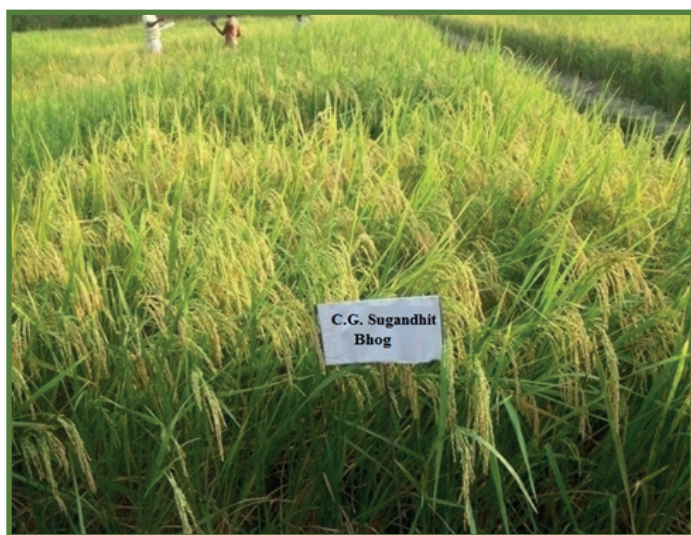
Soil Nutrient Status: Soil organic carbon, available nitrogen, phosphorus in soil after harvest of chick pea crop did not influence significantly on availability of these nutrients in soil except potassium. The ranged for organic carbon was found to be between 0.73

to 0.77%, whereas, the ranged for available N was from 264.2 – 270.7 kg/ha, whereas, available P and K were in range from 21.8-22.8 and 332.1 – 350.3 kg/ha respectively.

Table: 7.3.11.3: Available nutrients status after harvest of different improved varieties of chickpea under organic production system.

Variety	Organic Carbon (%)	Available N (Kg ha ⁻¹)	Available P (Kg ha ⁻¹)	Available K (Kg ha ⁻¹)
Vaibhav	0.75	268.7	22.7	340.7
JG-226	0.75	269.9	21.8	337.3
Jaki	0.73	269.4	22.6	344.3
RG2009-01	0.77	267.8	22.6	349.6

Variety	Organic Carbon (%)	Available N (Kg ha ⁻¹)	Available P (Kg ha ⁻¹)	Available K (Kg ha ⁻¹)
RG2009-16	0.76	268.0	22.6	350.3
RG2003-28	0.76	264.2	22.1	343.7
Vishal	0.76	265.8	22.2	340.1
JG-16	0.75	270.7	22.5	344.1
Vijay	0.76	269.1	22.0	345.8
JG-11	0.75	267.4	22.3	339.4
JG-14	0.75	268.2	22.6	345.1
BGD-128	0.75	266.5	22.2	335.6
Daftari-21	0.77	266.5	22.1	332.1
PKV Kabuli	0.77	269.03	22.7	342.4
JG-130	0.74	265.2	22.0	337.6
CD (P=0.05)	NS	NS	NS	11.3



Best Performance varieties of rice and chickpea under organic farming at Raipur

Ranchi (Table 7.3.12.1 – 7.3.12.4)

Twelve varieties of rice and wheat were evaluated for their suitability under organic farming in the system mode with same level and sources of nutrients

Rice (Table 7.3.12.1): Variation for plant height among the rice varieties ranged from 102.5 to 134.7 cm. Significantly tallest plant (135.7cm) was noted in B.V.D-110 than all other varieties except, Birsa Dhan-201 and Achchhai. M.T.U 1010 attains the smallest height (102.5cm). Though, panicle length (26.8cm) and grains/panicle (113 nos.) was significantly higher in Lalat followed by Birsamati, but 1000-grains weight,

grain and straw yield was maximum in M.T.U-1010 (24.1 g, 4022 and 6296 kg/ha respectively). Lalat and Birsamati was the successor of MTU-1010 in case of yield and found on par to each other. Birsa Vikas Dhan 110 produced lowest grain yield (2667kg/ha).

Wheat (Table 7.3.12.2): Variation for yield attributes and yield were found to be significant among the wheat varieties. The range of plant height was noted from 79.1 to 91.2 cm. DBW-39 recorded tallest plant while, HD-2733 been smallest in plant height. Number of tiller m⁻² was in ranged between 265-336.7, spike length been in range from 7.0 - 9.2 cm, number of grains/spike was in range between 28.3



to 34.6 and the variation in 1000-grains weight of the wheat ranged from 40.5g (K-0307) to 45.5g (WR-544). K-0307 recorded significantly higher number of tiller m⁻² (336.7), spike length (9.2 cm), number of

grains/spike (34.6) and grain yield of 3158 kg/ha which was statistically at par with Raj 4229 (3022 kg/ha), DBW 39 (2889 kg/ha), GW 366 (2878 kg/ha) and BG-3 (2700kg/ha).

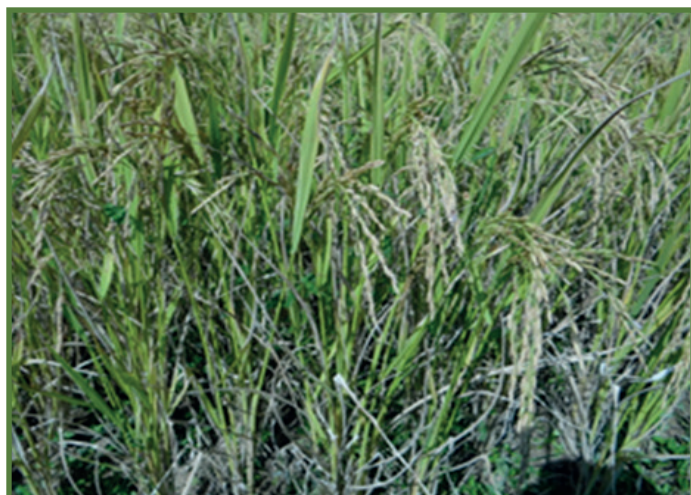
Table 7.3.12.1: Yield and yield attributing characters of rice varieties under organic management practices at Ranchi

Rice varieties	Plant height (cm)	Panicle length (cm)	Grain/panicle	1000 grain weight (g)	Effective tillers/m ²	Grain yield (kg/ha)	Straw yield (kg/ha)
Birsa Vikas Dhan 203	110.9	22.4	101.0	21.4	250	3433	5656
Birsa Dhan 201	130.2	23.1	97.7	22.9	238	3333	5200
Birsa Vikas sugandha 1	119.0	24.9	103.7	20.5	241	3244	5400
Birsa Vikas Dhan 110	134.7	22.2	91.0	21.9	212	2667	4778
Sahbhagi dhan	105.9	23.2	96.3	22.3	225	3022	4889
Birsamati	116.0	25.9	111.0	19.4	265	3644	5842
Anjli	112.2	22.6	93.3	21.2	221	2733	4644
Lalat	109.3	26.8	113.0	22.3	245	3844	6020
M.T.U 1010	102.5	24.6	102.3	24.1	257	4022	6296
Akhchhai	128.0	22.9	94.0	22.7	223	2956	5122
Pusa Sugandha	118.6	25.7	107.7	20.4	248	3489	5498
Naveen	114.7	25.5	105.3	21.1	252	3556	5711
CD (P=0.05)	11.4	1.6	10.9	1.9	29.4	463	785

Table 7.3.12.2: Yields and yield attributing characters of wheat varieties under organic management practices at Ranchi

Wheat varieties	Plant height (cm)	Spike length (cm)	No. of grains/spike	1000 grain weight (g)	Number of tillers/m ²	Grain yield (kg/ha)	Straw Yield (kg/ha)
Raj 4250	74.5	7.3	29.0	42.3	275.0	2244	3913
GW 366	85.6	8.7	33.9	40.9	313.3	2878	4516
NW 2036	83.7	7.9	30.0	43.8	300.0	2556	4156
K0307	80.1	9.2	34.6	40.5	336.7	3156	4222
K9107	77.9	8.0	32.0	41.4	301.7	2667	4324
HI 1563	77.1	7.4	29.3	45.0	278.3	2422	4000
Raj 4229	89.3	9.0	34.1	42.9	316.7	3022	4578
DBW 14	86.3	7.7	30.0	43.3	296.7	2533	4089
WR 544	80.3	7.6	29.7	45.5	283.3	2500	4000
BG 3	79.4	8.3	31.1	45.1	295.0	2700	4418
HD 2733	71.9	7.0	28.3	43.3	265.0	2156	3933
DBW 39)	91.2	8.5	32.6	44.3	305.0	2889	4422
CD (P=0.05)	11.2	1.2	4.4	3.7	41.8	368	583





Best Performance varieties (M.T.U.-10) rice and (K0307) wheat under organic farming

Soil nutrient status at the end of cropping cycle (Table 7.3.12.3): There was improvement in soil pH, organic carbon, available N, P and K among varieties under rice-wheat cropping system from their initial values. Soil pH was significantly improved (6.46) in rice (Anjali)-wheat (Raj 4229) system of their initial value of 5.5. After completion of cropping cycle, higher organic carbon (0.72%) was found in rice (Pusa Sugandha) - wheat (HD 2733) system and it was increased by 71% to their initial value of 0.42. Availability of N, P and K in the soil after completion of cropping cycle was also found in rice (Pusa sugandha) - wheat (HD 2733) of 19.7, 37.3 and 36.3%

higher to their initial value. Among rice varieties, MTU-10 recorded the highest N uptake (91.10 kg/ha) while in rabi, wheat variety Raj 4229 retain the maximum N (70.30 kg/ha), P (15.26 kg/ha) and K (48.28 kg/ha) uptake. Among cropping sequence, MTU-1010 - WR-544 registered the highest N (150.61 kg/ha) uptake as well total NPK uptake (304.09 kg/ha) of the system. Available N status in soil showed (+ve) balance in all the rice -wheat cropping sequence, however maximum N balance after removal by the crop recorded in rice (B.V.D110) - wheat (K-0307) system.

Table 7.3.12.3: Soil nutrient status of different varieties of rice and wheat under organic management practices at Ranchi

Cropping system	pH	OC%	Available nutrient (kg/ha)			Uptake (kg/ha)			N balance after harvest of wheat	
			N	P	K	N	P	K	added	Balance
Rice (Birsa Vikas Dhan 203)-Wheat (Raj 4250)	6.34	7.10	273.8	44.3	216.5	135.1	28.1	111.2	180	44.9
Rice (Birsa Dhan 201)-Wheat (GW 366)	6.33	6.67	256.5	39.4	198.9	141.4	29.8	112.7	180	38.6
Rice (Birsa Vikas Sugandha 1)-Wheat (NW 2036)	6.14	6.95	264.1	42.8	210.0	136.7	28.7	112.1	180	43.3
Rice (B.V.D110)-Wheat (K0307)	6.33	6.52	261.7	39.8	200.0	127.2	26.6	100.0	180	52.8
Rice (Sahbhagi)-Wheat (K9107)	6.28	7.02	266.9	42.6	205.7	130.6	27.2	104.5	180	49.4
Rice (Birsamati)-Wheat (HI 1563)	6.23	7.08	268.9	43.4	213.9	142.8	29.4	115.6	180	37.2
Rice (Anjali) - Wheat (Raj 4229)	6.46	6.71	261.2	40.4	203.2	128.5	27.2	102.3	180	51.5

Cropping system	pH	OC%	Available nutrient (kg/ha)			Uptake (kg/ha)			N balance after harvest of wheat	
			N	P	K	N	P	K	added	Balance
Rice (Lalat) – Wheat (DBW 14)	6.10	6.85	260.3	41.9	210.1	146.8	30.7	119.4	180	33.2
Rice (M.T.U10)-Wheat(WR 544)	6.24	7.01	262.5	41.7	209.5	150.6	31.2	122.2	180	29.4
Rice (Akhchhai) –Wheat (BG 3)	6.22	6.96	264.4	42.2	202.5	132.7	27.9	109.9	180	47.3
Rice (Pusa Sugandha)-Wheat (HD 2733)	6.00	7.19	275.3	44.3	220.8	136.3	28.2	111.3	180	43.7
Rice (Naveen)-Wheat (DBW 39)	6.17	6.68	253.9	40.5	196.6	148.3	30.9	118.9	180	31.7
CD (P=0.05)	0.19	0.50	22.6	3.2	17.8	14.5	3.6	12.1		
Initial	5.5	0.42	230	32.25	162					

Dry matter accumulation (Table 7.3.12.4): Dry matter accumulation of weed per unit area was minimum in rice (Lalat) – wheat (DBW 14) cropping sequence during *kharif* at 25 & 40 DAT/ DAS, while in *rabi*, minimum dry matter accumulation of weeds was recorded with the cropping sequence rice (Shahbhagi) – wheat (K-9107) at 25 & 40 DAT/ DAS. The highest dry matter accumulation was recorded with Birsa Vikas sugandha -1 and NW- 2036 system during *kharif* season at 25 & 40 DAT/ DAS (Table 7.3.12.5).

Systems productivity and economics of system (Table 7.3.12.5): In terms of rice equivalent yield (system productivity) of rice-wheat system, rice (M.T.U 1010)-wheat (WR 544) sequence gave significantly higher system productivity (6652 kg/ha) than rice (Naveen)-wheat (DBW 39) of 6594kg/ha and rice (Lalat)-wheat (DBW 14) of 6509 kg/ha but not varied to each other. Rice (Pusa Sugandha)-wheat (HD 2733) gave minimum system equivalent yield of

5756 kg/ha. In term of economics, rice variety MTU-1010 resulted in significantly higher net return (Rs. 56057/ha) and B:C ratio (1.49) over other varieties but it remains at par with Lalat (Rs.51925/ha), Birsamati (49427/ha), Naveen (Rs. 45555/ha), Pusa Sugandha (Rs. 45475/ha), Birsa Vikash sugandha-1 (Rs. 443048/ha), Birsa Vikash Sugandha-1 (Rs. 40371/ha), and Birsa Dhan-201 (Rs. 39971/ha).

Among wheat variety, K-0307 registered significantly higher net returns (Rs.23035/ha) and benefit: cost ratio (0.58) than rest of the varieties, but remains statistically at par with Raj-4229 (Rs.22246/ha), GW-366 (Rs.19826/ha), DBW-39 (Rs. 19668/ha) and BG-3 (Rs. 16772/ha). In terms of system economics of rice-wheat cropping sequence, rice (MTU1010) and wheat (WR-544) gave highest system net returns (Rs.68317/ha) and system B:C ratio (0.88) while, the lowest system net return (Rs. 49034/ha) and B:C ratio (0.63) was obtained from BVD (rice) -K-0307 (wheat) cropping sequence.

Table 7.3.12.4: Dry matter accumulation of weeds (g/m²) in rice – wheat cropping sequence organic management (2016-17)

Cropping system	Rice (Kharif)		Wheat (Rabi)	
	Weed dry Wt. (g/m ²) 25 DAT	Weed dry Wt. (g/m ²) 40 DAT	Weed dry Wt. (g/m ²) 25 DAS	Weed dry Wt. (g/m ²) 40 DAS
Rice (Birsa Vikas Dhan 203) - Wheat (Raj 4250)	21.64	31.18	12.94	23.45
Rice (Birsa Dhan 201) – Wheat (GW 366)	22.50	31.98	8.05	17.38
Rice (Birsa Vikas Sugandha 1) -Wheat (NW 2036)	24.23	33.84	9.75	19.50
Rice (B.V.D110) – Wheat (K0307)	28.06	36.51	6.72	14.67



Cropping system	Rice (Kharif)		Wheat (Rabi)	
	Weed dry Wt. (g/m ²) 25 DAT	Weed dry Wt. (g/m ²) 40 DAT	Weed dry Wt. (g/m ²) 25 DAS	Weed dry Wt. (g/m ²) 40 DAS
Rice (Sahbhagi) – Wheat (K9107)	24.38	34.28	9.05	19.07
Rice (Birsamati) – Wheat (HI 1563)	20.38	28.32	12.11	22.12
Rice (Anjli) – Wheat (Raj 4229)	27.28	35.09	7.13	16.63
Rice (Lalat) – Wheat (DBW 14)	19.40	27.22	10.29	19.70
Rice (M.T.U 10) – Wheat (WR 544)	18.63	25.15	11.81	20.69
Rice (Akhchhai) – Wheat (BG 3)	26.80	35.15	8.91	18.23
Rice (Pusa Sugandha) –Wheat (HD 2733)	21.11	30.79	13.75	24.72
Rice (Naveen) – Wheat (DBW 39)	20.60	29.95	8.51	17.86
CD (P=0.05)	1.84	2.61	1.57	1.68

Table 7.3.12.5: Systems productivity and economics of different varieties of rice and wheat crop under organic management practices at Ranchi

Cropping system	System productivity (Kg/ha)	Kharif		Rabi		System	
		Net Returns (Rs/ha)	B : C ratio	Net Returns (Rs./ha)	B:C ratio	Net Returns (Rs./ha)	B:C ratio
Rice (Birsa Vikas Dhan 203)–Wheat (Raj 4250)	5794	43048	1.14	8059	0.20	51107	0.66
Rice (Birsa Dhan 201)–Wheat (GW 366)	6360	39971	1.06	19826	0.50	59797	0.77
Rice (Birsa Vikas Sugandha 1)–Wheat (NW 2036)	5932	40371	1.07	13652	0.34	54023	0.70
Rice (B.V.D110)–Wheat (K0307)	5985	25999	0.69	23035	0.58	49034	0.63
Rice (Sahbhagi)– Wheat (K9107)	5827	33166	0.88	15937	0.40	49103	0.63
Rice (Birsamati)–Wheat(HI 1563)	6192	49427	1.31	11074	0.28	60501	0.78
Rice (Anjli) – Wheat (Raj 4229)	5912	26957	0.72	22246	0.56	49204	0.64
Rice (Lalat) – Wheat (DBW 14)	6509	51925	1.38	13079	0.33	65004	0.84
Rice (M.T.U10)–Wheat(WR 544)	6652	56057	1.49	12260	0.31	68317	0.88
Rice (Akhchhai) –Wheat (BG 3)	5795	32457	0.86	16772	0.42	49230	0.64
Rice (Pusa Sugandha)–Wheat (HD 2733)	5756	45475	1.21	6774	0.17	52249	0.67
Rice (Naveen)–Wheat (DBW 39)	6594	45555	1.21	19668	0.49	65223	0.84
CD (P=0.05)	709	10958	0.29	7303	0.18	15195	0.20

Umiam (Table 7.3.13.1-7.3.13.5)**Performance of different varieties of maize, french bean and tomato**

The experiment consisted of three major crops viz., maize, frenchbean and tomato. In Maize, 11 varieties were screened among which eight were composites, one hybrid and two local varieties. French bean consisted of 10 varieties where 8 were improved and 2 local varieties and for tomato crop, 20 varieties/lines were screened in the experiment

Maize (Table 7.3.13.1): Significant variation was observed among the maize varieties for all the traits. Among the varieties, plant height was highest in RCM 75 (254.8 cm) followed by RCM 1-3 (251.3 cm) and RCM-1-1 (246.8 cm) whereas Hybrid (JKMH) recorded the shortest plant (222.6 cm). Variation in chlorophyll content across the growth stages were

also noticed among the maize varieties. Significantly higher chlorophyll index (CI) at 30 and 60 DAS was recorded in DA-61-A (42.7 and 49.1%) followed by RCM-1-3 (41.5 and 47.6%) while, minimum chlorophyll index was recorded in variety RCM-1-1 (43.5%) at 60 DAS. Yield attributes and yields of different varieties of maize were significantly varied. Difference among the varieties for cob length ranged from (11.5-14.7 cm), cob weight (179.4-231.5 g), green cob yield (4100-6200 kg/ha), kernel yield (2500-3700 kg/ha) and Stover yield (6100-8700 kg/ha). Maximum cob length, cob weight, green cob yield and kernel yield were recorded with variety DA 61-A (14.7 cm 231.5 g, 6200 kg/ha and 3700 kg/ha respectively) and found to be on par with RCM-75 and RCM-1-3 whereas lower green cob yield and kernel yield was recorded in the Vijay composite (4100 and 2500 kg/ha respectively).

Table 7.3.13.1: Plant height and chlorophyll index of different varieties of maize under organic production system

Varieties	Plant height (cm)	Chlorophyll index (CI)		Cob Length (cm)	Cob weight (g)	Green cob yield (kg/ha)	Kernel yield (kg/ha)	Stover yield (kg/ha)
		30 DAS	60 DAS					
RCM-1-1	246.8	37.0	43.5	12.5	212.9	5500	3500	7700
RCM-1-2	235.3	37.9	45.7	12.8	206.7	5300	3400	7000
RCM-1-3	251.3	41.5	47.6	13.1	216.6	5800	3600	8400
RCM-75	254.4	40.7	46.4	14.4	226.9	5900	3700	8400
RCM-76	242.2	39.5	45.9	14.3	214.8	5600	3600	8600
Vijay composite	241.2	36.9	45.9	13.3	196.8	4100	2500	6100
Hemant	245.8	35.5	44.2	12.7	195.6	5100	3600	6900
DA 61 A	236.8	42.7	49.1	14.7	231.5	6200	3700	8700
Hybrid (JKMH)	222.6	35.3	46.2	13.2	204.3	4900	3500	7600
Local Yellow	226.7	37.7	44.6	12.8	185.2	4700	3000	7100
Local White	233.3	39.4	45.1	11.5	179.4	4300	3200	7300
CD(P=0.05)	6.44	3.88	NS	1.34	10.8	1280	530	1080



Land preparation for maize sowing



Maize under varietal trail for organic production

Fodder quality (Table 7.3.13.2): RCM-1-3 were recorded the higher crude protein and content among the maize varieties while lower was recorded with Vijay composite and RCM1-1. The reverse was found in respect to ether extract wherein Vijay composite were recorded higher of 1.73%. In case of ash, RCM-75 noted highest (14.1%). Local white recorded maximum nitrogen free extract of 53.3%.

Stem borer infestation (Table 7.3.13.3): Among the 11 maize varieties, RCM-1-1 and Local yellow exhibited highest stem borer infestation and leaf injury and found to be high susceptible to the resistance reaction. RCM-1-2 found to be resistant to insect-pest due to lower infestation%, leaf injury and resistance reaction.

Table 7.3.13.2: Fodder quality of different varieties of maize under organic production systems at 90 DAS

Varieties	Crude protein (%)	Crude fiber (%)	Ether extract (%)	Ash (%)	NFE (%)
RCM-1-1	10.8	23.9	1.32	12.4	50.24
RCM-1-2	12.3	24.3	1.46	11.6	50.37
RCM-1-3	12.7	28.2	1.63	11.3	46.38
RCM-75	11.1	26.5	1.26	14.1	47.77
RCM-76	10.2	26.2	1.29	10.3	50.78
Vijay composite	10.2	25.4	1.73	11.5	50.97
Hemant	11.9	25.3	1.54	10.9	50.27
DA 61 A	10.8	26.5	1.52	11.4	51.27
Hybrid (JKMH-501)	11.2	24.2	1.58	10.3	51.63
Local Yellow	10.7	28.1	1.35	9.6	50.52
Local White	11.5	24.4	1.43	10.5	53.30
CD (=0.05)	0.95	0.89	0.06	0.39	1.36

E.E- Extract ether, NFE-Nitrogen free extract

Table 7.3.13.3: Screening of maize varieties against stem borer, (*Chilopartellus* Swinhoe)

Varieties	Stem borer infestation (%)		Leaf Injury Rating (LIR)	Resistance reaction
	Plant Infestation (%)	Dead Heart (%)		
RCM-1-1	73.0	7.1	8.0	HS
RCM-1-2	19.4	3.2	2.8	R
RCM-1-3	40.7	7.4	6.0	MS
RCM-76	53.9	6.9	6.8	HS
DA-61-A	41.5	6.1	6.3	HS
RCM-75	52.9	7.2	6.4	HS
Hybrid	40.4	5.5	6.3	HS
Local White	35.7	5.5	6.7	HS
Hemant	54.8	6.1	6.3	HS
Vijay Composite	40.8	6.0	7.3	HS
Local Yellow	71.0	12.0	7.8	HS
CD (P=0.05)	9.47	0.88		

LIR>3 or <6 = moderately susceptible (MS); LIR > 6 = Highly susceptible (HS); LIR ≤ 3 Resistance (R)

Soil chemical and physical properties (Table 7.3.13.4): Soil pH, bulk density and available K did not differ significantly whereas RCM-76 recorded maximum pH and bulk density. Among the varieties of maize, significantly higher soil organic carbon was recorded

with variety DA 61A (2.36%) followed by RCM-75 and RCM 1-3. The available N and P status in soil varied significantly and recorded maximum under Local Yellow (216.1 and 24.4 kg/ha respectively) whereas, maximum K was recorded under RCM 1-3 (206.7 kg/ha).

Table 7.3.13.4: Soil physical and chemical properties after different varieties of maize under organic production system at 0-15 cm soil depth

Varieties	Soil pH	SOC (%)	Bulk density (Mg/cm ³)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
RCM-1-1	5.06	2.16	1.17	211.8	18.3	206.2
RCM-1-2	5.13	2.08	1.15	213.1	16.5	197.0
RCM-1-3	4.94	2.25	1.13	215.3	16.4	206.7
RCM-75	5.07	2.26	1.16	195.2	15.5	205.7
RCM-76	5.16	2.09	1.20	204.3	14.4	196.7
Vijay composite	5.12	2.19	1.16	207.7	17.0	195.8
Hemant	4.84	1.78	1.15	202.1	14.1	189.7
DA 61 A	4.83	2.36	1.17	200.4	14.2	202.8
Hybrid (JKMH-501)	5.10	1.84	1.16	161.3	13.1	193.3
Local Yellow	5.15	2.17	1.15	216.1	24.4	205.1
Local White	5.12	2.13	1.15	212.6	23.1	199.2
CD(p=0.05)	NS	0.21	NS	15.1	3.95	NS

Tomato (Table 7.3.13.5): Significant variation among the varieties for yield attributes and yield were observed. Plant height at 60 DAS for different tomato varieties ranged from 36.1 to 104.1 cm. O-17 was the tallest variety while vikash was the smallest. In case of chlorophyll index, highest chlorophyll was found in MT-2 (47.5% at 30 DAS) followed by Rocky (at 60 DAS). Primary branches, secondary branches and fruit yield also showed significant variation. Primary branches and secondary branches of different tomato varieties ranged from 5.7 – 7.1 and 4.7 – 6.9 at 60 DAS. O-17 and MT-2 recorded maximum primary branches at 60 DAS whereas NS-812 and MT-2 recorded higher number of secondary branches

as compared to other cultivars. The range of fruit yield of tomato were from 17880 to 20500 kg/ha among the different varieties. Tomato cultivars MT-2 produce higher fruit yield (20500 kg/ha) compared to other cultivars due to the less pod borer incidence and being at par with O-17, MT11XMT2 and Pant T10. The lowest yield of tomato was recorded in the cultivar Rocky (7600 kg/ha) due to the less secondary branches and heavy pod borer incidence. Less fruit borer infection (7.1%) was observed in MT-2 compared to the other cultivars. Other less infested cultivars were O-17 (7.2%) and MT 1 X MT 2 (10.2%). Among the cultivars, highly infested cultivar was Sel 9A (18.0%).

Table 7.3.13.5: Growth, yield and their insect pests (pod borer) of different tomato varieties under organic production system at Umiam

Cultivars	Plant height (cm)		Chlorophyll Index		Primary branches		Secondary branches		Pod borer incidence (%)	Yield (Kg/ha)
	30 DAT	60 DAT	30 DAT	60 DAT	30 DAT	60 DAT	30 DAT	60 DAT		
O-17	44.2	104.4	42.2	42.0	7.0	7.1	1.5	6.0	7.2	20330
Sel-1	31.9	49.4	42.4	38.9	6.7	7.0	1.4	5.0	14.4	13590
Sel-9A	31.4	39.5	44.2	36.0	5.7	6.9	0.5	4.7	18.0	14040
Vikash	22.9	38.5	40.2	43.1	5.1	6.2	0.6	5.5	14.4	11610
TMC-5	24.2	36.1	41.3	42.3	5.0	6.0	0.5	6.4	16.4	12040
Pant-T 10	30.9	49.3	42.9	37.5	5.2	6.1	0.5	5.3	13.6	18690
DMT-5	30.3	44.9	45.2	42.9	5.5	6.3	1.1	5.8	15.0	15270
Rocky	30.5	60.0	45.0	47.0	4.1	5.7	1.1	4.7	17.5	7600
MCTR-4	32.2	50.5	43.1	40.9	6.3	7.0	0.8	5.9	15.0	15590
MT 11 X MT 2	35.0	66.3	46.9	41.1	6.6	7.0	1.6	6.8	13.1	18770
MT 1 X MT 2	36.6	50.2	44.5	41.7	6.8	7.1	1.6	6.5	10.2	17880
INDET-IET	34.5	50.9	41.0	42.0	6.0	6.2	1.3	6.6	10.9	17000
MT 2	38.1	68.8	47.5	43.1	6.9	7.1	1.7	6.6	7.1	20500
NS-812	36.3	52.7	45.7	42.7	6.5	6.9	1.3	6.9	12.0	17120
CD (P=0.05)	2.92	3.70	2.53	3.66	0.54	0.18	0.31	0.61	1.48	2290



French bean under varietal trail for organic production



Tomato under varietal trail for organic production



French bean (Table 7.3.13.6): Among the French bean varieties, yield attribute and yield showed significant variation. Naga Local performed best among 10 varieties evaluated for their suitability. Plant height (248.8 cm), pod length (16.2), average pod weight (11.1 g), green pod yield (9000 kg/ha), seed yield (440 kg/

ha) and stover yield (7700 kg/ha) was higher in Naga Local followed by RCM-FB-18 (238.1cm, 16cm, 10.5g, 8300, 3900 and 6300 kg/ha respectively). The lowest green pod and seed yield was recorded in Maram (1400 and 1300kg/ha).

Table 7.3.13.6: Evaluation of different varieties of french bean under organic farming

Variety	Plant height (cm)	Pod length (cm)	Average pod weight (g/pod)	Green pod yield (Kg/ha)	Seed yield (Kg/ha)	Stover yield (Kg/ha)
RCM FB 18	238.1	16.0	10.5	8300	3900	6300
RCM FB-19	211.3	15.3	7.8	5900	3500	5800
RCM FB-37	225.4	15.0	7.3	5600	2600	5200
RCM FB 61	171.7	14.3	6.6	3500	2500	5100
RCM FB-62	227.2	13.3	6.4	5600	2800	5500
RCM FB-80	228.4	15.0	7.5	6000	3200	5.000
Nagaland local 1	224.4	13.7	4.8	2500	2000	3400
Nagaland local 3	158.1	14.4	6.0	5400	3100	6100
Maram	113.8	13.1	4.3	1400	1300	1700
Naga local	243.8	16.2	11.1	9000	4400	7700
CD (P=0.05)	13.84	1.22	0.71	580	1030	1040

Ajmer (Table 7.3.14.1-7.3.14.6)

Seed spice crops coriander and fennel including different varieties in *rabi* and green gram and cluster bean in *kharif* were evaluated/screened for organic farming. The total eight varieties each crop i.e. coriander, fennel, green gram and cluster was evaluated of their suitability for organic farming.

Green gram (Table 7.3.14.1): There were significant difference in its performance in terms of growth and seed yield of green gram. Green gram variety Mum-2 performed significantly better in term of plant height (60.3cm), number of primary branches (4.53), number of nods/plant (28.7), number of seeds/pod (11.2), also for seed yield and biomass yield. It recorded 943.2 kg/

ha seed yield closely followed by RMG-975 whereas SML 668 and Ganga-1 which produced lower yield of 757.7 and 750.2 kg/ha respectively.

Cluster bean (Table 7.3.14.2): Among the cluster bean varieties' significant variation for all the traits was recorded. Though tallest variety was RGC-986 (144.1 cm) followed by RGC-1038 (118.3 cm), RGC-1055(115.9 cm) and RGC-1038 but, variety RGC-1038 performed better among the different cluster bean varieties with highest nos. of primary branch/plant (7.07), pods/plant (64), seeds/pod (8.67) and seed yield (1250 kg/ha) and it was found at par with RGC-1055. Lowest performance in terms of number of pods/plant (27.3), numbers of seeds/pod (7.5), seed yield per hectare (766 kg) was observed in variety RGC-986.

Table 7.3.14.1: Performance of green gram varieties under organic management practices during Kharif at Ajmer

Green gram varieties	Plant height at harvest (cm)	No. of primary branches Plant ¹	No. of pods/plant	No. of seeds pod ¹	Seed yield (kg/ha)	Biomass yield (kg/ha)
RMG-975	59.3	4.5	28.4	11.1	937	3782
RMG-62	58.1	4.4	22.6	11.1	832	3042

Green gram varieties	Plant height at harvest (cm)	No. of primary branches Plant ⁻¹	No. of pods/plant	No. of seeds pod ⁻¹	Seed yield (kg/ha)	Biomass yield (kg/ha)
MSG-118	51.9	3.7	27.6	8.6	777	2755
RMG-492	58.8	4.3	24.9	10.1	782	3292
SML-668	46.1	3.9	20.0	10.1	758	2479
GANGA-1	58.3	4.4	26.6	10.0	750	2525
IPM-02-3	53.9	4.3	24.9	10.9	784	2583
MUM-2	60.3	4.5	28.7	11.2	943	3670
CD(P=0.05)	7.9	0.5	3.6	1.4	131	511

Table 7.3.14.2: Performance of cluster bean varieties under organic management practices during Kharif at Ajmer

Treatment	Plant height at harvest (cm)	No. of primary branches Plant ⁻¹	No. of pods/plant	No. of seeds pod ⁻¹	Seed yield (kg/ha)	Biomass yield (kg/ha)
RGC-936	104.2	4.6	42.6	8.4	833	3553
RGC-1001	103.6	3.7	34.9	8.3	883	3855
RGC-1003	102.1	4.1	42.7	8.1	1016	3978
RGC-1038	118.3	7.1	64.0	8.7	1250	4922
RGC-986	144.1	2.7	27.3	7.5	766	3230
RGC-1055	115.9	5.2	61.0	8.6	1063	4717
RGC-1066	105.1	1.1	36.4	8.2	933	3262
RGC-12-1	113.3	4.1	44.5	8.1	966	3410
CD(P=0.05)	9.6	0.6	7.5	0.6	169.71	697.85



Best Performance varieties green gram (MUM-2) and cluster bean (RGC-1038) under organic farming

Coriander (Table 7.3.14.3): Growth and yield parameter of coriander showed significant variation. Maximum plant height of 102.3 cm was recorded with ACr-1 followed by Azad Dhan-1 (96.6 cm) however, Azad Dhan-1 was found superior in case of primary and secondary branches/plant (7.3 & 25.3),

days to 50% flowering (77.7 days) number of umbels/plant (43.2), number of umbellets/umbel (6.1) and seed yield (1653 kg/ha) followed by ACr-1 and Hissar Anand while RCr- 446 been lowest performing variety recorded secondary branches/plant (21) and seed yield (1263 kg/ha).

Fennel (Table 7.3.14.4): Among fennel varieties, GF-12 performed superior with all yield attributes and yield. It recorded highest plant height (161.1 cm), number of primary and secondary branches (12.7 & 22.5), umbels

per plant (42.1), umbelletes per umbel (26.8) and seed yield per hectare (6500 kg) which was at par with AF-1, RF-125. RF-101 was the least performing variety in terms of seed yield (5970 kg/ha).

Table 7.3.14.3: Performance of coriander varieties under organic management practices during rabi at Ajmer

Treatment	Plant height (Cm) At harvest	No. of primary branches /plant	No. of secondary branches / plant	Days to 50% flowering	No. of Umbel /plant	No. of umbellate / umbel	Seed yield (kg/ha)
ACr-1	102.3	7.1	24.3	78.0	40.0	6.0	1619
Azad Dhania-1	96.6	7.3	25.5	77.7	43.2	6.1	1653
RCr- 435	83.1	6.4	23.9	73.3	38.1	5.2	1303
RCr- 436	77.0	6.6	21.3	68.7	37.9	5.1	1267
RCr- 446	84.6	6.3	21.0	70.3	34.5	4.6	1263
RCr- 684	83.2	7.1	23.1	75.7	33.8	5.1	1328
Hissar Sugandha	88.3	6.3	22.4	75.3	34.1	5.4	1342
Hissar Anand	88.3	6.7	24.0	74.7	39.7	5.7	1410
CD(P=0.05)	13.3	0.7	2.7	2.3	5.0	0.7	252

Table 7.3.14.4: Performance of fennel varieties under organic management practices during rabi at Ajmer

Treatment	Plant height (Cm) At harvest	No. of primary branches /plant	No. of secondary branches / plant	Days to 50% flowering	No. of Umbel / plant	No. of umbellate / umbel	Seed yield (kg/ha)
AF-1	158.0	12.1	22.1	87.3	96.7	39.3	3218
RF-101	148.5	8.1	16.7	85.0	92.3	30.1	2985
Co-1	156.0	7.7	17.7	85.0	92.3	30.9	3108
Rajendra Saurabha	150.6	8.7	18.0	85.7	93.0	32.1	3125
GF-12	161.1	12.7	22.5	82.3	89.0	42.1	3250
RF-281	135.8	9.1	20.1	85.7	94.0	33.5	3177
RF-125	148.5	10.7	20.2	86.3	94.3	35.1	3190
GF-2	154.4	10.6	17.2	83.0	89.7	30.9	3017
CD(P=0.05)	13.6	1.3	2.4	4.0	5.7	2.9	693



Best performing variety of (Azad Dhania-1) coriander and fennel (GF-12) under organic farming



Nutrient Uptake by coriander and fennel (Table 7.3.14.5): Significant difference in N, P and K uptake were observed after harvesting of coriander and fennel varieties under organic system. Among coriander varieties, N was found to be significantly higher in ACr-1 (50.14 kg/ha) followed by Azad dhania-1 (47.54 kg/ha) while lowest was in RCr-684 (33.85 kg/ha). P and K uptake was significantly higher in Azad dhania-1 (10.18 & 72.67 kg/ha) followed by

ACr-1 (9.14 & 71.50 kg/ha) while lowest uptake was in RCr-646 (7.73 & 52.81 kg/ha). Among different fennel varieties, N, P and K uptake was found to be significantly higher in AF-1 (98.6, 20.8 and 141.3 kg/ha respectively) which was statistically on par with GF-12 (93.9, 20.6 and 140.9), RF-281 (92.9, 20.25 and 145.4 kg/ha respectively). Minimum uptake of nutrients was recorded in GF-2 among the fennel varieties.

Table 7.3.14.5: Total N, P, K uptake in different varieties of coriander and fennel under organic production system

Treatment	N-uptake (kg/ha)	P - uptake (kg/ha)	K - uptake (kg/ha)
Coriander			
ACr-1	50.14	9.94	71.50
Azad Dhania-1	47.54	10.18	72.67
RCr- 435	35.79	8.21	56.37
RCr- 436	36.69	7.43	54.88
RCr- 446	37.42	7.58	52.81
RCr- 684	33.85	7.73	56.79
Hissar Sugandha	37.07	8.05	57.78
Hissar Anand	38.06	7.78	60.72
CD(P=0.05)	6.71	1.55	10.77
Fennel			
AF-1	98.62	20.80	141.30
RF-101	85.88	18.60	131.06
Co-1	87.58	18.55	130.60
Rajendra Saurabha	84.25	19.91	136.55
GF-12	93.91	20.62	140.87
RF-281	92.92	20.25	145.38
RF-125	87.52	19.64	140.81
GF-02	83.40	18.34	130.36
CD(P=0.05)	19.63	4.78	30.23



Best performing variety of coriander and fennel at Ajmer

Gangtok (Table 7.3.15.1-7.3.15.3)**Varietal evaluation of maize and buckwheat under organic management in maize-buckwheat cropping system**

Maize (Table 7.3.15.1 & 7.3.15.2): 12 varieties of maize composite were evaluated under organic management: Variation for cob length found in range between 11.1 -16.4 cm, and for yield, ranged was 1420 - 2890kg/ha. RatoMakkai and RCm1-1 recorded maximum cob length (16.4 cm) while, Vivek sankul-37 recorded shortest cob length (11.1 cm). Vivek sankul -35 performed better in term of grain yield (2890 kg/ha), net return (Rs.72900/ha) and return per rupee invested (2.71) which were on par with RCM -75 and Vivek sankul -31 while lowest yield was recorded in KaloMakkai (1420 kg/ha). Among the insect pest incidence, lowest percent leaf feeding of army worm was observed in Pahlenlo Makkai (10.0%) followed

by RCM 1-3 (12.2%) and RCM 1-1 (14.0%). The leaf feeding rating for Pahlenlo Makkai, RCM 1-3 and RCM 1-1 was 1, 1.2 and 1.2, respectively. Also the lowest percent plant infestation by stem borer was observed in Pahlenlo Makkai (8.53%) followed by RCM 1-3 (26.07 %) and RCM 1-1 (32.2%). The lowest percent dead hearts due to stem borer infestation for Pahlenlo Makkai, RCM 1-3 and RCM 1-1 was 0.70, 3.0 and 3.07, respectively. Whereas the screened against the natural infection of *turicum* leaf blight disease of 12 entries, the local germplasm of Sikkim outperformed the lines introduced from outside. The lowest disease incidence was observed in the Kalo Makkai, Baiguni Makkai, Rato Makkai, Pahlenlo Makkai and Sethi Makkai with TLB score 1.60, 1.51, 1.40, 1.97 and 1.84 respectively. Vivek Sankul-35 and RCM 75 lines recorded severe incidence of disease with TLB scoring of 4.02 and 3.52, respectively.

Table 7.3.15.1. Evaluation of maize composite under organic management condition

ENTRIES	Cob length (cm)	Grain yield (t/ha)	Gross Return ($\times 10^3$ /ha)	Net Return ($\times 10^3$ ₹/ha)	Return rupee ⁻¹ invested	PE (Kg/ha/365)	Profitability ₹/ha/day	LUE %
SetiMakkai	16.2	2.22	8.89	4.62	2.08	6.09	126.71	28.86
PahlenloMakkai	14.8	2.11	8.44	4.18	1.98	5.78	114.53	33.97
RatoMakkai	16.4	1.72	6.89	2.62	1.62	4.72	71.91	32.88
BaiguniMakkai	15.1	2.22	8.89	4.62	2.08	6.09	126.71	32.60
KaloMakkai	14.3	1.42	5.67	1.40	1.33	3.88	38.43	32.88
Satheya	13.5	1.47	5.89	1.62	1.38	4.03	44.52	29.95
RCM 1-1	16.4	2.33	9.33	5.07	2.19	6.39	138.89	30.96
RCM 1-3	15.5	1.69	6.78	2.51	1.59	4.64	68.87	31.51
RCM 75	15.0	2.56	10.22	5.96	2.40	7.00	163.24	30.32
Vivek Sankul-31	13.2	2.56	10.22	5.96	2.40	7.00	163.24	28.86
Vivek Sankul-37	11.1	2.17	8.67	4.40	2.03	5.94	120.62	28.31
Vivek Sankul-35	12.5	2.89	11.56	7.29	2.71	7.91	199.77	36.89

Table 7.3.15.2: Evaluation of insect, pest and disease on different maize composite at Gangtok

Entries	Army worm		Stem borer infestation		Leaf Injury Rating (LIR)	Resistance reaction to insect pest	TLB Score	Level of resistance to TLB
	% leaf feeding	Leaf feeding rating	Plant infestation (%)	Dead heart (%)				
SetiMakkai	72.60	2.3	63.83	8.15	8.4	HS	1.97	R
PahlenloMakkai	10.00	1.0	8.53	0.70	2.8	R	1.84	R



Entries	Army worm		Stem borer infestation		Leaf Injury Rating (LIR)	Resistance reaction to insect pest	TLB Score	Level of resistance to TLB
	% leaf feeding	Leaf feeding rating	Plant infestation (%)	Dead heart (%)				
RatoMakkai	20.87	1.4	38.07	6.40	6.1	HS	1.60	R
BaiguniMakkai	50.00	2.0	52.47	5.00	6.0	MS	1.51	R
KaloMakkai	19.43	1.6	37.07	4.20	5.7	MS	1.40	R
Satheya	65.97	2.2	56.47	7.57	6.8	HS	2.15	MS
RCM 1-1	14.00	1.2	32.20	3.07	7.4	HS	2.63	MS
RCM 1-3	12.20	1.2	26.07	3.00	3.4	MS	2.64	MS
RCM 75	44.00	1.8	52.23	4.17	6.0	MS	3.52	S
Vivek Sankul-31	35.87	1.8	43.70	6.40	7.2	HS	2.81	MS
Vivek Sankul-37	37.40	2.0	63.47	6.03	6.0	MS	2.72	MS
Vivek Sankul-35	40.77	2.0	62.20	7.90	7.9	HS	4.02	S

Buckwheat (Table 7.3.15.3): Among the buckwheat varieties, Local Meethay recorded as longest spike (1.41 cm) whereas, IC 15393 recorded as shortest spike (1.14 cm). Differences among the buckwheat varieties for yield ranged from 1440 to 2610 kg/ha. IC 109433 was the highest yielded variety and VL-

ugal was the lowest yielded variety. In terms of economics, gross return, net return and return per rupees invested, production efficiency, profitability and land use efficiency was also higher in IC 109433 followed by Local teethay. IC 107929 was next higher variety in term of yield and economic return.

Table 7.3.15.3: Evaluation of buckwheat varieties under organic management at Gangtok

ENTRIES	Spike length (cm)	Grain yield (t/ha)	Gross return ($\times 10^3$ ₹/ha)	Net Return ($\times 10^3$ ₹/ha)	Return rupee ⁻¹ invested	PE (kg/ha/365)	Profitability ₹/ha/day	LUE %
Local Meethay	1.41	2.50	10.00	7.21	2.58	6.85	197	30.41
Local Teethay	1.20	1.72	6.89	4.10	1.47	4.72	112	29.86
IC 104727	1.22	1.67	6.67	3.87	1.39	4.57	106	30.96
IC 36805	1.30	1.78	7.11	4.32	1.55	4.87	118	30.68
IC 109729	1.20	2.39	9.56	6.76	2.42	6.54	185	30.96
IC 15393	1.14	1.78	7.11	4.32	1.55	4.87	118	30.96
IC 109433	1.23	2.61	10.44	7.65	2.74	7.15	210	30.68
IC 49671	1.22	2.33	9.33	6.54	2.34	6.39	179	30.96
IC 2018742	1.19	1.56	6.22	3.43	1.23	4.26	94	29.86
PRB-1	1.16	1.44	5.78	2.99	1.07	3.96	82	30.96
VL-Ugal	1.18	1.48	5.88	2.99	1.07	3.96	82	30.68
Sangla B-1	1.15	1.50	6.00	3.21	1.15	4.11	88	30.96



Varietal evaluation of maize and buckwheat under organic condition at Gangtok

Sardarkrushinagar (Table 7.3.16.1 – 7.3.16.2)

Eight varieties of each crop in groundnut-wheat-green gram system were grown for their performance under organic farming

Groundnut (Table 7.3.16.1): Yield attributes characters, yield and economics showed significant variations among groundnut varieties. Significant higher number of nodules /plants was observed in GJG 17 (103.6) whereas lower nos. of nodule was in GJG HPS-1 (73.1). Plant height was noted highest in GJ-7(B) however, GJG-17 recorded smallest plant. Though number of pods and pod weight/plant was highest in GJG-17 and TG-37 but number of branches /plants, pod yield (2052 kg/ha), net return (Rs 75,048/ha) and BC ratio (2.02) was maximum with GG-20(SS) followed by GIJ-17(s), both were found on par to each other statistically.

Wheat (Table 7.3.16.2): Plant height, grain yield, spike length, test weight showed significant variation among the wheat varieties. Difference for the plant height ranged in 71.2 – 89.3 cm. GW 451 recorded smallest whereas, GW 273 attain highest height. Ear length was also recorded higher in GW 273 of 11.8

cm. Number of grains/ear was not differ significantly and was in range 27.7 – 31.7. Grain and straw yield showed significant variations among different wheat varieties. Grain yield of different varieties varies from 3328 to 4015 kg/ha. Maximum yield was found in variety GW-451 (4015 kg/ha) which is significantly higher than other varieties but was on par with GW 496, GW-273 and GDW-1255. Highest net return and B:C ratio was also obtained in GW 451 (Rs 30744/ha and 0.47).

Green gram (Table 7.3.16.3): Yield attributes characters did not differ among the green gram varieties whereas yield showed significant variations. Differences in plant population (nos.), plant height (cm), number of branches and pods /plant (nos.) and 100-seeds weight were found in range from 8.7-10, 37.9-41.6, 5.0-6.5, 25.8 – 28.7 and 33.0-36.3 respectively. Seed yield varied from 504 to 687 kg/ha. Variety GM 4 recorded significantly higher seed yield (687 kg/ha), net return (Rs 25158/ha) and B:C ratio (0.87) but been at par to GM-5 and Meha. IPM-410-3 resulted in lower yield (504 kg/ha), net return (Rs 25158/ha) and B:C ratio (0.38).



Table 7.3.16.1: Yields attributes and yield of different groundnut varieties under organic farming at SK Nagar

	Num- ber of nodules plant at 50 DAS	Plant height (cm) at harvest	Num- ber of branch- es/plant	Num- ber of pods/ plant	Pod weight / plant (g)	Pod yield kg/ha	Haulm yield kg/ha	Gross return	Net return	B:C Ratio
GJG-HPS-1(S)	73.1	54.9	3.04	21.1	10.2	1738	2824	95360	582689	1.57
GG- 20 (SS)	80.6	56.8	4.06	24.6	10.5	2052	3182	112140	75048	2.02
GG-7 (B)	79.9	70.3	3.36	19.6	8.5	1616	2632	88709	51618	1.39
TG-37 (A) (B)	92.5	61.6	3.88	24.3	7.5	1870	2840	102037	64945	1.75
GJG-9 (B)	81.9	69.4	3.53	19.0	8.1	1659	2759	91241	54149	1.46
GG-5 (B1)	97.3	65.4	3.60	17.8	9.8	1446	2376	79410	42319	1.14
GJG-17 (S)	103.6	52.1	3.76	19.4	1.0	2034	3103	111013	73921	1.99
KDG-123 (B)	75.0	59.4	3.34	18.3	7.9	1713	2715	93775	56683	1.53
CD (P=0.05)	5.3	9.6	0.57	4.8	1.2	363	493			

Table 7.3.16.2: Yield attributes and yield of different wheat varieties during rabi at SK Nagar

	Plant height at harvest	Ear length (cm)	No. of grain / ear head	test weight (g)	Grain yield (kg/ha)	Straw yield kg/ ha	Gross re- turn (Rs/ha)	Net return (Rs/ha)	B:C ratio
GW 451	71.2	7.3	27.7	34.1	4015	5412	96534	30744	0.47
GW 366	79.3	8.2	29.0	32.2	3496	4571	83639	17849	0.27
GW 322	76.6	10.4	28.7	37.9	3328	4548	80213	14423	0.22
GW 273	89.3	11.8	29.0	34.1	3720	4803	88800	23010	0.35
GW496	82.0	10.5	30.7	34.7	3926	5185	94072	28282	0.43
GDW 1255	72.4	7.5	29.3	36.0	3701	4670	88034	22244	0.34
GW1139	72.5	8.1	30.0	33.5	3671	5048	88568	22778	0.35
HI 8498	74.4	8.1	31.7	34.1	3393	4526	81429	15639	0.24
CD (P=0.05)	4.22	1.30	NS	3.15	437	605			

Table 7.3.16.3: Yield attributes and yield of different green gram varieties during summer at SK Nagar

	Plant height at harvest (cm)	Number of branch- es/plant	Number of pods/ plant	Number of seeds/ pod	1000 seed weight (g)	Seed yield kg/ha	Stover yield kg/ha	Gross return (Rs/ha)	Net return (Rs/ha)	B:C Ratio
GM 4	40.6	6.5	28.7	10.7	35.7	687	1245	54045	25158	0.87
Meha	38.9	6.1	28.1	10.3	36.3	673	1207	52859	23972	0.83
K 851	38.3	6.2	28.1	8.5	34.7	572	1114	45117	16230	0.56
PDM 139	41.6	6.4	27.0	8.9	34.0	524	1080	41493	12606	0.44
IPM 410-3	40.9	6.1	26.8	8.1	33.0	504	1096	39971	11084	0.38
GM 5	40.7	6.3	28.1	10.5	33.3	684	1228	53790	24903	0.86

	Plant height at harvest (cm)	Number of branches/plant	Number of pods/plant	Number of seeds/pod	1000 seed weight (g)	Seed yield kg/ha	Stover yield kg/ha	Gross return (Rs/ha)	Net return (Rs/ha)	B:C Ratio
PKVAKM 4	38.8	5.0	26.0	9.1	33.7	564	1109	44551	15664	0.54
BGS 9	37.9	5.2	25.8	8.9	32.7	561	1083	44277	15390	0.53
CD (.05)	NS	NS	NS	1.03	NS	94	126			



Best performing variety of (GG-20 SS) groundnut and green gram (GM-4) under organic farming

Energy indices: (Table 7.3.16.5): Maximum output energy (331666 MJ/ha), and net energy return (288086 MJ/ha) were observed under T1 (GJG-HPS-1-GW-451-GG- 20) closely followed by treatment T7 (GJG-17-GW1139). Energy use efficiency (25.97) was found in T2 (GG-20-GW 366-GJG-17) closely followed by T7 (GJG-17-GW1139). Energy productivity (0.48

kg/MJ) was recorded here in treatment T7 (GJG-17-GW1139) which was at par with T1 (GJG-HPS-1-GW-451-GG- 20) and T2 GG-20-GW 366-GJG-17. Lower specific energy (21.27 MJ/kg) was found in T1 (GJG-HPS-1-GW-451-GG- 20) and T2 (GG-20-GW 366-GJG-17).

Table 7.3.16.5: Energy of groundnut- wheat- green gram cropping system at SK Nagar

Kharif: Groundnut	Rabi: Wheat	Summer: Green gram	Input energy (MJ/ha)	Output energy (MJ/ha)	Net energy returns (MJ/ha)	Energy use efficiency	Energy productivity (MJ/kg)	Specific energy (MJ/kg)
GJG-HPS-1(S)	GW 451	GG- 20 (SS)	43580	331666	288086	25.19	0.47	21.27
GG- 20 (SS)	GW 366	GJG-17 (S)	43580	316802	273222	25.97	0.47	21.27
GG-7 (B)	GW 322	GW496	43580	287192	243612	22.42	0.41	25.05
TG-37 (A) (B)	GW 273	GW 451	43580	309872	266292	23.98	0.45	24.53
GJG-9 (B)	GW496	GM 4	43580	314946	271365	23.46	0.43	25.15
GG-5 (B1)	GDW 1255	GM 5	43580	294718	251138	22.38	0.42	22.82
GJG-17 (S)	GW1139		43580	323417	279836	25.48	0.48	23.42
KDG-123 (B)	HI 8498		43580	291516	247935	22.86	0.43	24.83



Nutrient Uptake and soil fertility status at the end of crop sequences (Table 7.3.16.6 & 7): Data indicated that maximum total uptake of N, P and K (216, 33.9, and 131 kg/ha respectively) was observed in cropping system GJG-HPS-1(S)-GW 451-GG- 20(SS) and GG- 20 (SS) -GW 366-GJG-17 (S). KDG 123 (B - HI 8498 - BGS 9 system removed minimum N, P and K. Soil organic carbon was found to be higher in GG-5 (B1) -GDW 1255-GM 5 and GJG-17 (S) -GW1139 (0.256%) and it was increased 34.7% to their initial value. Residual N, P and K was available in the soil ranged N from

163-177 kg/ha, P ranged from 14.9-15.3 kg/ha and K range was from 167-189 kg/ha. Availability of micro-nutrients of iron (Fe) in the soil after completion of crop sequence recorded higher in GJG-9 (B) - GW496-GM 4 whereas zinc was maximum in GG-7 (B) -GW 322-GW496. Manganese and copper were higher in TG-37 (A) (B) -GW 273-GW 451. Minimum bulk density (1.304 g/cc) was recorded in GG-5 (B1) -GDW 1255-GM 5 however water holding capacity improved to their initial status.

Table 7.3.16.6: Nutrients uptake by different varieties of groundnut, wheat and green gram at Dharwad

Cropping Systems	Kharif			Rabi			Summer			Total Uptake		
	N	P	K	N	P	K	N	P	K	N	P	K
GJG-HPS-1(S)-GW 451-GG- 20 (SS)	89	11.7	44	99	18.0	75	28	4.3	12	216	33.9	131
GG- 20 (SS)-GW 366-GJG-17 (S)	101	14.8	51	87	15.9	65	28	3.8	11	216	33.8	128
GG-7 (B)-GW 322-GW496	84	11.7	43	83	14.6	54	25	4.1	11	193	30.5	128
TG-37 (A) (B)-GW 273-GW 451	89	11.3	48	90	15.1	65	23	3.3	9	202	29.9	118
GJG-9 (B)-GW496-GM 4	86	12.4	45	96	17.3	69	23	3.8	9	204	33.5	122
GG-5 (B1)-GDW 1255-GM 5	73	10.8	39	92	15.1	57	28	4.4	11	193	30.6	124
GJG-17 (S)-GW1139	99	13.9	51	91	16.4	66	22	3.3	10	213	33.6	108
KDG-123 (B)-HI 8498	83	10.8	44	82	13.3	59	22	3.1	10	186	28.2	127

Table 7.3.16.7: Soil properties after completion of crop cycle at SK Nagar

Cropping Systems	BD (g/cc)	MWHC (%)	pH	EC (dsm ⁻¹)	SOC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)	Fe (mg/kg)	Mn (mg/kg)	Zn (mg/kg)	Cu (mg/kg)
GJG-HPS-1(S)-GW 451-GG- 20 (SS)	1.407	32.46	7.47	0.08	0.246	172	15.01	175	3.35	7.56	0.33	0.38
GG- 20 (SS) -GW 366-GJG-17 (S)	1.432	33.06	7.29	0.08	0.231	173	15.64	179	3.02	7.17	0.37	0.34
GG-7 (B) -GW 322-GW496	1.385	31.55	7.24	0.08	0.214	177	15.0	182	2.94	6.51	0.40	0.37
TG-37 (A) (B) -GW 273-GW 451	1.369	30.37	7.18	0.08	0.252	170	14.22	173	3.16	7.99	0.37	0.40
GJG-9 (B) -GW496-GM 4	1.310	29.15	7.20	0.09	0.244	176	14.68	167	3.40	7.48	0.29	0.34
GG-5 (B1) -GDW 1255-GM 5	1.304	21.60	7.08	0.08	0.256	169	14.85	189	3.37	7.48	0.26	0.31
GJG-17 (S) -GW1139	1.364	31.36	7.38	0.09	0.256	163	14.37	174	3.16	6.10	0.35	0.31
KDG-123 (B) -HI 8498	1.495	30.44	7.31	0.09	0.250	176	15.32	171	3.04	7.30	0.37	0.34
Initial	1.480	26.62	7.14	0.09	0.190	147	10.92	140	2.62	5.70	0.25	0.24

Equivalent yield and economics of groundnut-wheat-green gram system (Table 7.3.16.8): Highest groundnut equivalent yield, gross return, and

net return ratio was obtained in GG 20 (SS) - GW 366 - GJG-17 (S) cropping system of 4973 kg/ha, Rs. 2,52,809/ha and Rs. 1,21,040 respectively which is

closely followed by GJG-HPS-1(S)-GW 451-GG- 20 (SS) (4919 kg/ha, Rs. 2,48,769/ha and 1,17,000/ha respectively) whereas highest B:C ratio was obtained in GG-7 (B) -GW 322-GW496 (2.50) but it gave

minimum equivalent yield, gross and net return followed by GG-5 (B1) -GDW 1255-GM 5 and KDG-123 (B) -HI 8498 (2.42).

Table 7.3.16.8: Economics of different crops in cropping sequence at SK Nagar

Cropping sequences	Ground nut equivalent yield (kg/ha)	Gross Return (Rs/ha)	Cost of cultivation (Rs/ha)	Net return (Rs/ha)	B: ratio
GJG-HPS-1(S)-GW 451-GG- 20 (SS)	4919	248769	131769	117000	2.13
GG- 20 (SS) -GW 366-GJG-17 (S)	4973	252809	131769	121040	2.09
GG-7 (B) -GW 322-GW496	4280	219434	131769	87665	2.50
TG-37 (A) (B) -GW 273-GW 451	4647	236826	131769	105057	2.25
GJG-9 (B) -GW496-GM 4	4505	230224	131769	98455	2.34
GG-5 (B1) -GDW 1255-GM 5	4425	224891	131769	93122	2.42
GJG-17 (S) -GW1139	4882	247904	131769	116135	2.13
KDG-123 (B) -HI 8498	4390	224521	131769	92752	2.42

Thiruvananthapuram (Table 7.3.17.1-7.3.17.3)

Twelve varieties of cassava were grown under organic management using the organic production technology.

Growth attributes and yield of cassava (Table 7.3.17.1)

Sree Athulya attained the maximum height (308.9 cm), but remained on par with M4, Sree Visakham, and H-226. Kalpaka was the smallest variety (177 cm) at 6MAP. Sree Swarna had the highest foliage at 6MAP (472g). Sree Athulya had the maximum stem girth but on par with Sree Swarna and H-226. Response of different varieties of cassava to organic farming

indicated that the varieties varied significantly in Tuber girth, Average tuber weight tuber yield, total dry matter production and harvest index. Among the 12 varieties, H-226 and Sree Pavithra recorded maximum tuber length in size (34.7 and 34.4cm) and on par with CR-24-4, Sree Visakham, H-165, Sree Athulya and M-4. H-165 attained the maximum tuber girth and was on par with H-226, Sree Pavithra, Sree Athulya, CR-24-4 and M-4. Although, Sree Pavithra recorded highest average tuber weight/plant (602.3 g), but CR-24-4 was the highest yielded (40.7 t/ha) variety.

Table 7.3.17.1: Response for yield and yield attributes of cassava varieties under organic management

Varieties	Plant height (cm) at 6 MAP	Leaf production at 6 MAP	Stem girth (cm) at 6 MAP	Tuber length (cm)	Tuber girth(cm)	Average tuber weight (g/plant)	Tuber yield (t ha ⁻¹)	Dry matter production (t ha ⁻¹)	Harvest index
H-226	263.2	249	9.4	34.7	17.4	526.1	14.7	14.7	0.33
H-165	236.4	240	8.9	27.4	18.2	335.6	15.0	13.3	0.38
Sree Athulya	308.9	227	10.3	26.9	17.4	422.1	24.3	19.2	0.50
Sree Swarna	244.2	474	10.0	20.2	10.7	257.5	13.5	11.9	0.18
Sree Jaya	245.2	359	9.0	18.6	11.6	480.4	28.1	16.5	0.40
Sree Vijaya	226.7	358	8.6	16.7	8.5	259.8	14.8	12.2	0.20
Kalpaka	177.0	199	8.1	19.7	6.4	281.9	14.3	8.9	0.30



Varieties	Plant height (cm) at 6 MAP	Leaf production at 6 MAP	Stem girth (cm) at 6 MAP	Tuber length (cm)	Tuber girth(cm)	Average tuber weight (g/plant)	Tuber yield (t ha ⁻¹)	Dry matter production (t ha ⁻¹)	Harvest index
Vellayani Hraswa	187.8	326	8.3	14.2	9.6	367.0	18.1	11.8	0.29
Sree Pavithra	231.8	259	8.7	34.5	17.4	602.3	29.5	20.2	0.54
Sree Visakham	266.8	207	9.0	31.5	18.0	332.8	11.1	13.5	0.29
CR-24-4	230.0	229	8.2	33.4	16.0	414.7	40.7	23.1	0.59
M-4	290.9	220	8.6	24.7	15.1	283.2	14.1	15.2	0.35
CD (0.05)	52.13	97.46	1.2	10.0	5.5	141.2	7.4	4.6	0.13

Tuber quality of cassava (Table 7.3.17.2 & 7.3.17.3): Sree Athulya had the highest tuber dry matter content (38.88%), which was on par with Sree Pavithra, M-4, Sree Visakham, H-165 and Sree Jaya. The starch content among the varieties, M-4 had the highest starch content (24.58%), which was similar to all the varieties, except Sree Swarna. The total sugar content of H-226 was the highest (2.13%), which was on par with H-165, Sree Athulya, Sree Visakham and Sree Reksha; while Sree Vijaya had the lowest total

sugar percentage (0.56%). There was no significant variation in the crude protein content of the tubers among the varieties evaluated. The varieties had similar mineral contents in tubers, except P and Zn content. The tuber P content in Vellayani Hraswa was higher (179.93 mg 100g⁻¹) and it was on par with Kalpaka and Sree Jaya. The significantly highest Zn content was observed in the tubers of M-4 variety (4.95 mg 100g⁻¹).

Table 7.3.17.2: Biochemical composition of tubers of cassava varieties under organic management

Varieties	Dry matter (%)	Starch (% FW)	Crude protein (% FW)	Total sugars (% FW)
H-226	32.72	21.53	0.89	2.13
H-165	34.18	23.59	1.01	1.98
Sree Athulya	38.88	21.45	1.19	1.93
Sree Swarna	32.16	15.03	0.99	0.83
Sree Jaya	33.55	21.75	0.96	0.97
Sree Vijaya	23.87	14.86	0.78	0.56
Kalpaka	29.60	19.46	0.96	0.65
Vellayani Hraswa	28.12	14.99	0.91	0.65
Sree Pavithra	37.73	24.02	1.28	1.46
Sree Visakham	36.11	20.68	1.18	1.84
CR-24-4	33.12	19.63	1.01	2.11
M-4	37.96	24.58	1.12	1.47
CD (0.05)	5.35	5.63	NS	0.43

Table 7.3.17.3: Mineral composition of tubers of cassava varieties under organic management (DW basis mg 100g⁻¹)

Varieties	P	K	Ca	Mg	Fe	Mn	Zn	Cu
H-226	100.92	510.80	160.67	103.17	17.49	2.11	1.66	1.22
H-165	101.72	527.67	223.67	127.83	21.09	2.24	1.67	1.35
Sree Athulya	112.10	452.80	228.50	132.33	14.58	2.39	1.76	1.28
Sree Swarna	139.23	461.53	238.33	91.50	23.07	1.80	2.41	1.68
Sree Jaya	157.08	493.93	148.17	72.83	16.77	1.51	1.93	1.50
Sree Vijaya	141.37	655.53	183.33	71.50	22.95	1.47	1.95	1.24
Kalpaka	164.93	801.87	199.67	70.17	15.13	1.69	2.48	1.76
Vellayani Hraswa	179.93	635.40	175.83	78.33	16.43	1.53	2.37	1.40
Sree Pavithra	82.82	596.20	291.83	113.50	7.90	1.77	1.70	1.21
Sree Visakhham	81.40	594.07	165.17	80.17	18.52	1.87	1.78	1.33
CR-24-4	85.68	511.13	170.50	86.50	9.61	2.13	1.19	1.29
M-4	136.37	607.53	130.33	59.17	11.03	1.73	4.95	1.25
CD (0.05)	30.327	NS	NS	NS	NS	NS	1.803	NS

Soil properties (Table 7.3.17.4 & 5): The EC, organic carbon and available N content of soil significantly varied among the varieties under organic practice. The soil under organic Sree Reksha had the highest electrical conductivity (0.46 dS m⁻¹), which was identical to the electrical conductivity of the soils where Sree Swarna, Sree Athulya and M-4 were grown. The organic C content was higher under Kalpaka (1.20%), which was on par with that of Sree Jaya. Among the varieties, plots where Sree Jaya was grown had the highest available N content

(131.71 kg ha⁻¹), which was on par with those of Sree Swarna, Sree Pavithra, Sree Visakhham, Sree Vijaya, H-226, M-4 and Sree Reksha. All the other major, secondary and micro nutrients were unaffected (Tables 21 & 22). Significant variation was observed in the dehydrogenase enzyme activity under the different varieties. Among these, the plots where Sree Vijaya was grown had the significantly highest dehydrogenase enzyme activity (185.37 µg TPF g⁻¹ soil h⁻¹). But urease and acid phosphatase activity were not significantly affected (Table 23).

Table 7.3.17.4. Response for chemical properties of soil under cassava varieties in organic production

Varieties	pH	EC	Organic C (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
H-226	5.09	0.33	0.93	117.60	54.49	236.39
H-165	5.17	0.36	0.70	95.65	58.27	296.80
Sree Athulya	5.43	0.43	0.85	99.83	64.85	287.47
Sree Swarna	4.98	0.45	0.90	127.01	43.86	232.74
Sree Jaya	5.02	0.33	1.01	131.71	75.98	229.38
Sree Vijaya	5.70	0.36	0.95	119.69	38.19	326.14
Kalpaka	5.20	0.39	1.20	78.40	25.43	310.91
Vellayani Hraswa	5.23	0.26	0.90	102.44	18.35	265.89
Sree Pavithra	4.99	0.28	1.00	121.78	56.69	265.29
Sree Visakhham	5.20	0.29	0.99	121.26	52.91	291.20
CR-24-4	4.63	0.46	0.84	111.33	37.56	269.47

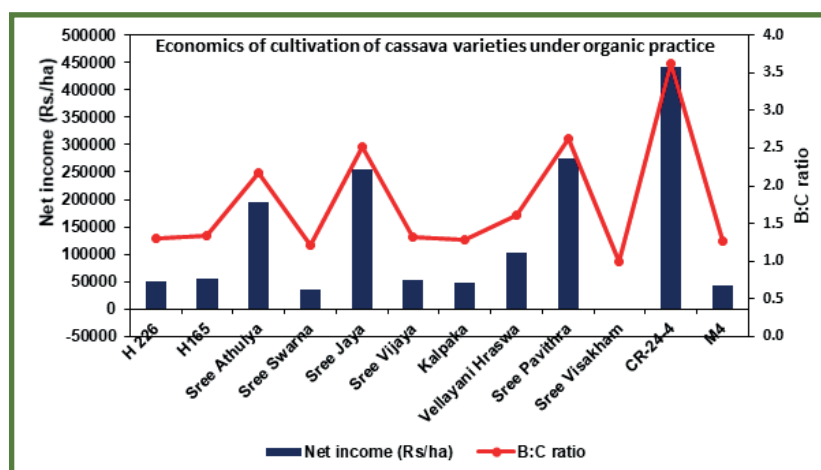
Varieties	pH	EC	Organic C (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
M-4	5.10	0.42	0.97	112.90	54.64	222.95
CD (0.05)	NS	0.064	0.188	25.116	NS	NS

Table 7.3.17.5: Secondary and micro nutrient status of soil and soil enzyme activity after harvest under cassava varieties in organic condition.

Varieties	Exch. Ca (cmol kg ⁻¹)	Exch. Mg (cmol kg ⁻¹)	Avail-able Fe (ppm)	Avail-able Mn (ppm)	Avail-able Zn (ppm)	Avail-able Cu (ppm)	Dehydro-genase (µg TPF ₁ g ⁻¹ soil h ⁻¹)	Acid phos-phatase (µg p-nitro phenol ₁ g ⁻¹ soil h ⁻¹)	Urease (µg urea ₁ g ⁻¹ soil h ⁻¹)
H-226	3.17	1.40	20.45	19.90	2.49	1.54	99.49	410.20	66.57
H-165	3.35	1.49	15.16	18.80	2.81	1.36	90.52	393.60	66.56
Sree Athulya	4.47	1.88	18.22	24.80	4.32	1.67	95.30	442.40	66.51
Sree Swarna	3.69	1.42	13.87	16.70	2.99	1.55	85.74	390.10	66.57
Sree Jaya	3.64	1.61	17.26	20.80	3.22	1.75	121.33	490.00	66.58
Sree Vijaya	3.91	1.78	18.44	19.90	3.63	1.69	185.37	441.10	66.55
Kalpaka	3.98	1.41	9.59	15.60	2.89	1.56	99.71	431.50	66.57
Vellayani Hraswa	3.70	1.33	21.05	15.80	3.20	1.51	113.90	425.70	66.58
Sree Pavithra	3.99	1.80	18.78	25.00	3.45	1.54	125.37	480.50	66.56
Sree Visakham	3.92	1.71	24.59	20.00	2.72	1.53	126.33	412.50	66.55
CR-24-4	3.26	1.38	16.38	17.50	2.77	1.57	99.71	433.90	66.55
M-4	3.92	1.59	20.51	17.10	2.91	1.58	113.24	435.70	66.58
CD (0.05)	NS	NS	NS	NS	NS	NS	42.927	NS	NS

Economics Among the varieties evaluated, cultivar of H-226 and CR-24-4 under organic practice was profitable as these varieties generated higher profit (Rs. 5,32,229 ha⁻¹ and Rs. 5,18,855 ha⁻¹ respectively)

and B: C ratio (4.16 and 4.08). Sree Athulya and Sree Pavithra were the next good performers (net returns of Rs. 3,76,022 and Rs. 3,33,182 ha⁻¹; B:C ratio of 3.23 and 2.98 respectively).



Udaipur (Table 7.3.18.1–7.3.18.4)

Evaluation of response of different varieties of maize and wheat grown in maize–wheat system under organic farming

Yield attributes of maize (Table 7.3.18.1): Yield attributes of maize showed that variety, Variety Pratap Hybrid Maize-3 among maize grain varieties, Sugar-75 among sweetcorn varieties, VL Amber Popcorn among popcorn varieties and Farmers' selection in local varieties showed comparative better performance of yield attributes of different types of maize. Among the different maize varieties, varieties PHM-3 recorded significantly higher weight of grains per cob and test weight (100.23 g and 272 g, respectively) as compared to other varieties.

Yield and economics of different varieties of maize (Table 7.3.18.2): Among the different maize varieties, Sugar -75 recorded significantly higher maize equivalent yield (12778 kg/ha) as compared to other varieties. In case of hybrid varieties, PHM-3 recorded significantly higher maize equivalent yield (6389 kg/ha) as compared to PQPM-1 (6019 kg/ha) and PM-9 (4537 kg/ha). Among sweet corn varieties, sugar-75 gave significantly higher maize equivalent yield (12778 kg/ha) as compared to Madhula variety (8333 kg/ha) and MAHY-103 (7593 kg/ha). In case

of baby corn varieties, PM-3 recorded higher maize equivalent yield (4511 kg/ha) as compared to PM-5 variety (3267 kg/ha). Among popcorn varieties, VL-Amber observed significantly higher maize equivalent yield (11822 kg/ha) as compared to Amber popcorn (5081 kg/ha). Among local varieties, farmers' selection gave significantly higher maize equivalent yield (4537 kg/ha) as compared to Navjot (4259 kg/ha).

Among different maize varieties, Sugar-75 recorded significantly higher gross return (Rs.2,35,583/ha) and net return (Rs. 1,56,763/ha) as compared to other varieties. In case of hybrid varieties, PHM-3 recorded significantly higher gross and net return (Rs. 1,35,972 and Rs.80,102/ha, respectively) as compared to PM-9 but it was at par with PQPM-1 (Rs. 1,29,472 and Rs.73,602/ha). Among the sweet corn, sugar-75 recorded significantly higher gross and net return (Rs.2,35,583 and Rs.1,56,763/ha). In case of baby corn varieties, PM-3 recorded significantly higher gross and net return (Rs.79,472 and Rs.23,852/ha) and was at par with PM-5 (Rs.57,972 and Rs.2352/ha, respectively). In case of popcorn, VL-Amber gave significantly higher gross and net return (Rs.2,08,972 and Rs.1,53,912/ha) as compared to Amber popcorn. Among local varieties, Navjot gave significantly higher gross and net return (Rs. 98,750 & Rs.43,430, respectively) as compared to Farmer's Selection.

Table 7.3.18.1: Evaluation of response of different varieties of maize on yield attributes at Udaipur

Varieties	Number of cobs per plant	Number of grain rows per cob	Number of grains per row	Number of grains per cob	Weight of grain per cob (g)	Test weight (g)
Maize (Grain)						
Pratap QPM Hybrid - 1	2.00	15.33	31.43	480.00	88.60	184.67
PM - 9	1.67	13.33	28.00	371.67	71.22	191.67
Pratap Hybrid Maize - 3	1.67	13.33	27.74	368.33	100.23	272.00
Sweet corn						
Sugar 75	2.00	16.00	26.67	426.67	39.68	93.00
Madhula	1.33	14.00	20.71	290.00	15.56	53.67
Misty	1.33	13.33	24.27	321.33	22.57	70.33
Baby corn						
PM- 3	1.33	0.00	0.00	0.00	0.00	0.00
PM- 5	1.33	0.00	0.00	0.00	0.00	0.00

Varieties	Number of cobs per plant	Number of grain rows per cob	Number of grains per row	Number of grains per cob	Weight of grain per cob (g)	Test weight (g)
Pop corn						
VL Amber	1.33	12.67	30.36	383.33	58.17	151.67
Amber	1.33	11.33	24.03	271.67	21.25	78.33
Local varieties						
Navjot	1.33	13.33	24.79	327.67	59.30	181.00
Farmers selection	1.67	12.67	29.76	370.00	73.25	198.33
CD at 5 %	0.928	1.856	4.448	35.604	6.172	7.546

Table 7.3.18.2: Maize equivalent yield and economics of different varieties of maize grown under organic farming at Udaipur

Varieties	Economic yield (kg/ha)	Fodder yield (kg/ha)	MEY (kg/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	Net return per rupee invested
Maize (Grain)						
Pratap QPM Hybrid - 1	6019	7685	6019	129472	73602	2.32
PM - 9	4537	6111	4537	99222	43352	1.78
Pratap Hybrid Maize - 3	6389	7870	6389	135972	80102	2.43
Sweet corn						
Sugar 75	6390	8611	12778	235583	156763	2.99
Madhula	4167	6111	8333	156167	77347	1.98
Misty	3796	5463	7593	141750	62930	1.80
Baby corn						
PM- 3	1611	2315	4511	79472	23852	1.43
PM- 5	1167	1759	3267	57972	2352	1.04
Pop corn						
VL Amber	4222	6204	11822	208972	153912	3.80
Amber	1815	2593	5081	89444	34384	1.62
Local varieties						
Navjot	4537	6019	4537	98750	43430	1.79
Farmer's selection	4259	6296	4259	96000	40680	1.74
CD at 5 %	780.2	1125.4	1127.0	23921	23921	0.379

Yield attributes of wheat (Table 7.3.18.3): In organic management practices, 12 wheat varieties were grown. Among them, variety HI- 8713 recorded significantly higher number of grains/ear (52.78) as compared to other, but it was at par with HI-8663 (52.29) while maximum number of spikelets/ear (19 nos.) was recorded in HI-1531 as compared to other wheat varieties and it was

at par with HI-8713 (18.67).

In case of *Triticum aestivum* varieties, significantly higher number of grains/ear and ear length was recorded in MP-3288 (51.67 and 10.47 cm, respectively) as compared to other *aestivum* varieties. In case of *Triticum durum*, HI-8713 recorded significantly higher number of grains/ear and number of spikelet/ear (52.7 and 18.67) as compared

to other durum varieties and it was at par with HI-8663 (52.29 and 17.7, respectively). Among local wheat varieties, C-306 recorded significantly higher number of grains/ear and ear length (43.33 and 9.86 cm, respectively) as compared to Lok-1 (32.67 and 7.72 cm, respectively). Among all varieties of wheat, the durum wheat varieties MPO-1215, HI-8713 and HI-8663 recorded the higher test weight which was at par with each other but was significantly higher in comparison to other wheat varieties.

Yield and economics of wheat (Table 7.3.18.4): Among 12 wheat varieties, HI-8713 recorded significantly higher grain yield (5424 kg/ha) and net return (Rs.

1,54,307/ha) as compared to other varieties. Among *Triticum aestivum* varieties, variety MP-3288 recorded significantly higher grain yield (4626 kg/ha) and net return (Rs. 1,30,065/ha) as compared to other wheat varieties. In case of *Triticum durum* varieties, variety HI-8713 gave significantly higher grain yield (5424 kg/ha) and net return (Rs. 1,54,307/ha) as compared to other durum varieties and it was at par with HI-8663 (5024 kg/ha and Rs. 1,40,772/ha, respectively). In local wheat varieties, variety C-306 recorded significantly higher grain yield (4233 kg/ha) and net return (Rs. 1,14,013/ha) as compared to Lok-1 (3547 kg/ha Rs. 88,260/ha, respectively).

Table 7.3.18.3: Yield attributes of wheat varieties grown under organic farming at Udaipur

Varieties	Number of spikelet's/ ear	Ear length (cm)	Number of grains/ear	Test weight (g)	Grain yield (kg/ha)	Straw yield(kg/ha)	Harvest index (%)
<i>Triticum aestivum</i>							
HI-1531	19.0	7.3	47.7	47.3	4504	8748	33.9
MP-3288	17.7	10.5	51.7	44.7	4626	9075	33.7
Raj-3765	18.3	9.1	47.0	48.6	3452	6743	33.8
Raj-4037	14.1	7.3	32.3	52.1	4121	7519	35.4
Raj-4120	13.7	8.3	43.6	50.3	3435	6662	34.2
<i>Triticum durum</i>							
HI-8627	17.4	7.3	47.7	57.7	4518	8509	34.7
HI-8663	17.7	6.4	52.3	51.7	5024	8986	35.9
HI-8713	18.7	7.2	52.8	58.3	5424	9447	36.5
MPO-1215	16.7	7.1	39.8	59.3	4245	8513	33.3
HI-1500	17.3	8.0	42.3	45.3	3431	7405	31.8
<i>Wheat (Local)</i>							
Lok-1	14.3	7.7	32.7	45.7	3547	6802	34.3
C-306	15.0	9.9	43.3	48.7	4233	8081	34.4
CD at 5 %	1.13	1.55	4.00	2.73	418.7	884.3	3.11

Table 7.3.18.4: Yield and economics of wheat varieties under organic farming at Udaipur

Varieties	Gross return (Rs ha ⁻¹)	Net return (Rs ha ⁻¹)	Net return per rupee invested
<i>Triticum aestivum</i>			
HI-1531	170717	124981	2.73
MP-3288	175801	130065	2.84
Raj-3765	131034	85298	1.87
Raj-4037	153742	108006	2.36

Varieties	Gross return (Rs ha ⁻¹)	Net return (Rs ha ⁻¹)	Net return per rupee invested
Raj-4120	130166	84430	1.85
Triticum durum			
HI-8627	169911	124175	2.72
HI-8663	186508	140772	3.08
HI-8713	200043	154307	3.37
MPO-1215	162278	116542	2.55
HI-1500	133842	88106	1.93
Wheat (Local)			
Lok-1	133996	88260	1.93
C-306	159749	114013	2.49
CD at 5 %	13231.64	13231.64	0.289



Best Performance varieties (Pratap Hybrid Maize-3) maize and (MP-3288) wheat under organic farming



Best Performance varieties (PM-3) Baby corn and (Sugar-75) Sweet corn under organic farming



PHM-3



PM-5



Sugar 75



PM-3



Sugar 75



PQPM-1

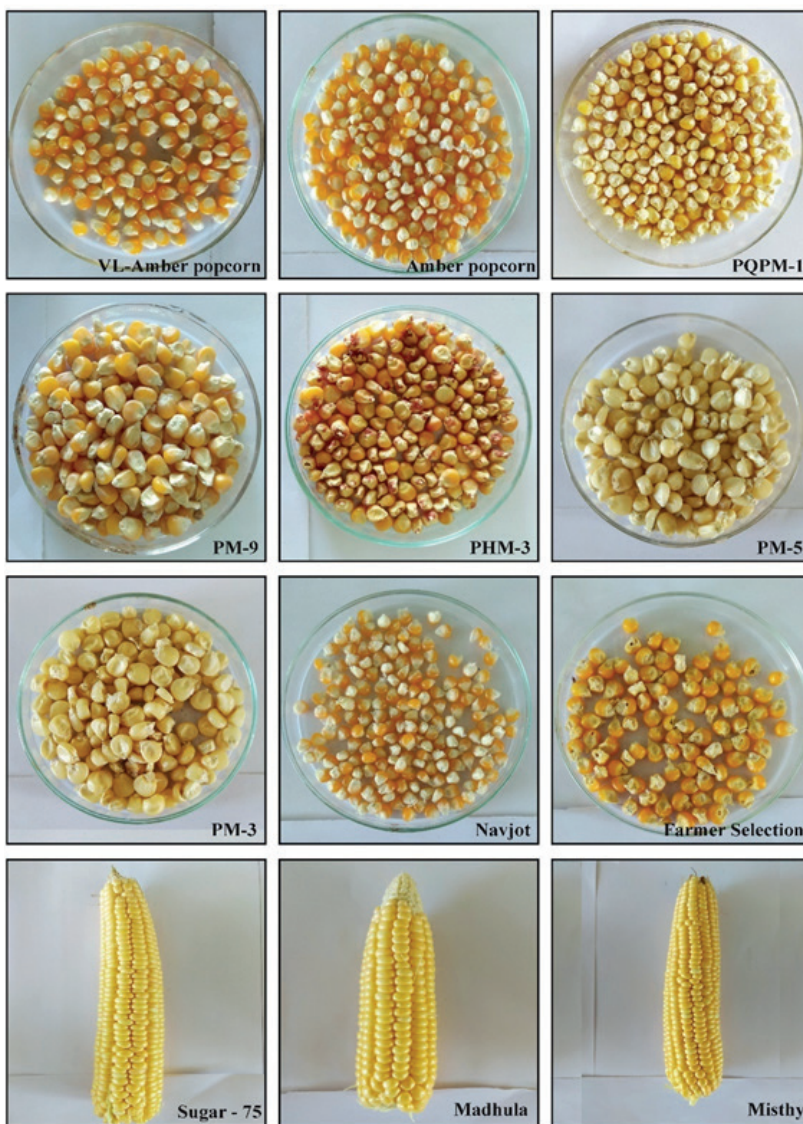


Madhula



PM-9

Field performance of maize varieties under organic farming at Udaipur



Seed samples of varieties of different types of maize at Udaipur

7.4: Evaluation of bio-intensive complimentary cropping systems under organic production systems

Objectives

- To evaluate the various land configuration and intercropping options for managing the soil nutrient and pests under organic production system
- To assess the infestation level of insect, disease and weeds under bio-intensive complimentary systems

Treatments: Four land configuration methods in main plot and cropping system in sub plot were taken up.

Land Configuration: i) Conventional, ii) Furrow Irrigated Raised Bed, iii) Broad bed & Furrow and iv) Raised & Sunken Bed

Cropping system: Four location specific complimentary bio-intensive cropping systems were taken in sub plots. Experiment was conducted at Dharwad, Pantnagar and Umiam centres with 3 replications in split plot design.

Year of start: 2016-17

Results:

Dharwad (Table 7.4.1.1 to 7.4.1.6)

Evaluation of performance of different cropping systems influenced by conservation agriculture practices and land configuration with or without crop residues under organic management

Four land configuration and residues management viz. broad bed furrow method of planting with crop residue, broad bed furrow method of planting without residue, conventional flatbed planting method with residue and conventional flatbed planting method without residue in main plot and 4 cropping systems namely soybean-wheat, groundnut + cotton (2:1), greengram-sorghum and soybean + pigeonpea (2:1) in sub plot with 3 replications in split plot design were evaluated to know the performance of cropping systems (two sequence cropping systems

viz., soybean - wheat and greengram - sorghum and two intercropping systems viz., groundnut + cotton and soybean + pigeonpea to the different land configuration with or without crop residues under exclusive organic production system in respect of both nutrients and insect pest and diseases management.

Yield and economics of different crops as influenced by land configuration and crop residue management.

Conventional flatbed (FB) method of planting in addition to recycling of crop residues produced higher yield of soybean, groundnut, greengram and pigeonpea (1345, 1192, 126 and 841 kg/ha respectively) compared to broad bed and furrow planting method. The reduction with broad bed and furrow method of planting are observed as 32.04, 24.2, 14.3 and 16.2% than conventional flat bed with residue. The wheat crop was not sown because of moisture shortage at the time of sowing after harvesting of soybean. System equivalent yield of different systems also recorded higher with conventional flatbed method of planting in addition to recycling of crop residue. Conventional flatbed method of planting with crop residue produced higher gross return, net monetary returns and benefit cost ratio across to cropping systems. Among the cropping systems, soybean-wheat system recorded maximum net return and B:C ratio of Rs. 31,722/ha and 2.25 respectively (Table 7.4.1.1-1.2)

Physical and chemical properties of soil as influenced by land configuration and crop residue management.

The soil bulk density (BD) was not significantly influenced by either land configuration-residue management practices or cropping systems. The BD values varied only marginally; between 1.18 to 1.22 amongst treatment combinations. Broad bed and furrow (BBF) method of planting with crop residues recorded pH 7.1 as significant from conventional flatbed (FB) method of planting without crop residue (1.02). EC significantly differ in cropping system

groundnut +cotton and green gram-sorghum. The organic carbon was significantly influenced by either land configuration-residue management practices or cropping systems. The soil organic carbon increased significantly from conventional method of planting without crop residue (4.89 g/kg) to broad bed furrow method of planting with crop residue (6.28 g/kg). Among the cropping systems, available N recorded significantly higher in soybean + pigeon pea system (261 kg/ha) whereas, among planting methods, broad bed and furrow in addition to crop residue observed highest. P and K increased significantly from 34.8 and 371.0 kg/ha with conventional flatbed method of planting without crop residue to 57.1 and 427.0 kg/ha, respectively with broad bed furrow method of planting with crop residue. The available micronutrients sulphur and zinc differ significantly from land configuration and residue management. Broad bed and furrow method of planting recorded higher S and Zn 38.32 and 0.98 mg/kg availability and among the cropping systems green gram-sorghum

having higher sulphur availability in the soil (36.02 mg/kg) while groundnut +cotton achieved higher zinc availability in the soil (1.00 mg/kg). Cu, and Fe increased significantly higher from 3.03 and 18.34 to 3.26 and 19.27 mg/kg with broad bed and furrow method of planting without crop residue respectively with conventional flatbed method of planting with crop residue (Table 7.4.1.3 -1.4)

Microbial population as influenced by land configuration and crop residue management.

Among the planting methods for rhizosphere, microbial population of bacteria and actinomycetes recorded significantly higher in conventional flatbed planting method with crop residue (78.25×10^6 cfu/g and 16.17×10^3 cfu/g), whereas fungal population (7.67×10^4 cfu/g) and phosphate solubilizing microorganisms (9.42×10^5 cfu/g) found to higher in broad bed and furrow (BBF) method of planting without incorporation of residues under soybean +pigeonpea (2:1) cropping system (Table 7.4.1.5 -1.6)

Table 7.4.1.1: Yield and equivalent yield of various crops in cropping system as influenced by land configuration and crop residues management at Dharwad

Cropping systems	Kharif yield (kg/ha)					Rabi yield (kg/ha)					Systems equivalent yield (kg/ha)				
	Broad bed and furrow		Conventional flatbed		Mean	Broad bed and furrow		Conventional flatbed		Mean	Broad bed and furrow		Conventional flatbed		Mean
	with crop residues	without crop residues	with crop residues	without crop residues		with crop residues	without crop residues	with crop residues	without crop residues		with crop residues	without crop residues	with crop residues	without crop residues	
Soy-bean-wheat	914	883	1345	1181	1081	-	-	-	-	-	914	883	1345	1181	1081
Groundnut + cotton (2:1)	904 + 691	884 + 696	1192 + 663	1080 + 657	1015+677	-	-	-	-	-	1492	1482	1723	1617	1579
Green gram-sorghum	108	93	126	108	109	1669	1561	1942	1729	1725	2014	1860	2346	2075	2074
Soybean + pigeon pea (2:1)	453 + 705	429 + 579	651 + 841	545 + 731	520 + 714	-	-	-	-	-	1179	1025	1517	1297	1255

Cropping systems	Gross return (Rs./ha)			Cost of cultivation (Rs./ha)				Net return (Rs./ha)				B:C ratio									
	Broad bed and furrow	Conventional flatbed		Mean	Broad bed and furrow	Conventional flatbed		Mean	Broad bed and furrow	Conventional flatbed		Mean	Broad bed and furrow	Conventional flatbed		Mean					
		with crop residues	without crop residues			with crop residues	without crop residues			with crop residues	without crop residues			with crop residues	without crop residues						
Soybean-Wheat	38860	37507	57168	50179	45929	27399	27399	27399	25446	25446	26422	11461	10108	31722	24733	19506	1.42	1.37	2.25	1.97	1.75
Ground-nut+ Cotton (2:1)	67246	66709	77541	72770	71067	57740	57740	57740	55803	55803	56772	9506	8969	21738	16967	14295	1.16	1.16	1.39	1.30	1.25
Green gram -Sorghum	37759	34866	43991	38899	38879	43935	43935	43935		42784	43360	-6176	-9069		1207	-4481	0.86	0.79	1.03	0.91	0.90
Soybean + pigeon pea (2:1)	50097	43554	64484	55141	53319	32932	32932	32932	30994	30994	31963	17165	33490	10622	24147	21356	1.52	1.32	2.08	1.78	1.68

Cropping systems	Gross return (Rs./ha)				Cost of cultivation (Rs./ha)				Net return (Rs./ha)				B:C ratio								
	Broad bed and furrow		Conventional flatbed		Mean	Broad bed and furrow		Conventional flatbed		Mean	Broad bed and furrow		Conventional flatbed		Mean	Broad bed and furrow		Conventional flatbed		Mean	
	with crop residues	without crop residues	with crop residues	without crop residues		with crop residues	without crop residues	with crop residues	without crop residues		with crop residues	without crop residues	with crop residues	without crop residues		with crop residues	without crop residues				
Soybean-Wheat	38860	37507	57168	50179	45929	27399	27399	27399	25446	25446	26422	11461	10108	31722	24733	19506	1.42	1.37	2.25	1.97	1.75
Ground-nut+ Cotton (2:1)	67246	66709	77541	72770	71067	57740	57740	57740	55803	55803	56772	9506	8969	21738	16967	14295	1.16	1.16	1.39	1.30	1.25
Green gram -Sorghum	37759	34866	43991	38899	38879	43935	43935	43935		42784	43360	-6176	-9069		1207	-4481	0.86	0.79	1.03	0.91	0.90
Soybean + pigeon pea (2:1)	50097	43554	64484	55141	53319	32932	32932	32932	30994	30994	31963	17165	33490	10622	24147	21356	1.52	1.32	2.08	1.78	1.68

Cropping systems	Bulk density (g/cc)			pH			Electrical conductivity (dS/m)				Organic carbon (g/kg)									
	Broad bed and furrow		Conventional flatbed	Broad bed and furrow		Conventional flatbed	Broad bed and furrow		Conventional flatbed	Broad bed and furrow		Conventional flatbed	Mean							
	with crop residues	without crop residues	with crop residues	with crop residues	without crop residues	with crop residues	without crop residues	with crop residues	without crop residues	with crop residues	without crop residues	with crop residues	Mean							
Soy-bean-Wheat	1.20	1.21	1.20	1.21	1.20	6.99	6.94	6.96	7.04	6.99	0.11	0.09	0.10	0.07	0.09	5.10	5.80	4.80	4.17	4.97
	1.20	1.20	1.21	1.19	1.20	7.14	7.10	7.07	7.10	7.10	0.12	0.09	0.10	0.08	0.10	6.60	6.40	5.00	4.30	5.58
Ground-nut+Cotton (2:1)	1.22	1.18	1.20	1.19	1.20	7.22	7.16	7.02	7.13	7.13	0.07	0.06	0.09	0.06	0.07	6.60	6.20	5.10	6.50	6.10

Cropping systems	Bulk density (g/cc)				pH			Electrical conductivity (ds/m)				Organic carbon (g/kg)								
	Broad bed and furrow		Conventional flatbed		Broad bed and furrow		Conventional flatbed		Broad bed and furrow		Conventional flatbed		Broad bed and furrow		Conventional flatbed		Mean			
	with crop residues	without crop residues	with crop residues	without crop residues	with crop residues	without crop residues	with crop residues	without crop residues	with crop residues	without crop residues	with crop residues	without crop residues	with crop residues	without crop residues	with crop residues	without crop residues				
Soy-bean-Wheat	1.20	1.21	1.20	1.21	1.20	6.99	6.94	6.96	7.04	6.99	0.11	0.09	0.10	0.07	0.09	5.10	5.80	4.80	4.17	4.97
	1.20	1.20	1.21	1.19	1.20	7.14	7.10	7.07	7.10	7.10	0.12	0.09	0.10	0.08	0.10	6.60	6.40	5.00	4.30	5.58
Ground-nut+Cotton (2:1)																				
Green gram-Sorghum	1.22	1.18	1.20	1.19	1.20	7.22	7.16	7.02	7.13	7.13	0.07	0.06	0.09	0.06	0.07	6.60	6.20	5.10	6.50	6.10

Cropping systems	Bulk density (g/cc)			pH			Electrical conductivity (dS/m)			Organic carbon (g/kg)		
	Broad bed and furrow	Conventional flatbed	Mean	Broad bed and furrow	Conventional flatbed	Mean	Broad bed and furrow	Conventional flatbed	Mean	Broad bed and furrow	Conventional flatbed	Mean
	with crop residues	with crop residues	with crop residues	with crop residues	with crop residues	with crop residues	with crop residues	with crop residues	with crop residues	with crop residues	with crop residues	with crop residues
Soybean + pigeon pea (2:1)	1.20	1.22	1.20	7.13	7.06	7.10	0.10	0.11	0.09	6.80	6.00	5.58
Mean	1.21	1.20	1.20	7.12	7.07	7.11	0.10	0.09	0.10	6.28	5.23	4.89
CD (P=0.05)	LCRM	CS	LCRM X CS	LCRM	CS	LCRM X CS	LCRM	CS	LCRM X CS	LCRM	CS	LCRM X CS
	NS	NS	NS	0.047	NS	NS	NS	0.016	NS	1.034	0.625	1.25

Table 7.4.1.4: Available N, P and K at the end of cropping cycle as influenced by land configuration and crop residues management

Cropping systems	Available N (kg/ha)			Available P (kg/ha)			Available K (kg/ha)			Available sulphur (mg/kg)		
	Broad bed and furrow	Conventional flatbed	Mean	Broad bed and furrow	Conventional flatbed	Mean	Broad bed and furrow	Conventional flatbed	Mean	Broad bed and furrow	Conventional flatbed	Mean
	with crop residues	with crop residues	with crop residues	with crop residues	with crop residues	with crop residues	with crop residues	with crop residues	with crop residues	with crop residues	with crop residues	with crop residues
Soybean -Wheat	228	237	235	44.58	64.40	48.01	430	436	405	39.03	31.69	34.51
Ground-nut+ Cotton (2:1)	241	258	254	64.99	59.72	58.10	500	436	451	42.0	30.50	35.26
Green gram -Sorghum	256	252	248	52.59	66.67	64.58	386	356	367	35.44	39.53	36.02
Soybean + pigeon pea (2:1)	254	267	261	66.43	59.79	66.87	390	384	396	36.81	32.40	34.29
Mean	245	253	247	57.15	62.65	59.39	427	403	371	38.32	33.53	31.86
CD (P=0.05)	LCRM	CS	LCRM X CS	LCRM	CS	LCRM X CS	LCRM	CS	LCRM X CS	LCRM	CS	LCRM X CS
	NS	7.7	16.8	10.61	6.65	14.10	39.0	25.6	50.3	4.41	NS	4.26

Pant Nagar (Table 7.4.2.1–7.4.2.5)

Resource conservation techniques in different crops and cropping systems under organic cultivation Yield, yield attributes and harvest index of paddy

Yield attributing characters of basmati rice viz, plant height, effective tillers/m² and test weight were significantly influenced by different resource conservation treatments. In rice crop plant height (103cm) was attained in SRI-wheat-sesbania cropping system. Significantly higher number of effective tillers/m² (321) were recorded under basmati rice (DSR)-chickpea-Moong on BB&F System while weight of grain/ panicle (1.88g) observed maximum under basmati rice-wheat-sesbania compared to all other resource conservation technologies, however, it was at par with basmati rice (DSR)-vegetable pea on BB&F +mustard in furrow system. Grain weight

per panicle was not influenced due to resource conservation technique however, 1000-grains wt. of basmati rice (22.9 g) was higher in SRI-wheat-sesbania system.

Grain yield of basmati rice was not influence due to the resource conservation practices whereas straw yield and harvest index was significantly differed. Basmati rice-wheat-sesbania system recorded significantly higher basmati rice grain yield (4133 kg/ha) over all other resource conservation techniques, straw yield was also significantly higher under basmati rice-wheat-sesbania (4426 kg/ha) and was at par with DSR- wheat (ZT)- sesbania system. Higher harvest index (0.477) was obtained with DSR-chickpea-moong on broad bed furrow System over all other resource conservation treatments (Table 7.4.2.1).



Basmati rice (DSR)+chickpea (ZT)+coriander



DSR +soyabean -Vegetable Pea+ Mustard)

Broad bed & furrow resource conservation technologies

Table 7.4.2.1: Yield attributes and yield of rice as influenced by different resource conservation practice

Treatments	Plant height (cm)	Effective tillers/ m ²	1000-grains wt. (g)	Grain yield kg/ha)	Straw yield (kg/ha)	Harvest Index
Basmati rice-wheat-sesbania	89	239	22.0	4133	4426	0.457
SRI-wheat- sesbania	103	208	22.9	3633	3906	0.440
DSR-wheat (Zero tillage) -sesbania	80	319	21.9	3500	3995	0.447
DSR-wheat-moong on broad bed and furrow	93	307	21.7	3092	3501	0.450
DSR-vegetable pea -cowpea on broad bed and furrow	86	316	21.6	3327	3631	0.463



Treatments	Plant height (cm)	Effective tillers/m ²	1000-grains wt. (g)	Grain yield kg/ha	Straw yield (kg/ha)	Harvest Index
DSR-chickpea-moong on broad bed and furrow	88	321	21.6	3471	3905	0.477
FIRB: DSR+ soybean -vegetable pea+ mustard	88	317	21.7	2540	0.00	0.470
FIRB: rice +pigeon pea-cowpea +okra	91	276	21.5	2673	3058	0.460
CD(P=0.05)	NS	17.43	NS	NS	441	0.015

Note: SRI-System rice intensification, DSR-Direct seeded rice, FIRB- Furrow irrigated raised bed

Yield and Yield attributes of rabi crops

Maximum plant height (90.7 cm), spikes/m² (205) and 1000-grains weight (47.36 g) of wheat was recorded under basmati rice-wheat-*sesbania*. Grain yield of wheat (3643 kg/ha) was also recorded in basmati rice-wheat- *sesbania* system while lowest grain yield (3135 kg/ha) was observed in rice (DSR) - wheat-(ZT)-*sesbania*. Green pod yield of vegetable pea was found higher (7424 kg/ha) in rice (DSR) +soybean - vegetable pea + mustard on raised bed & furrow system (FIRB), as compared to 7197 kg/ha in rice (DSR) -vegetable pea-cowpea on broad bed and furrow system (BB&F) chickpea yield under rice (DSR)-chickpea-moong system on broad-bed and furrow was 1821 kg/ha (Table 7.4.2.2-2.3).

System productivity and economics

System productivity of different cropping systems as influenced by resource conservation techniques differ significantly. Maximum net returns (Rs.1,85,742 /ha) and system productivity in terms of basmati rice yield equivalent (10018 kg/ha) was recorded in (DSR)+ soyabean- vegetable pea+ mustard on FIRB which was at par with rice (DSR)-chickpea-moong on broad bed and furrow system which recorded of Rs. 1,80,674 and 9845k kg/ha respectively (Table 7.4.2.4).

Nutritional status of soil after completion of crop cycle

Nutritional status of soil after completion of crop cycle, organic carbon, available N, P, K and S were significantly influenced by resource conservation practices. Significantly higher organic carbon was observed in rice (DSR)-chickpea-moong on broad bed and furrow system which was at par with that of under DSR-wheat-moong on broad bed and furrow and DSR-vegetable pea-cow pea on broad bed and furrow system. Available N ranged from 318 to 377 kg/ha was observed in the different resource conservation techniques however significantly higher available N being observed under DSR-chickpea-moong on broad -bed and furrow system which was at par with DSR-Vegetable pea-cow pea on broad bed and furrow practices. Available phosphorus after crop cycle ranged from 29.5 to 38.9 kg/ha, maximum availability observed in DSR-wheat (zero tillage)- *sesbania*. Availability of K, however, was significantly higher (255 kg/ha) under DSR-chickpea-moong on BB&F System which was at par with DSR-vegetable pea -cowpea on BB&F System and FIRB: rice +pigeon pea-cowpea +okra system. Availability of sulphur was significantly higher in DSR-wheat-moong on BB&F System which was at par with DSR-wheat (Zero tillage)-*sesbania* system and DSR-vegetable pea -cowpea on BB&F System resource conservation practices (Table 7.4.2.5).

Table 7.4.2.2: Yield attributes and yields of *rabi* crops as influenced by different resource conservation techniques

Treatments	Plant height (cm)	Spikes/m ² of wheat pods /plant of veg. pea and cowpea	Nos. of grains/spike of wheat pods/plant of veg. pea and cowpea	1000 grains wt. of wheat & 100 seeds wt. of veg. pea and cowpea
Basmati rice-wheat- <i>sesbania</i>	90.7	205	35.6	47.36
SRI-wheat- <i>sesbania</i>	83.2	159	34.3	46.33
DSR-wheat (Zero tillage) - <i>sesbania</i>	79.1	182	33.1	45.73
DSR-wheat-moong on broad bed and furrow	80.7	180	37.1	46.56
DSR-vegetable pea -cowpea on broad bed and furrow	89.8	14.3	5.90	44.40
DSR-chickpea-moong on broad bed and furrow	94.3	52.0	2.06	29.40
FIRB: DSR+ soybean -vegetable pea+ mustard	95.0	14.7	5.80	54.20
FIRB: rice +pigeon pea-cowpea +okra	0.00	-	0.00	0.00

Table 7.4.2.3: Yield of *rabi* crops as influenced by different resource conservation techniques

Treatments	Yield of <i>rabi</i> crops (kg/ha)				
	Wheat	Vegetable pea	Chickpea	Coriander	Mustard
Basmati rice-wheat- <i>sesbania</i>	3643	-	-	-	-
SRI-wheat- <i>sesbania</i>	3519	-	-	-	-
DSR-wheat (Zero tillage) - <i>sesbania</i>	3135	-	-	-	-
DSR-wheat-moong on broad bed and furrow	3296	-	-	-	-
DSR-vegetable pea -cowpea on broad bed and furrow	-	7197		597	
DSR-chickpea-moong on broad bed and furrow	-		1821	631	
FIRB: DSR+ soybean -vegetable pea+ mustard	-	7424			267
FIRB: rice +pigeon pea-cowpea +okra	1107	-	-	-	-

Table 7.4.2.4: Relative economics of different resource conservation technologies

Treatments	System productivity (kg/ha)	Cost of cultivation (Rs./ha)	Net Return (Rs./ha)	B:C Ratio
Basmati rice-wheat- <i>sesbania</i>	7294	74815	107541	1.44
SRI-wheat- <i>sesbania</i>	6686	68130	99020	1.45
DSR-wheat (zero tillage) - <i>sesbania</i>	6219	61732	93764	1.52
DSR-wheat-moong on broad bed and furrow	5952	76835	71976	0.94
DSR-veg. pea -cowpea on broad bed and furrow	8725	72245	145878	2.02
DSR-chickpea-moong on broad bed and furrow	9845	65445	180674	2.76
FIRB:DSR+ soybean-vegetable pea+ mustard	10018	64706	185742	2.87



Treatments	System productivity (kg/ha)	Cost of cultivation (Rs./ha)	Net Return (Rs./ha)	B:C Ratio
FIRB: rice +pigeon pea-cowpea +okra	3484	39101	47998	1.23
CD (P=0.05)	766	-	-	-

Table 7.4.2.5: Nutrient status of soil after completion of crop cycle

Treatments	Organic carbon (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)	Available S (kg/ha)
Basmati rice-wheat- <i>sesbania</i>	1.20	333	32.5	209	21.9
SRI-wheat- <i>sesbania</i>	1.21	359	31.4	225	25.9
DSR-wheat (Zero tillage) – <i>sesbania</i>	1.32	349	38.9	243	30.0
DSR-wheat-moong on broad bed and furrow	1.35	340	30.9	234	31.8
DSR-veg. pea -cowpea on broad bed and furrow	1.34	367	29.5	244	30.7
DSR-chickpea-moong on broad bed and furrow	1.37	377	32.5	255	27.0
FIRB: DSR+ soybean-vegetable pea+ mustard	1.25	318	30.0	224	26.9
FIRB: rice +pigeon pea-cowpea +okra	1.06	342	34.2	243	24.5
CD (P=0.05)	0.07	23.9	4.50	14.0	4.24

Umiam: (Table 7.4.3.1–7.4.3.3).

Evaluation of bio-intensive complimentary cropping systems under raised and sunken bed techniques

Land Configuration

The raised and sunken bed were made in sequence for efficient drainage and inter-plot water harvesting with a fixed width i.e. 1 m for raised and 1.25 m for sunken bed. The surface soil layer of each sunken bed was removed and deposited on the adjacent raised beds making about 30 cm bed height. All the crop residues and weed biomass were placed below the raised beds and covered properly with the soil from sunken beds.

Nutrient Management

Farmyard manure (FYM) was used for all the crops to meet crop nutrient requirement on nitrogen (N) equivalent basis. Phosphorus requirement was compensated through rock phosphate. Neem cake @150 kg/ha was applied uniformly for all the

crops to control soil borne disease and supply some additional nutrients.

Crop culture

Transplanted rice was grown in sunken beds during *kharif* season with four rice varieties namely Shahsarang-1, Lampnah, IR 64 and Vivek Dhan-82. The transplanting was carried out in July first week. FYM was applied well in advance of the transplanting of the crops. potato (cv. Kufri Jyoti), french bean (Naga local) and carrot (New Kuroda) were grown during pre-*kharif* season (January to May) followed by okra in *kharif* season (June to August/Sept). *Kharif* rice was harvested by leaving at least 20 cm standing stubble during last week of November and thereafter in sunken beds lentil was grown under zero tillage. For growing lentil in sunken beds, the rice fields were drained at physiological maturity. Other intercultural operations were followed as per the need.

Growth parameters and yield of rice on sunken bed

Among the rice varieties, the longest plant height

was recorded in Vivek-Dhan-82 (89.9 and 90.6 cm) in both the cropping systems i.e., rice lentil and rice pea respectively which was followed by Shahsarang-1 (88.4 cm) while variety Lampnah (68.3 cm) recorded the shortest plants. Tillers and panicle m^{-2} recorded maximum in Shahsarang-1 (322.3) followed by IR 64 (264.6). The lowest numbers of tillers were recorded in Lampnah (237) under rice lentil system. Numbers of panicle per square meter also followed the same trend as tillers m^{-2} and among the varieties lowest numbers of tillers and panicles per square meter were recorded in Lampnah in both cropping sequences. In rice based cropping systems on sunken beds, the rice yield in sunken beds ranged from 3400 to 4400 kg/ha under different sequences with mean productivity of 4010 kg/ha and 3940 kg/ha under rice-lentil and rice-pea cropping system, respectively. Among the rice varieties, Shahsarang-1 recorded the highest grain yield (4470 kg/ha) under rice-lentil cropping sequence. During *rabi*, lentil yield ranged from 1190 to 1380 kg/ha. The highest lentil yield was recorded following Shahsarang-1 variety of rice (1380 kg/ha) followed with rice variety (Vivek dhan-82) of 1200 kg/ha among rice-lentil system whereas, pea yield (4680 kg/ha) was also higher with rice (Vivek dhan-82) in rice-pea system. The highest rice equivalent yield was recorded under rice (VD-82) -pea (13210

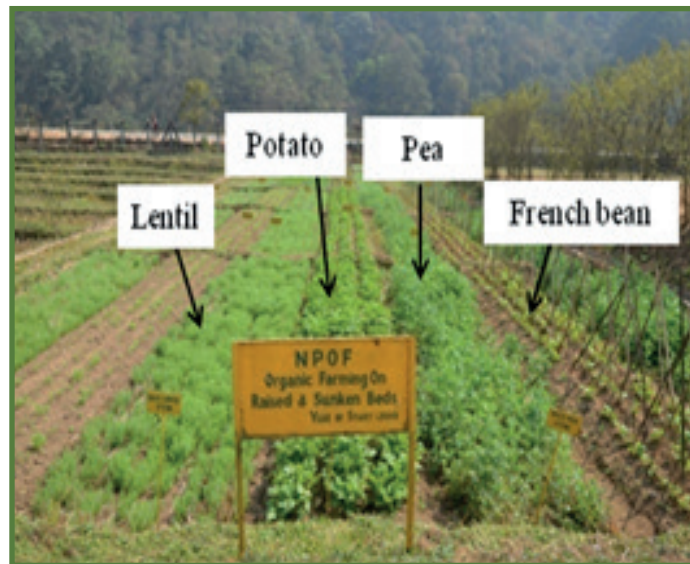
kg/ha) followed by rice (Lampnah) -pea 13200 kg/ha (Table 7.4.3.1).

Yield of vegetables on raised bed: During pre-kharif vegetable crops, potato, frenchbean and carrot recorded yield on raised bed of 18400, 12200 and 22800 kg/ha respectively. The yield of okra during *kharif* season ranged from 9000 to 9500 kg/ha and was higher with frenchbean (9500 kg/ha) in the system whereas, rice equivalent yield was recorded higher under carrot-okra cropping system of 32000 kg/ha (Table 7.4.3.2).

Physio-chemical properties of soil: French bean-okra cropping sequence recorded higher soil pH (5.23), soil organic carbon (2.45%), available nitrogen (273.2 kg/ha), available phosphorus (25.7 kg/ha) and available potassium (269.6 kg/ha) under raised beds condition followed by carrot-okra cropping sequence except soil pH and SOC where it was higher in potato-okra cropping sequence. In case of sunken beds, rice (Shahsarang-1)-lentil and rice (VD-82) -lentil cropping sequence recorded maximum soil pH (5.20) however SOC (2.74%), available nitrogen (278.7 kg/ha) and available phosphorus (28.4 kg/ha) and available potassium (278.3 kg/ha) was recorded highest in rice (Shahsarang-1)-pea cropping sequence (Table 7.4.3.3).



Rice (sunken bed) and Okra (raised bed)



Pulses and vegetables in raised and sunken bed system



Harvested carrot and potato on raised beds

Table 7.4.3.1: Growth parameters and yield (kg/ha) Kharif and rabi crops on sunken beds.

Cropping sequence	Kharif				Rabi	REY (kg/ha)
	Plant height (cm)	Tiller/m ² nos.	Panicle/m ² nos.	Rice yield (kg/ha)	Lentil /Pea yield (kg/ha)	
Rice (IR-64) - lentil	74.2	250	246	3760	1220	7440
Rice (VD-82) -lentil	89.9	251	243	3510	1350	7480
Rice (Shahsarang-1) -lentil	82.6	311	271	4470	1380	8390
Rice (Lampnah)-lentil	68.3	237	238	4280	1190	7930
Mean	78.8	262.3	249.7	4010	1290	7810
Rice (IR-64) - Pea	72.5	264.6	244.0	3610	4390	12500
Rice (VD-82) -Pea	90.6	225.3	222.3	3460	4680	13210
Rice (Shahsarang-1) -pea	88.4	322.3	322.3	4400	4340	13180
Rice (Lampnah) -pea	71.7	245.6	243.0	4290	4480	13200
Mean	80.8	264.5	257.1	3940	4470	13020

Table 7.4.3.2: Yield and rice equivalent yield of vegetable crops on raised bed

Cropping sequences	Yield of raised bed crops (kg/ha)		REY(kg/ha)
	Pre-kharif	Kharif	
Potato-okra	18400	9000	27500
French bean- okra	12200	9500	29100
Carrot- okra	22800	9100	32000
Mean	17700	9200	29500



Table 7.4.3.3: Physico-chemical properties of soil

Cropping sequences	pH	Soil organic carbon (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
Raised bed					
Potato-Okra	5.15	2.26	269.47	22.44	254.50
French bean- Okra	5.23	2.45	273.20	25.77	269.63
Carrot- Okra	5.12	2.21	271.97	22.69	262.53
Mean	5.17	2.30	271.54	23.63	262.22
Sunken bed					
Rice (IR-64) - Lentil	5.15	2.64	267.77	23.81	266.60
Rice (VD-82) -Lentil	5.20	2.63	275.67	25.02	270.87
Rice (Shahsarang-1) -Lentil	5.20	2.74	278.73	28.40	278.37
Rice (Lampnah) -Lentil	5.18	2.69	274.63	26.32	272.47
Mean	5.18	2.68	274.20	25.89	272.08
Rice (IR-64) - Pea	5.17	2.71	267.9	24.57	263.20
Rice (VD-82) -Pea	5.19	2.81	270.9	25.20	271.40
Rice (Shahsarang-1) -Pea	5.21	2.84	284.1	27.77	275.30
Rice (Lampnah) -Pea	5.20	2.81	275.8	26.50	271.87
Mean	5.19	2.79	274.7	26.01	270.4





7.5: Development of Integrated Organic Farming System models

Objective

- To evaluate the modules of organic production system to develop integrated organic farming system

Farming system modules

Module	Components
Crop	Identified high value crops of organic farming + required quantity of fodder for livestock
Livestock	Cow/Buffalo/Goat/Poultry depending upon the location and size of the model
Complimentary enterprises	Biogas, Vermicompost unit, live fencing, seed/planting material production unit & boundary plantation

Locations: Calicut, Coimbatore, Sardarkrushinagar, Thiruvananthapuram, Udaipur and Umiam,

Year of start: 2013-14

Results

The component wise results of 2017-18 for each centre are presented and discussed.

Calicut

The plot with spices, fodder and vegetables

combination was established at ICAR-IISR main campus, Chelavoor. The crops are pepper, turmeric, fodder grasses (congo signal grass, CO-3, CO-4), tapioca, banana, cowpea and pineapple were planted as inter-crop in an established coconut garden. Four cows and their calves are also maintained. Banana 80 kg, tapioca 70 kg and vegetable cowpea 12 kg were harvested. Fodder grass fed to the cows that are maintained at IISR farm. A profit of Rs 1.08 lakhs was received from one acre.

Area, yield and income of IOFS at Calicut

Enterprise	Crop/Livestock	Area (ha)	Area share (%)	Yield Kg/L/ Nos	Unit Rate (Rs)	Income (Rs)	Income share (%)
Cropping Systems	Coconut (55 Nos)	0.26		2750 nos.	14	38500	15.2
	Fodder (Co3, Co4, DHN6, Congo Signal)	0.06		700 Kg	3.50	2450	
	Turmeric	0.04		200 kg	60	12000	
	Total	0.36	90			52950	
Livestock (4 Cows)	Milk			4358 L	60	261480	83.4
	Cow dung			12000 Kg	2.40	28800	
	Total	0.01	2.5			290280	
Horticulture	Banana	0.01		80 Kg	30	2400	1.4
	Tapioca	0.01		70 Kg	25	1750	
	Vegetable Cow pea	0.01		12 Kg	50	600	
	Total	0.03	7.5			4750	
Grand Total						347980	100
Total Expenditure (Rs)						239570	
Nett Profit (Rs)						108410	
Employment generation Man days/year						410	

Coimbatore

Composition of Organic Farming System Model at TNAU, Coimbatore (0.40 ha)

Components	Net area (m ²)	Treatments / Activities / Plant species
Crop component	3400	Cropping Systems 1. Green manure - Bhendi (CO-Bh1) - Maize COH(M)6 (0.12 ha) 2. Green manure - Cotton - Redgram (0.12 ha) 3. Fodder grass (Cumbu-Napier variety CO(CN)5) and Desmanthus (0.10 ha)
Agro-forestry	500	Neem (<i>Azadirachta indica</i>), Pungam (<i>Pongamia pinnata</i>), Gmelina (<i>Gmelina arborea</i>), Ailanthus (<i>Ailanthus excelsia</i>), Wood Apple (<i>Feronia elephantum</i>), Bamboo (<i>Bambusa vulgaris</i>), Orchid tree (<i>Bauhinia</i> sp.), Mahua (<i>Madhuca longifolia</i>), Red bead tree (<i>Adenanthra pavonina</i>), Malabar neem (<i>Melia dubia</i>), Jamun (<i>Syzygium cumini</i>), Mahogany (<i>Swietenia macrophylla</i>), Myrobalan (<i>Terminalia bellerica</i>), Portia tree (<i>Thespesia populnea</i>), Paradise tree (<i>Simarouba glauca</i>) and Fig tree (<i>Ficus glomerata</i>)
Peat Repellent Cafeteria		Jatropha (<i>Jatropha curcas</i>), Adhatoda (<i>Adhatoda vasica</i>), Yellow oleander (<i>Cassia thevetia</i>), Notchi (<i>Vitex negundo</i>), Indian laurel (<i>Calophyllum inophyllum</i>), Netted custard apple (<i>Annona reticulata</i>), Bael (<i>Aegle marmelos</i>), Tanner's cassia (<i>Cassia auriculata</i>), Karanda (<i>Carissa carandas</i>), Paper flower (<i>Bougainvillea glabra</i>), Lemon grass (<i>Cymbopogon citratus</i>), Brazilian button (<i>Centratherum punctatum</i>), Soapnut (<i>Sapindus emarginatus</i>), Cathedral Bells (<i>Kalanchoe pinnata</i>), Veld grape (<i>Cissus quadrangularis</i>), Indian snake root (<i>Rauwolfia serpentina</i>), Ringworm Cassia (<i>Cassia alata</i>), Indian Aloe (<i>Aloe vera</i>), Dyer's oleander (<i>Wrightia tinctoria</i>), Bitter albizia (<i>Albizia amara</i>), Cekurmanis (<i>Sauropus androgynus</i>), Morning glory (<i>Ipomoea purpurea</i>), Castor (<i>Ricinus communis</i>), Blue Ginger (<i>Alpinia galangal</i>), Kalmegh (<i>Andrographis paniculata</i>), Nerium (<i>Nerium oleander</i>), Century plant (<i>Agave tequilana</i>), Climbing brinjal (<i>Solanum trilobatum</i>), Madras thorn (<i>Pithecellobium dulce</i>), Henna (<i>Lawsonia inermis</i>), Lantana (<i>Lantana camara</i>), Noni (<i>Morinda citrifolia</i>), Calotropis (<i>Calotropis procera</i>), Datura (<i>Datura metel</i>), Vetiver (<i>Chrysopogon zizanioides</i>), Nithya kalyani (<i>Catharanthus roseus</i>), Kalluruki (<i>Scoparia ducis</i>), Karpuravalli (<i>Plectranthus amboinicus</i>), Thulasi (<i>Ocimum sanctum</i>), Ginger (<i>Zingiber officinale</i>), Turkey berry (<i>Solanum torvum</i>), Papaya (<i>Carica papaya</i>), Soursop (<i>Annona muricata</i>) and Crepe jasmine (<i>Tabernaemontana divaricata</i>).
Dairy	20	Heifer calves: 2 Nos.
Manure pit	30	Residue from the crops and manure from Dairy unit will be converted into compost and used as manure for crops
Supporting activities	50	Threshing floor, cattle shed, cow dung pit, cow urine collection unit composting units, nutrition garden etc.
Border plants	-	Banana, glyricidia, coconut, desmanthus, annual moringa, teak and curry leaf
Total	4000	

Performance of okra and maize in green manure-bhendi (okra) - maize system

Before raising bhendi, the green manure (*sesbania aculeata*) was raised, and in-situ incorporation was done at the time of flowering. The fresh and dry weight and nutrient contents of the *sesbania*

aculeata were estimated for nutrient management. The fresh biomass added was found to be 18.75 t/ha and nutrient added was found as 106.5 kg/ha.

The harvesting starts on 35 DAS and the fruits were harvested in tender stage at alternate days. The number of fruits per plant was 17.5 with the average



fruit length of 9.8cm. The fruit yield of bhendi was 14345 kg/ha whereas, the cost of cultivation incurred per hectare was Rs.61750 and the gross return obtained from bhendi crop was of Rs.143450/ ha. The net return was found to be of Rs.81700/ha with benefit cost ratio of as 2.32. Maize variety COH (M) 6 was sown in the system gave 4931 kg/ha of grain yield. Gross return of Rs. 73965/ha was recorded from maize plot. Maize recorded the net income of

Rs. 41,370/ha with 1.94 B:C ratio under integrated organic farming model.

Performance of cotton and redgram in green manure - cotton - red gram system

Cotton recorded 1396 kg/ha of seed cotton yield with the gross and net return of Rs. 62,820 and Rs. 27,050/ ha respectively. Redgram yield (1317 kg/ha) was also obtained with net return of Rs. 30,629/ha from the IOFS model.

Yield and economics of okra and maize under integrated organic farming system model at Coimbatore

Cropping system	Crop & variety	Yield (kg/ha)	Gross return (Rs./ha)	Cost of cultivation (Rs./ha)	Net return (Rs./ha)	BCR
Green manure - Bhendi - Maize	Bhendi CO(Bh)1	14345	143450	61750	81700	2.32
	Maize COH(M)6	4931	73965	39455	36976	1.94

Yield and economics of cotton and red gram under organic farming system model at Coimbatore

Cropping system	Crop	Yield (kg/ha)	Gross return (Rs./ha)	Cost of cultivation (Rs./ha)	Net return (Rs./ha)	BCR
Green manure- Cotton- Redgram	Cotton (TCH1819)	1396	62820	35770	27050	1.76
	Redgram (CO7)	1317	72435	42465	30629	1.72

Soil Organic Carbon (%) at different cropping systems at Coimbatore

Cropping system	Crop	2013-14	2014-15	2015-16	2016-17	2017-18
Green manure-Bhendi-Maize	Bhendi	0.44	0.46	0.47	0.57	0.58 31.82%
	Maize	0.46	0.46	0.48	0.53	0.54 17.4%
Green manure-Bhendi-Maize	Cotton	0.44	0.46	0.49	0.56	0.57 29.5%
	Redgram	0.45	0.47	0.53	0.56	0.59 31.1%

The total cost of cultivation was recorded at Rs. 2,16,090/- per year under the IOFS model with an area of 0.40 ha. Maximum expenditure was incurred in crop component of the model with 83% of the total cost of cultivation. Dairy unit with two milch animal registered 11.1% of the total cost of cultivation. A total net return of Rs. 3,17,923/- per year was achieved under the IOFS model. The highest contribution

towards the total net return was contributed by crop component of the model (56% of the total income Rs.176355) followed by dairy which contributed 32% share of the total income through milk and manure (Rs. 101068). Other allied components shared 13% of the total income (Rs. 40500) whereas 453 man-days were generated as employment within the year from IOFS model

Income generated from all the components of IOFS model at Coimbatore

Farming System components	Total area	Equivalent Yield (kg/ha)	Cost of cultivation (Rs/ha)	Net returns (Rs/ha)
Green manure-Bhendi-Maize	3400 m ²	8131	101205	118676
Green manure-Cotton-Red gram		3157	78235	57679
Fodder CO (CN) 5		15 t of green grass	5000	13500
Agro-forestry	500 m ²	-	-	-
Pest repellent cafeteria		70 plants	1000	2000
Dairy	30 m ²	2 milch animals	24000	79708
Manure pit	10 m ²	14.24 t cow dung	-	21360
Border plants	70 m ²	-	-	-
Coconut		3000 nuts / annum	4000	15000
Teak		-	-	-
Banana		10 plants	500	2000
Glyricidia		3 t green leaf	500	3000
Velimasal		2.5 t of green fodder	1000	2500
Annual moringa		50 kg	250	1000
Curry leaf		500 kg	400	1500
Total			2,16,090	3,17,923

Sardarkrushinagar

Composition of Organic Farming System Model at Sardarkrushinagar (Gujrat)

Farming system model components	Net Area (ha)
Crops: Groundnut-wheat-green gram	0.24
Green Fodder: F. Bajara- F. Maize + F. Oat- F. Bajara	0.15
Livestock + Vermicompost	0.01
Boundary Plantation: Adrusa, Napier grass, Hybrid Napier	Round the year
Total	0.40

IOFS model is comprised of different components viz., Crops (0.24 ha), green fodder crops (0.15 ha), dairy & vermi-compost (0.01 ha) and boundary plantation. Total net profit of ` 28,211 was received by crop component from 0.24 ha and net profit of `

19,737 was received by green fodder unit (0.15 ha.). Adrusa, Napier grass and lemon grass have been planted around the border and bunds. Total net profit from all the components of IOFS Model during 2017-18 was ` 47,948 from 0.4 ha area.

Yield (kg/ha) and economics (Rs./ha) of IOFS Model at Sardarkrushinagar

Sl. No.	Farming system components	Total Area (ha)	Ground nut equivalent yield (kg)	Gross return (₹)	Cost (₹)	Net Returns (₹)
1	Groundnut-wheat-green gram	0.24	1257	62838	34627	28211
2	F. Bajra- F. Maize + Oat- F. Bajra	0.15	1081	54066	34329	19737

Sl. No.	Farming system components	Total Area (ha)	Ground nut equivalent yield (kg)	Gross return (₹)	Cost (₹)	Net Returns (₹)
3	Livestock + Vermicompost	0.01	Construction of animal shed and purchases of animals is awaited due to unavailability of grant			
4	Boundary Plantation	-	-	-	-	-
Total		0.40	2338	116904	68956	47948
Employment generation (Man days)		0.27/day				
System Profitability		₹ 126/day				

Thiruvananthapuram

An Integrated Organic Farming System model is being developed at research farm of ICAR-CTCRI, Thiruvananthapuram consisting of food crop components, cassava, taro, vegetable cowpea, maize

and fodder grass. Crop cassava and taro were taken during 2017-18. The yield of cassava and taro was recorded 40121 and 10565 kg/ha with net return of Rs. 4,33,490 and 1,29,680 respectively from the model.

Farming system components	Total area	Equivalent yield (kg ha ⁻¹)	Cost (Rs ha ⁻¹)	Net returns (Rs ha ⁻¹)
2017-18				
Cassava (var. Sree Pavithra)	30 cents	40121	168325	433490
Taro (var. Sree Kiran)	30 cents	10565	292920	129680
2018-19				
Cassava (var. Sree Pavithra) + vegetable cowpea (Anaswara)	25 cents	Planted during August-September 2018		
Maize (var. Co-H(M)-6)	20 cents	Sown on 4 October 2018		
Hybrid Napier grass (var. Co-3)	15 cents	Sown on 8 October 2018		



Hybrid maize



Hybrid Napier grass



Food crop components of IOFS at Thiruvananthapuram

Udaipur

An integrated organic farming system model for 0.45 ha consisting of field crops in 0.25 ha (sweet corn + blackgram during *kharif* and wheat during *rabi*), fodder crops in 0.05 ha. (fodder maize + cowpea during *kharif* and berseem in *rabi* and *sesbania*

green manuring during *zaid*), vegetables in 0.10 ha (tomato and cowpea), fruit crop in 0.04 ha (guava) and compost unit in 0.01 ha were evaluated during 2017-18. The total maize equivalent yield of 5120 kg/ha and a net return of Rs. 63068 /ha was obtained from the farming system model.

Yield and economics of different components of organic farming system at udaipur

Farming System components		Total area (ha)	Actual yield (kg)	Maize equivalent yield (kg)	Cost of cultivation (Rs)	Gross return (Rs)	Net return (Rs/ha)	Net return per rupee invested
1. Crops								
Kharif	Sweet corn + Blackgram	0.25	520	970 (75)**	12322	18630	6308	0.51
Rabi	Wheat		857	1600	8650	40810	32160	3.71
2. Fodder								
Kharif	Fodder Maize + Cowpea	0.05	3050 (212)	1250 (212)	6000	18750	12750	2.12
Rabi	Berseem		2777	1000	3650	15000	11350	3.10
Zaid	Sesbania				Used as green manuring			
3. Vegetable								
Kharif	Tomato	0.10	-					
Zaid	Cowpea		-					
4. Fruits	Papaya	0.04	Guava is under 2 nd year of planting					
5. Com-post unit	NADEP com-post	0.01	14000	**Figure in parenthesis indicate actual yield of crop / intercrop. Price: Sweet corn- Rs. 30 /kg; Black gram- Rs. 90 /kg; Fodder Maize- Rs. 5.1 /kg; Fodder Cowpea- Rs. 5.4 /kg; Berseem- Rs. 5.4 /kg				
	Vermicompost		6000					
	Compost		12000					
	Vermiwash		380 lit	Three year data reveal that the total maize equivalent yield of 4829 kg/ha and a net return of Rs. 62447/ha was obtained from the farming system (Table 3.2).				
	BD 500		1.4					
	BD 501		1.2					
	Earthworms		200					
	Total							



Experimental site



Sweet corn + blackgram (2:2)



T. aestivum variety Raj-4120



Green manurecrop (*Sesbania rostrata*)



Guava (Lalit and Shweta)



Okra JCOH-7305

Crops in IOFS Model at NPOF, Udaipur



Panchagavya



Vermiwash production



Beejamrut



Jeevamrut



Earthworm Production



Different types of compost

Components of integrated farming system model at NPOF, Udaipur

Umiam

The IOFS model comprising different enterprises such as cereals (rice and maize), pulses (lentil, pea), oilseeds (soybean, rapeseed), vegetable crops (French bean, tomato, carrot, okra, brinjal, cabbage, potato, broccoli, cauliflower, chili, coriander, etc.), fruits (Assam lemon, papaya, peach), dairy unit (a milch cow + calf), fodder crops, central farm pond, farmyard manure pits and vermicomposting unit. A farm pond of 460 m² area with average depth of 1.5 m was part of the IOFS model for life saving irrigation and aquaculture. Climbing vegetables such as bottle gourd, chow-chow, cucumber, ridge gourd etc., were grown on a structure created above water bodies in one side of the pond dyke for vertical intensification. Pumpkin was raised in another side of the pond and allowed to crawl on the ground. The washings from the dairy unit were diverted to fish pond for promoting growth of zooplankton and phytoplankton for fish growth. The solid waste from cow shed was used for FYM making and vermicomposting.

The total cost of cultivation was recorded at Rs. 56,835/- per year under the IOFS model with an area of 0.43 ha. Maximum expenditure was incurred in crop component of the model with 46.15% of the total cost of cultivation. Dairy unit with one adult cow and one calf registered 37.74 % of the total cost of cultivation, while fishery component recorded 8.71% of the total cost of cultivation. For maintaining vermicomposting unit of 72 m² area and other important operations like hedgerow planting, residue recycling, rock phosphate application and liming, the expenditure incurred was Rs. 4200/- which account to 7.38 % of the total cost. A total net return

of Rs. 73,903/- per year was achieved under the IOFS model which is much higher than the region's farmer common practices of rice mono-cropping or improved practice of rice-vegetables cropping system. The highest contribution towards the total net return was contributed by crop component of the model (66.44%) followed by dairy (23.95%) and fishery component (15.29%). The fish production was 140 kg. The net return from dairy component was calculated only in terms of milk production since the cow dung produced was recycled back into the model which was used as manure for crop production. The quality of milk obtained under organic management of dairy has been observed in the Integrated Organic Farming System (IOFS) models experiment and was compared to the quality of milk obtained under conventional management

For 0.43 ha area, the total nutrient requirement for organic crop production has been estimated at nitrogen (N) - 66.15 kg, phosphorus (P₂O₅) - 23.63kg and potassium (K₂O) - 55.02kg (Table 29). On farm nutrient recycling in IFOS could produce an amount of 63.57 kg N, 19.56kg P₂O₅ and 55.04 K₂O. Hence, 94.34% of the total N requirement, 81.21% of the total P₂O₅ requirement and total of 98.23K₂O % requirement could be met within the model itself and only 4.6% of the total N requirement, 17.9 % of the total P₂O₅ requirement is required to be met from the external source to sustain the model. The nutrient requirement of the model from external source would be reduced substantially with the efficient recycling of pond silt, intercropping with legume, use of bio-fertilizers such as azotobacter, rhizobium, phosphorus solubilizing microorganism etc

Economics of the IOFS model at Umiam (Meghalaya)

Farming System components	Total area (ha)	Rice equivalent Yield (t/ha)	Cost (Rs)	Net returns (Rs)	Net return (Rs/ha)
Crops (Cereals, pulses, oilseeds, vegetables, fruits and fodder crops)	0.3745	5.02	26235	49103	-
Dairy (1 milch cow + 1 calf)	0.0036	2.61	21450	17700	-

Farming System components	Total area (ha)	Rice equivalent Yield (t/ha)	Cost (Rs)	Net returns (Rs)	Net return (Rs/ha)
Fishery (Composite)	0.046	1.08	4950	11300	-
Nutrient cycling (Vermicompost/FYM/Hedgerow planting/ Residue recycling/Rock phosphate application/Liming)	0.0070	-	4200	-4200	-
Total	0.4311	8.71	56,835	73,903	1,85,821
Net income/day	-	-	-	202	509

On-farm nutrient supply balance sheet under IOFS model at Umiam (Meghalaya)

Components	Nutrient requirement (kg)			On-farm nutrient recycled (kg)			Nutrient Balance (kg)		
	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
Cereals (Rice, Maize)	20.97	7.49	17.37	6.61	2.30	12.28	-14.36	-5.2	-5.09
Horticultural crops (Vegetables, Fruits)	33.08	11.82	27.62	14.97	3.14	11.21	-18.11	-8.68	-16.41
Dairy	0.0	0.0	0.0	12.10	4.54	6.05	12.1	4.54	6.05
Others (Oilseeds, Pulses, Green manuring crop, fodder, etc.)	12.10	4.32	10.03	29.89	9.58	25.50	17.79	5.26	15.47
Total	66.15	23.63	55.02	63.57	19.56	55.04	-3.74	-4.44	-0.97
							94.34%	81.21%	98.23%

Considering the benefits from the IOFS model with a net return of Rs. 73,903/- per year from 0.43-hectare area, a net income of Rs. 6262/- per month or Rs. 202/- per day was achieved which is a modest amount for living by a four-member family (2 adults and 2 children). Assuming of food requirement and other expenditure per day for a four-member family (2 adults and 2 children) for rice (1300 g, Rs. 33), dal

(150 g, Rs. 15), oil (300 g, Rs.15), vegetables (1000 g, Rs. 25), fruits (400 g, Rs. 20), fish (110 g, Rs.17), meat (100g, Rs.15), others (milk, egg etc. Rs. 15), a total of Rs. 155 is required per day towards food. However, there is further needed to enhance the income to meet the other requirement of the family i.e., medicine, schooling, clothing etc.





Different vegetables and Vermicompost unit under IOFS model at Umiam Meghalaya

7.6. Farm waste recycling techniques for organic farming

Objective

- To develop need-based cost-effective new techniques for farm-waste recycling

Locations: Almora, Dharwad and Modipuram

Year of start: 2014-15 (Modipuram); 2015-16 (Almora and Dharwad)

Results

Only Almora and Modipuram reported the results

Almora

Farm wastes were composted with different proportion of raw materials and inoculation of different microbes and earthworm. The total fungal population was highest with inoculation of *Pleurotus sajorcaju* + *Trichoderma harzianum* + Bio-

mineralizer + *Aspergillus niger* + *Azotobacter* spp. to the 3:1:1 ratio of CR -cereal residue :CDS - Cattle dung slurry :LR - Legume residue during composting (Table 4). The microbial count of *Trichoderma* spp. and *Aspergillus* spp. were highest with inoculation of *P. sajorcaju* + *T. harzianum* to the 3:1:1 ratio of CR:CDS:LR and *P. sajorcaju* + *T. harzianum* + 'Bio-mineralizer + *Aspergillus niger* + *Azotobacter* spp. to the 4:1 ratio of CR:CDS, respectively. The highest microbial count treatment recorded 52, 59 and 49% higher population of total fungus, *Trichoderma* spp. and *Aspergillus* spp. compared to control treatment, respectively. Vermicomposting with the 3:1:1 ratio of CR:CDS:LR provided 30 and 5% higher microbial count of total fungus and *Trichoderma* spp. compared to control treatment, respectively. Addition of legume residue for preparation of composts from farm waste enhanced the total fungal and *Trichoderma* count (Table 7.6.1.1)

Table 7.6.1.1: Microbial count of composts from farm waste

Treatment	Total fungal population (cfu/g)	Total <i>Trichoderma</i> spp. (cfu/g)	Total <i>Aspergillus</i> spp. (cfu/g)
Control (CR:CDS ^a) = 4:1	3.24	2.05	1.11
Vermi-compost (CR:CDS = 4:1)	3.99	2.10	1.02
Vermi-compost (CR:CDS:LR = 3:1:1)	4.21	2.15	1.05
CR:CDS = 4:1 + <i>Pleurotus sajorcaju</i> + <i>Trichoderma harzianum</i>	4.37	3.21	1.03
CR:CDS:LR = 3:1:1 + <i>P. sajorcaju</i> + <i>T. harzianum</i>	4.43	3.25	1.10
CR:CDS = 4:1 + <i>P. sajorcaju</i> + <i>T. harzianum</i> + 'Biomine-ralizer + <i>Aspergillus niger</i> + <i>Azotobacter</i> spp.	4.85	3.05	1.65
CR:CDS:LR = 3:1:1 + <i>P. sajorcaju</i> + <i>T. harzianum</i> + Biomine-ralizer + <i>Aspergillus niger</i> + <i>Azotobacter</i> spp.	4.92	3.10	1.59

^aCR -Cereal residue

CDS - Cattle dung slurry

LR - Legume residue

'Biomine-ralizer = Microbial consortia of P & Zn solubilizer and PGPR

Modipuram

Evaluation of Farm waste recycling techniques for organic farming:

Treatments details

Treatments	Description
T ₁	Maize stover+ rice straw (3:1 ratio) + Soil+ cow dung/urine (C:N ratio 30:1)



Treatments	Description
T ₂	Maize stover+ rice straw (3:1 ratio) + Soil + legume/ <i>Leucaena</i> biomass + cow dung/urine (C:N ratio 30:1)
T ₃	Maize stover+ rice straw (3:1 ratio) pre-treated with <i>Trichoderma</i> (15 days in advance)+ Soil+ legume/ <i>Leucaena</i> biomass + cow dung/urine (C:N ratio 30:1)
T ₄	Maize stover+ rice straw (3:1 ratio) + Soil +cow dung/urine + TNAU Biomineralizer@2kg/ton residue (C:N ratio 30:1)
T ₅	Maize stover+ rice straw (3:1 ratio) + Soil +other farm residues + cow dung (Vermicomposting) in 2 feet high piles
T ₆	Maize stover+ rice straw (3:1 ratio) + Soil +legume/ <i>Leucaena</i> biomass + cow dung/urine + bio-enrichment at curing phase with <i>Azotobacter</i> , <i>PSB</i> , <i>Trichoderma</i> etc. (C:N ratio 30:1)
T ₇	Maize stover+ rice straw (3:1 ratio) in piles as Control

Treatment maize stover + rice straw (3:1 ratio) pre-treated with *Trichoderma* (15 days in advance)+ soil+ legume/*Leucaena* biomass + cow dung/urine (C:N ratio 30:1) showed fastest decomposition within 60 days with final volume of 0.530 M³ against 0.970 M³ in control. The constant temperature (25°C) near to ambient was also noticed in case of treatment 3 i.e.

maize stover+ rice straw (3:1 ratio) pre-treated with trichoderma (15 days in advance)+ soil+ legume/*Leucaena* biomass + cow dung/urine (C:N ratio 30:1). Least rate of decomposition was found with control (total volume of 0.970 M³ at 60 days) with higher temperature (42°C) which shows the continuation of the active decomposition phase (Table 7.6.2.1)

Table 7.6.2.1: Effect of different treatments on nutrient content of different residues

Treatment details	Weight of waste (before composting)	Compost yield (kg)	Cost of inputs (Rs)	N content (%)	P ₂ O ₅ content (%)	K ₂ O (%)
Maize stover + rice straw (3:1 ratio) + Soil+ cow dung/urine (C:N ratio 30:1)	3 Qtl.	1.76 Qtl.	350	0.35	0.21	0.38
Maize stover+ rice straw (3:1 ratio) + Soil + legume/ <i>Leucaena</i> biomass + cow dung/urine (C:N ratio 30:1)	3 Qtl.	1.54 Qtl.	375	0.56	0.28	0.36
Maize stover+ rice straw (3:1 ratio) pre-treated with <i>Trichoderma</i> (15 days in advance)+ Soil+ legume/ <i>Leucaena</i> biomass + cow dung/urine (C:N ratio 30:1)	3 Qtl.	1.50 Qtl.	400	0.59	0.30	0.41
Maize stover+ rice straw (3:1 ratio) + Soil +cow dung/urine + TNAU Biomineralizer@2kg/ton residue (C:N ratio 30:1)	3 Qtl.	1.46 Qtl.	410	0.58	0.18	0.35
Maize stover+ rice straw (3:1 ratio) + Soil +other farm residues + cow dung (Vermicomposting) in 2 feet high piles,	3 Qtl.	1.58 Qtl.	430	0.53	0.23	0.34
Maize stover+ rice straw (3:1 ratio) + Soil +legume/ <i>Leucaena</i> biomass + cow dung/urine + bio-enrichment at curing phase with <i>Azotobacter</i> , <i>PSB</i> , <i>Trichoderma</i> etc. (C:N ratio 30:1)	3 Qtl.	1.62 Qtl.	450	0.60	0.19	0.51
Maize stover+ rice straw (3:1 ratio) in piles as Control	1.5 Qtl.	0.97 Qtl.	300	0.32	0.21	0.35

7.7. Documentation of ITK on organic production, pest & disease management

Objective

- To document popular ITKs in Organic Farming
- To test the documented ITKs

Year of start: 2015-16

Locations: Ajmer, Gangtok, Narendrapur and Udaipur

Results

The results of 2017-18 for each centre are presented and discussed.

Ajmer

- Uses of tumba (*Citrullus colocynthis*) fruit extract provide good protection against insect-pests in vegetables including seed spices.
- Use of asafoetida (*Ferula asafoetida*) pieces or neem leaves for safe storage of grains/pulses in the storage.
- Use of green leaf of neem (*Azadirachta indica*), datura (*Datura stramonium*) and aak (*Calotropis gigantea*) in equal quantity and buried in a pit and allow them to ferment the mixture for 25-30 days. After this process the resultant sprayed with 15 % solution it prevents sucking insect pests. For prevention grubs the ark of above product is given with irrigation water.
- In cucurbitaceous vegetables smoke of lobhan is released to prevent grub/ insect which affect shape of fruits and create hole in them.
- Dusting of finely dried tobacco (*Nicotiana tabacum* L.) leaves powder maintains sucking pests' population on seed spices.

Gangtok

- A. **ITK:** Farmers are using well decomposed cow dung extract (10%) and keeping it for 3-4 days then filtering the extract with a cotton cloth before applying to improve the production and productivity of vegetable crops. **Validation:** In

the current year, we have conducted studies taking following treatments to validate the ITK in broccoli, cauliflower and carrot crop. T1: Cow dung extract (5%); T2: Cow dung extracts (10%) Farmer's Practice; T3: Cow dung extract (15%) and T4: Control (only water spray).

Results: The experiments were conducted on broccoli, cauliflower and carrot crop growing under low cost plastic tunnels. It was observed that all the treatments have significantly improved the yield of broccoli, cauliflower and carrot as compared to control. There was not significant difference observed between farmers practice (T2) and higher doses (T3) applied for broccoli yield (7.3 kg/m² and 7.0 kg/m², respectively). However, when higher doses (T3) applied then cauliflower (7.2 kg/m²) and carrot (6.8 kg/m²) yielded higher than the farmers practice (T2) for cauliflower (6.5 kg/m²) and carrot (6.2 kg/m²), respectively. Lower dose (T1) yield was significantly less than the farmers practice (T2). The yield gap and per cent yield difference between farmers practice (T2) and control (T4) was recorded for broccoli (4.3 kg/m² and 58.90%), cauliflower (3.5 kg/m² and 53.80%) and carrot (2.3 kg/m² and 37.09%), respectively.

- B. **ITK:** Farmers are using cow urine @ 10% for improving the yield of cucurbitaceous vegetables (cucumber, sponge gourd and ridge gourd)

Validation: We have conducted studies taking following treatments to validate the ITK. T1: Cow urine (5%); T2: Cow urine (10%) Farmers Practice; T3: Cow urine (15%) and T4: Control (only water spray)

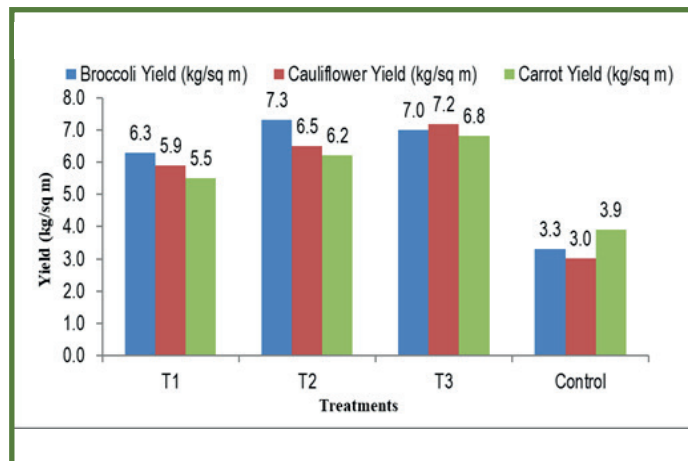
Results: The experiments were conducted on cucumber, sponge gourd and ridge gourd growing under low cost plastic rain shelters. It was observed that all the treatments have significantly improved the yield of cucumber, ridge gourd and sponge gourd as compared to control. There was no significant difference observed between farmers practice (T2) and

lower (T1) or higher doses (T3) applied. The yield of cucumber (5.3 kg/plant), ridge gourd (3.6 kg/plant) and sponge gourd (3.3 kg/plant) was highest in the farmers practice (T2) as compared to Control, T1 and T3. The yield gap and percent

yield difference between farmers practice (T2) and control (T4) was recorded for cucumber (2.7 kg/plant and 50.94%), ridge gourd (2.4 kg/plant and 66.66%) and sponge gourd (1.9 kg/plant and 57.5%), respectively.



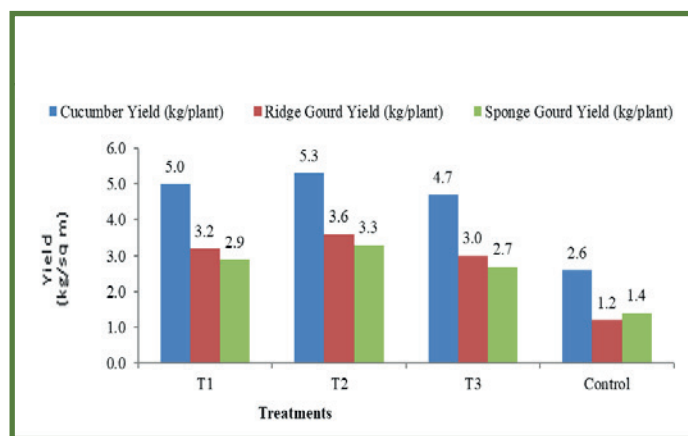
Farmers ITK validation in broccoli at Gangtok



Yield of broccoli, cauliflower and carrot at Gantok



Farmers ITK validation in cucumber at Gangtok



Yield of cucumber, ridge gourd and sponge gourd at Gangtok

Narendrapur

Name of the ITK: Kunapajala

- **With enrichment agent- Bombay Duck fish:** pH-5.90; EC-8.89 mS/cm; Available N-2.58 mg/ml; Available P-263.60 mg/ml; Available K-265.16 mg/ml; Organic Carbon-1.71%; Iron-3.075 ppm; Zinc-0.77 ppm; Copper-0.88 ppm; Manganese-2.70 ppm; and IAA content-83 µg/ml. Total microbial load: Bacteria-93.33±8.82x10⁸; Fungi- 136.67±6.67x10⁴; and Actinomycetes-163.33±14.53x10⁶.

- **With enrichment agent- Chicken and Mutton wastes (Fleashes, skin, soft bones):** pH-5.72; EC-7.95 mS/cm; Available N-2.42 mg/ml; Available P-500.98 mg/ml; Available K-219.90 mg/ml; Organic Carbon-1.81%; Iron-4.912 ppm; Zinc-0.590 ppm; Copper-0.750 ppm; Manganese-2.044 ppm; and IAA content-132.33 µg/ml. Total microbial load: Bacteria-276.67±1453x10⁸; Fungi-420.67±8.82x10⁴; and Actinomycetes-163.33±14.53x10⁶.

Udaipur

Management of Anthracnose, Alternaria Leaf Spot and Powdery Mildew of Organic Black gram (*Vigna mungo* L.) through ITKs

An experiment was conducted with the objective to evaluate the effect of different ITKs on management of Anthracnose, Alternaria leaf spot and powdery mildew of organic black gram and mungbean. Application of neem cake 2 q/ha + Trichoderma. 2

kg/ha incubated on 100 kg FYM applied uniformly in all the treatments except control. Foliar spray was given at 35, 50 & 65 DAS. Treatments included Neem oil, Neem leaf extract (NLE), Tulsi, Garlic bulb extract, Indian aloe and Indigenous fungicide (ITK). Three concentrations viz., lower dose (LD), optimum dose (OD) and higher dose (HD) for inputs used as mentioned below were applied. Black gram variety PU-31 was taken up.

Treatments

S. No	Treatment	Concentrations (%)
1	Neem oil	0.5, 1 & 1.5
2	NLE	5, 10 & 15
3	Tulsi leaf extract	0.5, 1 & 2
4	Garlic bulb extract	2, 4 & 5
5	Indian aloe	0.5, 1 & 2
6	ITK	Cow milk -5 litre Black pepper powder - 200g Water - 200 litre
7	Untreated control	-

Method of preparation:

Indigenous fungicide (ITK): Indigenous fungicide (ITK) used was Cow milk -5L, black pepper powder - 200g, water - 200 L, these constituents were mixed in required quantity for spray in 1 acre area. (Anon. 2015)

Neem oil: Neem oil developed by Shree Aushadh Pratisthan, Udaipur, for commercial purpose was used.

Garlic extract: 50 g of cleaned garlic bulbs were

washed and crushed in 2.5 litres of water. The crushed product was tied in muslin cloth and filtrate was collected and sprayed in pots.

The first spray of treatments (Neem oil (0.5% v/v), garlic bulb extract (2%), Indian aloe (2%), BD-501(1g/13L) and ITK) were applied on the initiation of symptoms and subsequent second spray repeated at 10-days interval by hand atomizer.

Methodology:

PDI was calculated by using the following formula: -

$$\text{Per cent disease index (PDI)} = \frac{\text{Sum of all individual disease rating}}{\text{Total No. of plants assessed} \times \text{maximum rating}} \times 100$$

Results (Table 7.7.1)

Application of neem oil recorded significantly lowest PDI 30.51 of *Alternaria* leaf spot in black gram followed by NLE, Tulsi, Garlic bulb extract, Aloe vera and Indigenous fungicide (ITK), with PDI 33.66, 37.86, 42.31, 43.36 and 48.62 respectively. Among three concentrations against *Alternaria* leaf spot of blackgram, LD exhibited significantly higher PDI

of 48.54 as compared to OD and HD. Application of neem oil to black gram recorded significantly lowest PDI 25.83 of Powdery Mildew followed by NLE, Tulsi, Garlic bulb extract, Aloe vera and Indigenous fungicide (ITK), with PDI, 32.73, 38.60, 42.75, 43.0 and 53.45 respectively. Among three concentrations of tested treatments against Powdery Mildew LD exhibited significantly higher PDI 49.63 as compared to OD and HD.

Similarly, application of neem oil to black gram recorded significantly lowest PDI 29.60 of Anthracnose followed by Neem Leaf extract, Tulsi, Garlic bulb extract, Aloe vera and Indigenous fungicide (ITK), with PDI 31.73, 32.75, 36.95, 38.0 and 38.15, respectively. Among three concentrations against Anthracnose, LD exhibited significantly higher PDI 41.62 as compared to OD and HD.

Yield: Among the different treatments evaluated,

maximum seed yield of black gram was observed with foliar application of neem oil with 1055 kg/ha followed by NLE, Indigenous fungicide (ITK), Garlic bulb extract, Aloe vera, and Tulsi with yield 962, 872, 917, 912 and 956 kg/ha, respectively. Lowest yield 780 kg ha⁻¹ was observed in control. Among three concentrations of tested treatments, HD exhibited significantly highest yield 1088 kg ha⁻¹ as compared to OD and LD.

Table 7.7.1: Effect of ITK on control of Powdery Mildew, *Alternaria* Leaf Spot, Anthracnose and yield of organic blackgram (*Vigna mungo* L.)

Treatments	Powdery mildew (PDI)	<i>Alternaria</i> leaf spot (PDI)	Anthracnose PDI	Yield (kg/ha)
Neem oil	25.83 (30.19)	30.51 (33.51)	29.60 (32.94)	1055
Neem leaf extract	32.73 (34.86)	33.66 (35.42)	31.73 (34.24)	962
Tulsi leaf extract	38.60 (38.37)	37.86 (37.91)	32.75 (34.90)	872
Garlic bulb extract	42.75 (40.82)	42.31 (40.54)	36.95 (37.42)	917
Indian aloe vera	43.00 (40.97)	43.36 (41.18)	38.00 (38.03)	912
ITK	53.45 (46.98)	48.62 (44.21)	38.15 (38.14)	956
Control	78.44 (62.36)	74.88 (60.07)	67.58 (55.32)	835
CD at 5 %	3.958	4.268	2.990	87
L.D	49.63 (44.93)	48.54 (44.26)	41.62 (40.15)	649
O.D	43.30 (41.04)	42.87 (40.89)	38.35 (38.15)	1053
H.D	41.99 (40.27)	41.97 (40.35)	37.79 (37.84)	1088
CD at 5 %	2.591	2.794	1.957	57

L. D = lower dose, O.D = optimum dose and H. D = high dose

Figure in Parenthesis: Arc sine values

Management of *Alternaria* leaf spot and Powdery mildew of mung bean through organic practices & ITKs under natural condition.

Treatment Details

- Seed treatment by Beejamrut
- Soil application of mushroom spent compost (5 % with FYM)
- Soil application of mushroom spent compost + Foliar spray of BD-501 (1 g 13 L-1 water)
- Seed treatment of Beejamrut + Foliar spray of BD-501 (1 g 13 L-1 water)
- Soil application of mushroom spent compost + Foliar spray of indigenous fungicide

- Seed treatment of Beejamrut + Foliar spray of indigenous fungicide
- Foliar spray of BD-501 (1 g 13 L⁻¹ water)
- Foliar spray of indigenous fungicide
- Control

Method of preparation & application:

Beejamrut: Beejamrutha was prepared using the ingredients viz cow dung, cow urine, water and lime. Cowdung (5 kg) tied in a cloth was dipped in a bucket containing 50 liters of water overnight. Next day morning, the tied dung is frequently squeezed and dipped in the water. Five litres of cow urine, a handful of soil and 50g of calcium chloride was added to this extract.

Mushroom spent compost: Mushroom spent compost was prepared by adding mushroom spent compost in FYM @ 5% and incubated for 15 days. Furrow application was given before sowing.

BD-501(Biodynamic Formulation - 501): Biodynamic

formulation sourced from the Organic Unit, Directorate of Research, MPUAT was used. BD 501 is “cow horn silica” and is made from quartz crystals ground to alum power consistency, stuffed into a cow horn, buried during spring equinox, and taken out during autumn equinox. The material is stored in glass bottle and exposed to the sun by the windowsill. Spray solution was prepared by dissolving 1 g BD-501 in 13 L of water, agitated with a clean wooden stick clockwise and anticlockwise for one hour and was sprayed as a fine mist on the foliage in the morning (before 9.00 AM). The application dates corresponded to days when moon ascending in the biodynamic calendar.

Indigenous fungicide (ITK): Indigenous fungicide (ITK) used was Cow milk -5L, Black pepper powder - 200g, Water - 200 L, these constituents were mixed in required quantity for spray in 1 acre area.

Methodology: PDI was calculated by using the following formula:

$$\text{Per cent disease index (PDI)} = \frac{\text{Sum of all individual disease rating}}{\text{Total No. of plants assessed} \times \text{maximum rating}} \times 100$$

Results (Table 7.7.2):

Seed treatment with beejamrut + one foliar spray of BD-501, significantly reduced the *Alternaria* blight of mungbean over their sole applications as well as un-treated inoculated control. The maximum PDI (72.33) was observed in the un-treated inoculated control. Lowest disease with PDI 36.33 was recorded in seed treatment with beejamrut + one foliar spray of BD-501. Similarly maximum suppression of

powdery mildew of mungbean was observed with seed treatment with beejamrut + one foliar spray of BD-501. Maximum PDI (64.67) was observed in the un-treated inoculated control. The lowest disease with PDI 27.67 was recorded in Seed treatment with beejamrut + one foliar spray of BD-501. The maximum seed yield (900 kg/ha) of mungbean was observed in seed treatment with beejamrut + one foliar spray of BD-501 which was significantly superior over untreated control (495 kg/ha).

Table 7.7.2: Effect of organic disease management practices on *Alternaria* blight and Powdery mildew disease of organic greengram and seed yield (*Vigna radiata* L.)

Treatment	Seed yield (kg/ha)	<i>Alternaria</i> blight (PDI)	Powdery mildew (PDI)
Seed treatment by Beejamrut	665	45.67	38.33
Soil application of mashroom spent compost (5 % with FYM)	615	54.33	48.33
Soil application of mashroom spent compost + Foliar spray of BD-501 (1 g 13 L ⁻¹ water)	776	44.67	34.33



Treatment	Seed yield (kg/ha)	Alternaria blight (PDI)	Powdery mildew (PDI)
Seed treatment of Beejamrut + Foliar spray of BD-501 (1 g 13 L ⁻¹ water)	900	36.33	27.67
Soil application of mashroom spent compost + Foliar spray of indigenous fungicide	662	47.0	40.00
Seed treatment of Beejamrut + Foliar spray of indigenous fungicide	769	42.33	33.00
Foliar spray of BD-501 (1 g 13 L ⁻¹ water)	713	50.67	43.00
Foliar spray of indigenous fungicide	712	52.33	44.67
Control	495	72.33	64.67
CD 5%	117.1	8.528	6.957

7.8 Evaluation of organic management practices for insect pest in various crops

Objectives:

- To evaluate the organic management practices for reducing the incidence of insect pests in major crops
- To identify the package of insect pest management for organic production system

Year of start: 2015-16

Location: Ajmer, Almora and Gangtok

Results

Ajmer

The relative efficacy of six organic based IPM modules (including control) against aphid and thrips on coriander and fennel was evaluated and observations were recorded from randomly selected plants from pests' initiation on crop to harvesting. Result showed that all IPM modules were found significantly superior over untreated check. The maximum percent reduction in aphid (71.4 and 62.1%) and thrips (73.0 and 64.0%) population was recorded

in module M-3 (garlic extract 10 ml/lit + *azadirachtin* 0.03% EC @ 5ml/lit + tumba fruit extract 10ml/lit.) in coriander and fennel respectively followed by M-2 (field sanitation + NSKE 5ml/lit + Ker extract 10 ml/li.), where population reduction was 69.4 and 59.1% for aphids and 67.2 and 61.2% for thrips in both the crops of coriander and fennel respectively.

Almora

Botanicals and bioagents evaluation against toria aphids

Pest management options for the control of aphids in toria was evaluated under organic condition. Spray of botanicals and bio-agents were made at the time of peak incidence of aphids, which coincided with late flowering of the crop. Pre-treatment count shows severe infestation of aphids up to 100%. None of the treatments except the chemical insecticide, acetamiprid was found to reduce the infestation of aphids in toria considerably. Nimbicidine spray 3 mL/L was found to reduce the aphid infestation by 17% (Table).

Table 7.8.1.1: Effect of organics on the management of aphids in toria

Treatment	Pre-treatment count (% infestation in the tagged plants)	Per cent reduction					
		1 DAT	3 DAT	5 DAT	7 DAT	10 DAT	Average
Melia extract 5 %	96	6.25	13.54	10.41	6.25	6.25	8.54
Artemisia 5%	93	3.22	13.97	13.97	10.75	7.52	9.88
Pine extract 5%	100	3.22	7.52	7.52	7.52	3.37	5.83
Nimbicidine 3mL/L	90	14.0	24.00	17.05	17.10	14.27	17.28
<i>Metarhizium anisopliae</i> 3g/L	86	7.50	10.75	10.75	7.52	7.50	8.80
<i>Beauveria bassiana</i> 3g/L	93	6.25	10.41	3.12	3.12	3.12	5.20
Acetamiprid 0.25g/L	97	65.6	79.16	83.33	86.45	89.58	80.82
Control	90	-3.25	-11.33	0.27	-9.27	-20.18	-8.75

Organic pest management options for pests of soybean

Seven treatments including control evaluated for organic pest management for soybean pests. The pre-treatment counts reveal that severe infestation of sucking bug (3.00 to 4.00 bugs per leaf as taken

average of top, mid and bottom leaves). The average bug reduction was about 0.20 to 0.98 in various treatments. Apart from chemical pesticide, Cartap hydrochloride which registered 84% reduction, melia extract 5 and 10% provided 47 and 43% reduction of soybean sucking bug, respectively (Table.....)


Table 7.8.1.2 : Effect of organics on the management of sucking bug of soybean (Mean of six replications)

Treatment	Pre-treatment Count	2 DAT	5 DAT	7 DAT	Average	Per cent reduction w.r.t. control
<i>Melia azederach</i> extract 5%	4.00	0.89	0.83	0.61	0.77	46.56
<i>Melia azederach</i> extract 10%	3.56	0.61	0.55	1.05	0.74	43.05
Nimbecidine 3 mL/L	3.00	1.11	0.72	1.11	0.98	10.09
<i>Beauveria bassiana</i> 3g/L	2.61	0.67	0.50	1.22	0.79	15.99
Parthenium extract 5%	3.05	0.85	0.56	1.06	0.82	25.70
Cartap hydrochloride 1g/L	3.56	0.33	0.17	0.11	0.20	84.28
Control	3.00	1.17	1.66	0.45	1.09	

The effect of organic pest management options on aphids of soybean is given in table The pre-treatment count has severe incidence of aphids of 33.33 to 50.94 aphids per plant. The incidence was

reduced in all the treatments including control drastically to 9.67 to 15.45 aphids per plant. therefore, the treatment effects are not noticeably clear in this experiment.

Table 7.8.1.3 : Effect of organics on the management of aphids of soybean

Treatment	Pre-treatment Count	2 DAT	5 DAT	7 DAT	Average	Per cent reduction w.r.t. control
<i>Melia azederach</i> extract 5%	37.06	17.89	13.11	10.05	13.68	19.17
<i>Melia azederach</i> extract 10%	33.33	12.05	11.28	11.44	11.59	23.87
Nimbecidine 3 mL/L	35.00	13.72	14.33	10.61	12.88	19.39
<i>Beauveria bassiana</i> 3g/L	50.94	17.39	14.83	11.89	14.70	36.81
Parthenium extract 5%	40.11	14.28	15.83	9.67	13.26	27.63
Cartap hydrochloride 1g/L	34.11	9.72	10.78	14.00	11.50	26.19
Control	37.61	20.84	15.27	15.45	17.18	

Pest incidence in organic production system

Among the different management production systems, the infestation/damage of leaf webber in grain amaranth was 6.6% as lowest with grown under 100% organic conditions whereas, it was observed 12.0% as highest damage under in-organic condition. Sporadic infestation of grasshoppers in finger millet (7.0%) and sucking bug of soybean (6 nos./3 leaves)

was found was lowest with integrated production system (50% organic + 50% inorganic) however, it was highest under 100% organic of 18.8 and 11.4% in finger millet and soybean respectively. Among the different production systems, aphid infestation in toria recorded in range from 30.7 to 45.6% however, it follows same trends as other.

Table 7.8.1.4 : Infestation of insect under different production systems

Treatment	Amaranth Leaf webber damage (%)	Finger millet Grasshopper damage (%)	Soybean Sucking bug (No/ 3 leaves)	Toria Aphid infestation (%)
100% Organic	6.6	18.8	11.4	32.7
75% Organic + 3% Panchagavya + Vermiwash	10.7	12.6	8.4	45.6

Treatment	Amaranth Leaf webber damage (%)	Finger millet Grasshopper damage (%)	Soybean Sucking bug (No/ 3 leaves)	Toria Aphid infestation (%)
50% Organic + 50% inorganic	9.3	7.0	6.0	30.7
100% Inorganic	12.0	15.4	5.8	33.2

Gangtok

Organic insect pest management in maize-based cropping system

Efficacy of the selected bio-pesticides against infestation of army worm and stem borer in maize crop was evaluated. Among all the different bio-pesticides, spinosad 45 SC @ 0.3 ml/l showed good result with the lower per cent leaf feeding by army

worm (9.8) and reduction in the per cent dead heart was 0.65%. The second-best treatment was *Beauveria bassiana* 7 g/l with 14.5 % leaf feeding by army worm and stem borer dead heart (2.98%). The leaf injury rating was found to be lowest in maize plots treated with Spinosad 45 SC @ 0.3 ml/l (2.5) followed by *Metarhizium anisopliae* 5 ml/l (5.2) and Petroleum oil based agrospray @ 10 ml/l (5.8).

Table 7.8.2.1 : Army worm and stem borer infestation in maize crop under organic farming

Bio-pesticides	Army worm		Stem borer infestation (%)		Leaf Injury Rating
	% leaf feeding	Leaf feeding rating	Plant infestation (%)	Dead heart (%)	
Neem oil (1500 ppm @ 4 ml/l)	20.55	2.4	32.40	5.15	8.2
<i>Beauveria bassiana</i> 7 g/l	14.05	1.5	30.20	2.98	7.0
<i>Metarhizium anisopliae</i> 5 ml/l	19.87	1.2	35.07	5.40	5.2
Petroleum oil based agrospray @ 10 ml/l	48.52	2.2	50.47	4.8	5.8
Petroleum oil based horticultural spray @ 10 ml/l	18.43	1.2	36.5	4.18	6.0
<i>Bacillus thuringiensis</i> @ 2 g/l	32.45	1.9	24.74	4.52	6.2
Spinosad 45 SC @ 0.3 ml/l	9.8	1.0	8.48	0.65	2.5



Semi looper on maize leaf



Army Worm on maize leaf



7.9 Evaluation of organic management practice for diseases in crops

Objective:

- To evaluate the management practices for management of diseases in high value crops
- To identify the suitable package for management of important diseases in selected crops

Year of start: 2015-16

Locations: Ajmer

Results

Ajmer

Management of Sclerotium rot of coriander

Five different treatments were evaluated including soil solarization (20 days), *trichoderma*, neem cake (0.5t/ha), castor cake (0.5t/ha) and control having four replications for each treatment. Soil solarization was conducted in the plots in summer (May-June) for 21 days by covering 100µm polyethylene sheets on ploughed, well pained and moist soil. *Trichoderma* @ 2kg /ha, neem cake (0.5t/ha), castor cake (0.5t/ha) were mixed with soil before sowing the coriander crop. The disease measurement was done throughout the cropping span by counting number of diseased plants and healthy plants separately and then percent disease index (PDI) was calculated. Among the treatments, 20 days soil solarization was found most effective (PDI 1.7) followed by neem cake (PDI 4.8) while the disease was recorded maximum (PDI 8.8 in control. Total number of weeds /m² area was counted after fifteen days of sowing (Table 7.9.1.1).

Table 7.9.1.1 : Influence of different treatments on Sclerotium rot disease of coriander

Treatments	Sclerotium Rot (PDI)	No. weeds /M ²	Yield (kg/ha)
Soil solarization (20 days)	1.7	87	790

Treatments	Sclerotium Rot (PDI)	No. weeds /M ²	Yield (kg/ha)
<i>Trichoderma</i> (Soil & Seed App.)	6.0	248	540
Neem cake (0.5 T/ha)	4.8	160	580
Castor cake (0.5 T/ha)	6.6	216	480
Control	8.8	252	490
SEm±	0.79	26.8	97.1
CD at 0.05%	2.47	83.6	-

Management of *Ramularia* blight of fennel

Five different treatments including arial spray of neem oil (0.5%), castor oil (0.5%), garlic extract (0.5%), onion extract (0.5%) and control in fennel crop were evaluated under organic condition. The spray schedule of different botanicals was adopted on initiation of the disease. Among the five treatments, garlic extract (0.5%) was found most effective followed by onion extracts (0.5%) and neem oil (0.5%). Total number of weeds /m² area was recorded also less with garlic extract (0.5%). In year 2017-18 the weather conditions were found unsuitable and unfavourable for the disease initiation and development hence *Ramularia* blight disease in fennel was not appeared till harvesting the crop (Table 7.9.1.2).

Table 7.9.1.2 : Influence of different treatments on weed and seed yield of fennel

Treatments	No. Weeds /m ²	Yield kg/ha
Neem oil (0.5%)	50.5	2400
Castor oil (0.5%)	47.5	2390
Garlic extract (0.5%)	46.1	2480
Onion extracts (0.5%)	54.8	2360
Control	49.2	2450
SEm±	44.81	3590
CV	13.36	297

7.10 Development of scientific organic package for large cardamom

Objective

- Standardization of organic source of nutrients in large cardamom for yield maximization

Location: Gangtok

Year of start: 2015-16

Results

The application of organic nutrients in the large cardamom crop shows the variations among the crop yield as well as soil physical and biological properties. Maximum fresh weight of capsule per clump was recorded with the vermin-compost @ 10 kg/clump + bio-fertilizer (98.82 g) followed by treatments vermin-compost @ 7.5 kg/clump + bio-fertilizer (95.25g). The dry wt. of capsules per clump and the productivity of the large cardamom were maximum, i.e., 19.52 g and 433 kg/ha, respectively in the plots in which vermin-

compost @ 10 kg/clump + bio-fertilizer were applied. The SOC percentage was highest with application of vermin-compost @ 10 kg/clump + bio-fertilizer (1.05 %) followed by FYM @ 10 kg + VC @ 2.5 kg/clump + BF (1.02 %). Bulk density was highest with application of vermin-compost @ 10 kg/clump + bio-fertilizer (1.31 mg/m³) followed by treatments vermin-compost @ 7.5 kg/clump + bio-fertilizer (1.21 mg/m³). Soil EC was higher in which vermin-compost @ 5.0 kg/clump + bio-fertilizer (0.37) were applied. Bacterial, fungal and actinomycetes population exhibited significant variation among organic nutrient management. Bacterial and actinomycetes population were maximum where treated with FYM @ 5 kg/clump + biofertilizer i.e., (59.62 × 10⁵ and 28.75 × 10³), respectively. Fungal population was maximum in the soils treated with the FYM @ 10 kg + VC @ 2.5 kg/clump + BF (31.49 × 10⁴) followed with FYM @ 5 kg/clump + BF (31.48 × 10⁴).

Table 7.10.1.1 : Effect organic nutrient management package for large cardamom

Treatments	Fresh weigh of capsule/clump (g)	Dry wt.of capsules / clump (g)	Productivity (kg/ha)	SOC %	Bulk density (mg/m ³)	Soil EC (dS/m)	Bacteria (× 10 ⁵) (cfu/g)	Fungi (× 10 ⁴) (cfu/g)	Actino-Mycetes (× 10 ³) (cfu/g)
FYM @ 5 kg/clump + BF	73.66	14.58	318	1.12	1.18	0.34	59.62	31.48	28.75
FYM @ 7.5 kg/clump + BF	78.41	15.36	328	1.18	1.24	0.34	59.25	31.46	28.65
FYM @ 10 kg/clump + BF	78.88	15.82	338	1.21	1.37	0.36	59.42	31.25	28.42
FYM @ 5 kg + VC @ 2.5 kg/clump + BF	84.92	16.02	368	1.17	1.08	0.32	59.26	31.46	28.31
FYM @ 7.5 kg + VC @ 2.5 kg/clump + BF	84.28	17.12	390	1.22	1.15	0.34	58.68	31.29	28.49
FYM @ 10 kg + VC @ 2.5 kg/clump + BF	94.76	18.36	405	1.25	1.12	0.35	59.36	31.49	28.52
VC @ 5.0 kg/clump + BF	87.25	17.00	398	1.18	1.10	0.37	59.24	31.18	28.43
VC @ 7.5 kg/clump + BF	95.25	18.42	418	1.18	1.21	0.34	58.62	31.28	28.53
VC @ 10 kg/clump + BF	98.82	19.52	433	1.28	1.31	0.36	59.24	31.28	28.64
Control	36.18	5.85	125	1.10	1.05	0.31	58.26	30.78	28.51
SEm	8.12	1.26	5.93	0.34	0.34	0.19	2.43	1.77	1.69
LSD (P=0.05)	5.03	2.22	10.47	0.61	0.61	0.33	4.29	3.12	2.98



Maximum capsules on VC @ 10 kg/clump + BF



Growth of large cardamom under organic nutrient management package

Response of large cardamom (growth and yield parameters) to soil and foliar application of micronutrients

Experiment was conducted to standardize the response in growth and yield parameters of large cardamom to soil and foliar application of micronutrients. The treatments comprising 7 treatments viz., T₁-1.0, 2.0 and 3.0 kg/ha for B; T₂-10, 15 and 20 kg/ha for Zn; T₃-50, 75 and 100 g/ha for Mo; T₄-0.1%, 0.2% and 0.3% for B; T₅-0.1%, 0.25% and 0.5% for Zn; T₆-0.05%, 0.1% and 0.2% for Mo; T₇-control in RBD design RBD with 3 replications. Data

showed in balance sheet of micronutrients revealed that the available zinc under foliar application is much effective in large cardamom. Foliar application in Zn, Boron and Molybdenum was more effective than soil application. Application of 3.0 kg/ha boron, 15 kg/ha zinc and 100 kg/ha molybdenum in the soil enhanced the yield as compared to control, similarly, 0.3% boron, 0.25% zinc 0.2% molybdenum application significantly increased the plant height (cm), immature tiller, mature tiller and vegetative buds as compared to control treatment.

Table 7.10.1.2 : Effect of soil and foliar application of micronutrients in large cardamom

Type of application	Treatments	Dose	Available Nutrients (ppm)	Immature tiller	Mature tiller	Vegetative buds
Soil application	T1-Boron	1.0 kg/ha	0.160	3.15	3.04	2.38
		2.0 kg/ha	0.172	3.09	3.15	2.40
		3.0 kg/ha	0.165	3.25	3.22	2.45
	T2-Zinc	10 kg/ha	3.68	2.78	2.88	2.35
		15 kg/ha	3.10	3.10	3.14	2.44
		20 kg/ha	3.28	2.98	2.97	2.40
	T3-Molybdenum	50 kg/ha	0.117	2.70	2.99	2.25
		75 kg/ha	0.116	2.72	3.06	2.30
		100 kg/ha	0.121	3.03	3.14	2.42

Type of application	Treatments	Dose	Available Nutrients (ppm)	Immature tiller	Mature tiller	Vegetative buds
Foliar application	T4-Boron	0.1 %	0.173	3.52	3.38	2.75
		0.2 %	0.170	3.64	3.51	2.70
		0.3 %	0.168	3.88	3.54	2.85
	T5-Zinc	0.1 %	3.51	3.51	3.18	2.58
		0.25 %	3.65	3.80	3.35	2.68
		0.5 %	3.71	3.71	3.32	2.65
	T6-Molybdenum	0.05 %	0.114	1.88	3.10	2.50
		0.1 %	0.114	2.14	3.08	2.60
		0.2 %	0.115	2.15	3.11	2.68
	T7-Control	Control	1.10	1.10	1.05	0.91

Organic disease management in large cardamom

Effect of different treatments against various diseases in cardamom was studied comprising of 11 treatments including control viz., Garlic 2.5%, artemisia 2.5%, chilauney 2.5%, commercial neem based 0.3%, *T. viride* 6.5%, *pseudomonas fluorescens* 0.5%, copper hydroxide 0.25%, copper oxychloride 0.5%, bordeaux mixture 0.25%, sulfex 0.1%, control. There was no disease recorded in the plants treated with garlic extract @ 2.5%, in rest of the treatments, the leaf blight disease was noticed only in cardamom (*colletotrichum gloeosporioides*). The lowest disease

incidence was seen in plants treated with *T. viride* 6.5%, *P.fluorescens* 0.5%, Sulfex 0.1% and *Artemisia* 2.5% (i.e. 11.11%), followed by Chilauney 2.5% (17.77%) and bordeaux mixture 0.25% (27.77%). The severity of disease was maximum in the plants treated with copper hydroxide 0.25% (44.44%) followed by commercial neem based 0.3% (36.66%) and copper oxychloride 0.5% (33.33%). The late blight disease severity was more than 60% in control. However, both the biocontrol agents and botanicals were found effective against Leaf blight of cardamom with less disease incidence from 0-11.1%.

Table 7.10.1.3 : Effect of locally available botanicals, commercially available bio control agents and organically permitted fungicides against blight of large cardamom

Sl. No	Treatments	Late blight (PDI)					
		Total no. of plants	Resistant Plants	Susceptible plants	Disease Incidence	Resistant	Susceptible
1	<i>Allium sativum</i> 2.5%	6	6	0	0	<4	>=4
2	<i>Artemisia vulgaris</i> 2.5%	6	5.33	0.66	11.11	<4	>=4
3	<i>Schima wallichii</i> 2.5%	5.66	4.66	1	17.77	<4	>=4
4	Neem based 0.3%	5.66	3.66	2	36.66	<4	>=4
5	<i>Trichoderma viride</i> 6.5%	6	5.33	0.66	11.11	<4	>=4
6	<i>Pseudomonas fluorescens</i> 0.25%	6	5.33	0.66	11.11	<4	>=4
7	Copper oxychloride 0.5%	6	4	2	33.33	<4	>=4
8	Copper hydroxide 0.25%	6	3.33	2.66	44.44	<4	>=4
9	Bordeaux mixture 0.25%	6	4.33	1.66	27.77	<4	>=4
10	Sulfex	6	5.33	0.66	11.11	<4	>=4
11	Control	6	2.33	3.66	61.11	<4	>=4

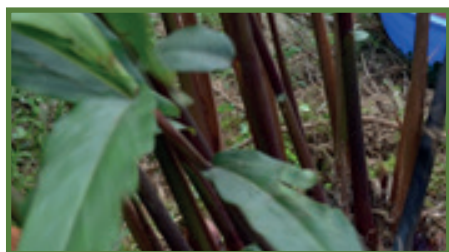


Spray of botanicals and bio control agents on large cardamom

Virus transmission with local implements

The virus infected clumps were collected, cut into small pieces and crushed in the sterile water to harvest the inoculums of virus. The mechanical transmission was performed with a flame sterilized knife (used for harvesting of large cardamom capsules). The flame sterilized knife was dipped for 20 minutes in the inoculum of virus and mechanically transferred to root region of ten consequent healthy spikes. The treatment spikes were separated from a healthy clump which was grown over three years and has not shown any symptom of Foorkey virus. The inoculated spike was further planted to sterile

soil and kept at separate place for observation. The experiments showed the transmission of virus through mechanical means. The Foorkey symptom was appeared after six months (20.08.2018) of planting (7.02.2018) in 8th spike of ten. The treatments are kept under observation for further appearance of symptoms in other pot. The experiment showed contrasting result to the study of Varma and Capoor (1964) in which mechanical transmission of virus was rejected. To date, this is the first report of mechanical transmission of Foorkey virus. This result paves the path of foorkey disease management by sterilizing the tool of harvesting.



Separation of healthy spike from clump



Healthy spike



Dipping of knife in virus inoculum



Inoculated spike in sterile soil



Planting of inoculated spike in sterile soil



Mechanical inoculation

Study on mechanical transmission of Foorkey virus

Organic insect pest management in large cardamom

Roving survey was conducted to know the per cent incidence (PI) of different insect pests in large cardamom fields of all four districts of Sikkim and the per cent incidence of different insect pests was recorded. As per previous year, shoot fly, leaf eating caterpillar and stem borer were found everywhere. Additionally, high infestation of mealy bug was observed in the root zone of large cardamom infected with foorkey disease. Higher infestation of Tea mosquito bug was recorded in this year. For such case, study of some new biopesticides and organically permitted insecticides were evaluated against insect pests of large cardamom. The experiment was conducted to evaluate the efficacy of biopesticides viz., neem oil (1500 ppm) @ 4 ml/l, *Beauveria bassiana* 7 g/l, *Metarhizium anisopliae* 5 ml/l, petroleum oil based agrospray @ 10 ml/l, petroleum oil based horticultural spray @ 10 ml/l, *Bacillus thuringiensis* @ 2 g/l, and spinosad 45 SC @ 0.3 ml/l against insect

pests of large cardamom viz., stem borer, shoot fly, leaf eating caterpillar and tea mosquito bug. All the treatments showed effective results to control insect pests over the control. However, spinosad 45 SC @ 0.3 ml/l was found to be the most effective to control all the pests (69.91 to 81.32% reduction of infestation over control) followed by neem oil (1500 ppm) @ 4 ml/l (61.32 to 67.64% reduction of infestation over control) and petroleum agrospray @ 10 ml/l (52.22 to 59.47% reduction of infestation over control).

The mean of original data of percent infestation was calculated as percent reduction of infestation over control as per following formula (Abbot's formula, 1925)

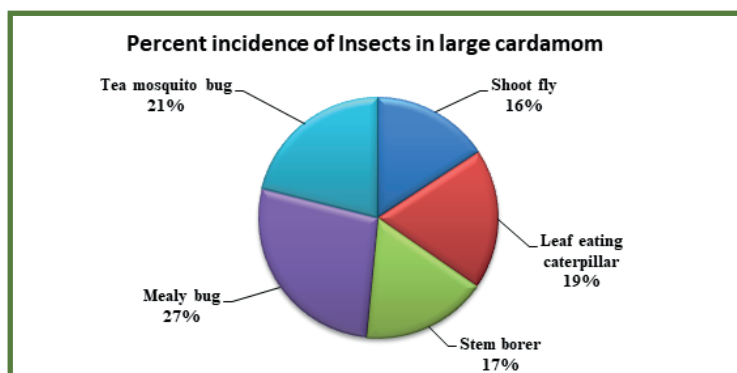
$$\text{Percent reduction of infestation} = \frac{C-T}{T} \times 100$$

Whereas C= Control

T= Treatment

Table 7.10.1.4 : Effect of treatments on insect of large cardamom.

Treatments	Percent reduction of infestation over control				
	Stem borer	Shoot fly	Leaf eating caterpillar	Mealy Bug	Tea Mosquito bug
Neem oil (1500 ppm @ 4 ml/l)	61.32	67.64	62.21	64.36	66.52
<i>Beauveria bassiana</i> 7 g/l	36.42	41.28	38.29	40.24	35.89
<i>Metarhizium anisopliae</i> 5 ml/l	41.24	40.28	39.74	40.62	40.56
Petroleum oil based agrospray @ 10 ml/l	52.22	54.32	59.47	53.21	56.24
Petroleum oil based horticultural spray @ 10 ml/l	48.24	46.52	52.14	41.24	42.34
<i>Bacillus thuringiensis</i> @ 2 g/l	51.21	49.28	50.62	47.28	48.32
Spinosad 45 SC @ 0.3 ml/l	69.91	74.35	81.32	73.29	75.44



Percent reduction of infestation over control

7.11 Biochemical characterization & molecular identification of microbial population of different organic manures

Objective

- To characterize the indigenous organic input preparations
- To identify the microbes and other parameters of indigenous manures

Year of Start: 2015-16

Location: Narendrapur

Physico-chemical parameters of ITK's- *Kunapajala*

7.11.1. Determination of pH of *Kunapajala*:

To study the microbial dynamics present in *Kunapajala*, pH of *Kunapajala* solution was first determined after different days of incubation. Previously, it has been reported that pH plays an important role to regulate the microbial dynamics and hence, in its activity (McCauley et.al, 2017). This study showed a gradual increment in pH upon more days of incubation (**Fig. R1**). Previously, it was observed that decomposition of organic matter releases more anions which can couple with free H^+ ions present in the system (McCauley et.al. 2017). Hence, microbial reaction results in reduction of free H^+ present in this system upon gradual increment in pH. Thus, it can be concluded from this study that decomposition of organic matter releases more anions and hence, pH of *Kunapajala* solution gradually increases upon days of decomposition.

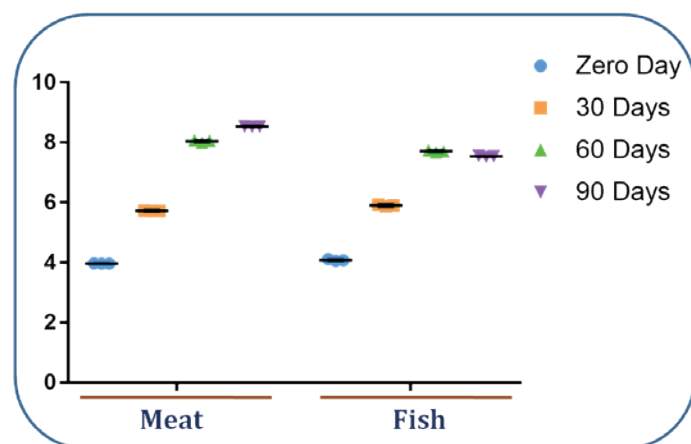


Figure R1. The pH of *Kunapajala* solution increases with days of incubation. The pH of *Kunapajala* solution of 0, 30, 60 and 90 days of incubated samples were determined with three replicates. The y-axis denotes the value of pH with standard error of mean (SEM).

7.11.2. Determination of electrical conductivity (EC) of *Kunapajala*:

The Electrical conductivity (EC) of soils or water is a measure of dissolved salts present in it. Thus, it is an important parameter of soil health, which can affect the availability of plant nutrients and activity of soil microbes (Rietz et. al., 2003). It is an indirect indicator of water soluble nutrients available to plants. Soils with EC greater than 1 mS/cm are considered to be saline and salinity is known to affect plant growth and hence, in yield (Rhoades et.al., 1989). It was observed that EC of *Kunapajala* solution is slightly saline in nature. Upon days of incubation, the EC level increases gradually. It clearly indicates that salt concentration in *Kunapajala* solution increases upon days of incubation (**Fig. R2**). It was reported that EC affects several microbial activities like respiration, nitrification, denitrification (Adviento-Borbe et. al., 2006). Thus, it will be interesting to study the microbial activities in relation to EC content of the system.

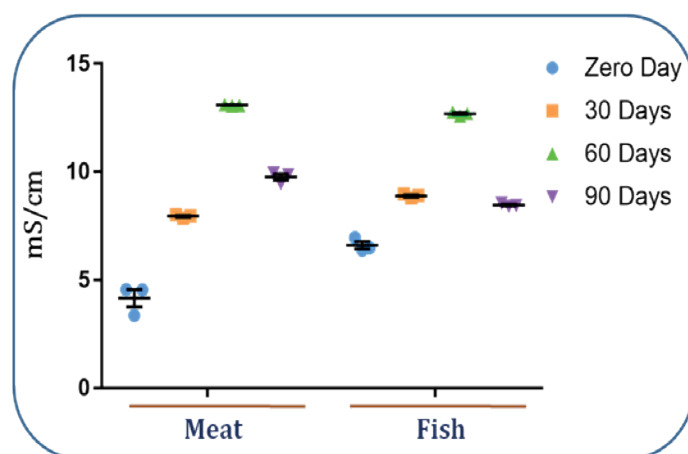


Figure R2. Determination of electrical conductivity (EC) of *Kunapajala* solution. The EC of *Kunapajala* solution of 0, 30, 60 and 90 days of incubated samples were determined with three replicates with standard

error of mean (SEM). The y-axis denotes the value of EC in milli-siemens per centimeter (mS/cm).

7.11.3. Estimation of Organic Carbon (OC) of Kunapajala:

It was observed that concentration of organic carbon (in percent value) of *Kunapajala* solution gradually gets depleted upon days of incubation. These results clearly suggest that microbial decomposition occurred in the system of *Kunapajala* and it releases CO₂ and methane as a respiration and metabolic by-product. So, upon days of incubation, percentage of organic carbon gets gradually depleted in the system of both fish and meat *Kunapajala* (Fig. R3). Thus, it will be interesting to study the microbial population and their dynamic in relation to organic carbon content in the system.

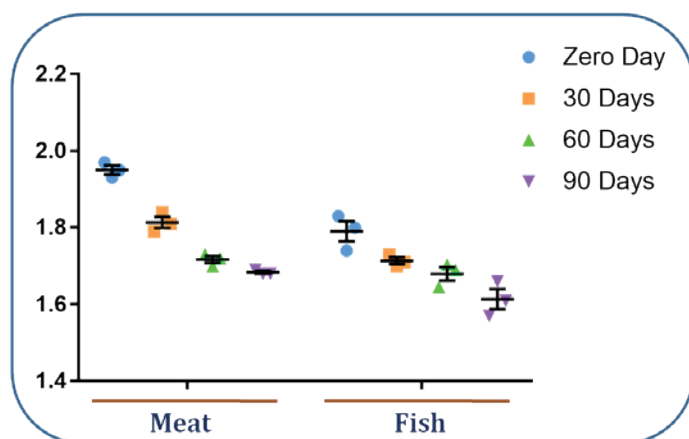


Figure R3. Determination of organic carbon (OC) of *Kunapajala* solution. The OC of *Kunapajala* solution of 0, 30, 60 and 90 days of incubated samples were determined with three replicates with standard error of mean (SEM). The y-axis denotes the concentration of organic carbon in percentage.

7.11.4. Determination of available nitrogen of Kunapajala:

The *Kunapajala* is a rich source of animal and fish proteins, which get decomposed into simpler forms of peptides and amino acids due to microbial metabolic activities. It was observed from this study that concentration of available nitrogen (largely ammonical form) gradually increases upon days

of incubation. This result clearly suggests that decomposition of proteins takes place in the system and contributes to the pool of available N-form (Fig. R4). Thus, it will be interesting to study the decomposition of soluble protein content in the system.

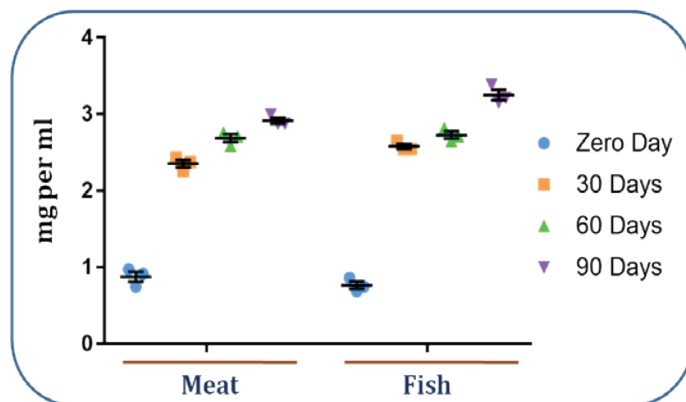


Figure R4. Status of available nitrogen content of *Kunapajala* solution. The available nitrogen (in ammonical form) of *Kunapajala* solution of 0, 30, 60 and 90 days of incubated samples were determined with three replicates with standard error of mean (SEM). The y-axis denotes the concentration of available nitrogen in milli-gram per milli-litre (mg/ml).

7.11.5. Determination of soluble protein present in Kunapajala:

Protein is an important component for growth of any living organisms. Microbial growth also requires protein source and microbes proliferate faster in protein rich media. The *Kunapajala* solution being a rich source of proteins attracts microbes to grow and proliferate. As a result, decomposition of protein takes place due to prolific growth of microbes and its metabolic activity. Indeed, we observed in *Kunapajala* solution that soluble protein content decreases gradually upon days of incubation. This study revealed that there are proteolytic activities of microbes which can degrade the complex form of protein into simpler forms in the system. As a result, the soluble protein concentration gets depleted upon days of incubation largely due to microbial decomposition (Fig. R5).

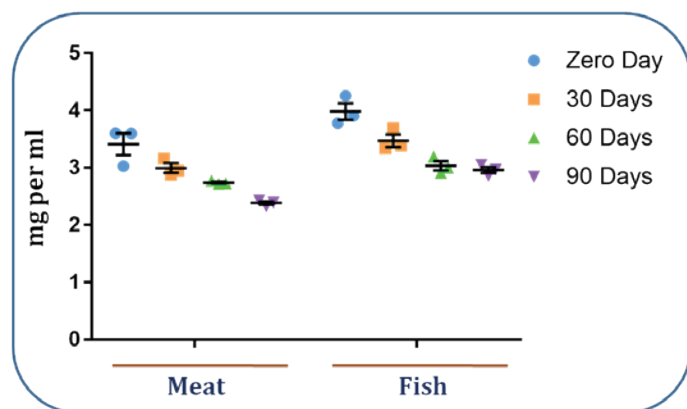


Figure R5. Determination of soluble protein content of *Kunapajala* solution. The soluble protein content of *Kunapajala* solution of 0, 30, 60 and 90 days of incubated samples were determined with three replicates with standard error of mean (SEM). The y-axis denotes the concentration of soluble protein in milli-gram per milli-litre (mg/ml).

7.11.6. Qualitative and quantitative analysis of IAA of *Kunapajala* by Thin Layer Chromatography (TLC) and High performance TLC (HP-TLC):

Previously, we have shown that the soluble protein in *Kunapajala* solution gets depleted and decomposes into simpler amino acids. Tryptophan, one of the amino acids, is a well known precursor to synthesize IAA by various biochemical activities. As *Kunapajala* is a rich source of protein, we are interested to check the presence of IAA in *Kunapajala* by thin layer chromatography (TLC). To perform this experiment, we ran the sample along with IAA and IBA standards and found that the signal of *Kunapajala* solution matches best with IAA standard solution. This study clearly indicates the presence of IAA and not IBA derivatives in *Kunapajala* solution (data not shown).

After the confirmation of IAA present in *Kunapajala* solution, the quantification of IAA was performed by using high performance thin layer chromatography (HPTLC) (Fig. R6A). The result showed that the highest concentration of IAA was observed in 30 days incubated sample in case of meat enriched *Kunapajala*, whereas the concentration of IAA gradually increases up to 60 days in case of fish

Kunapajala (Fig. R6B). Taken together, these studies suggest that *Kunapajala* solution is a rich source of IAA and can be applied as a foliar spray particularly in vegetable crops.

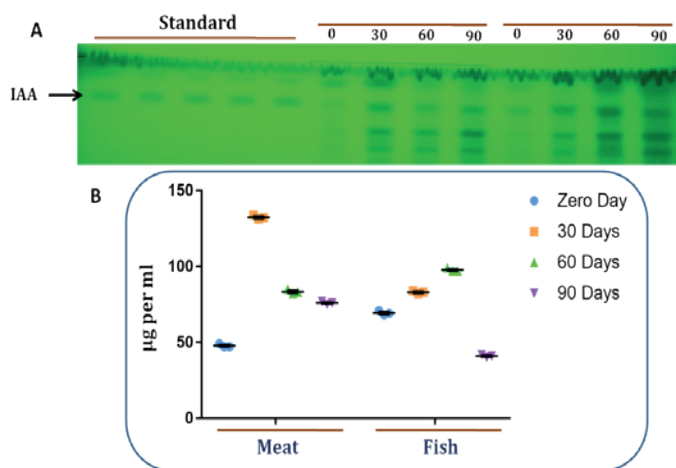


Figure R6. Determination of IAA content of *Kunapajala* solution. The IAA content of *Kunapajala* solution of 0, 30, 60 and 90 days of incubated samples were determined with three replicates with standard error of mean (SEM). The y-axis denotes the concentration of IAA in micro-gram per milli-litre (µg/ml).

7.11.7. Determination of available phosphorus of *Kunapajala*:

The phosphorus is an important element for plant growth and development and application of phosphorus fertilizers to soils is the only means to supply nutrients to plants. However, phosphorus in soils becomes frequently unavailable to the plants due to chelating and formation of a complex with several compounds. This can be reversed by alteration of pH, EC and microbial population mostly PSBs. Liquid manures are rich source of available phosphorus and PSBs. Thus, we are interested to determine the available phosphorus content in *Kunapajala* solution of different days of incubated samples. It was observed that concentration of available phosphorus gradually increases upon days of incubation. This result suggests the possible activities of microbes in decomposition of phosphorus compounds into its plant available forms (Fig. R7).

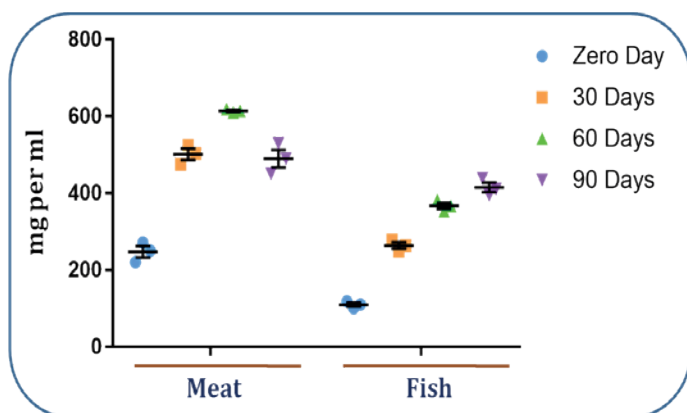
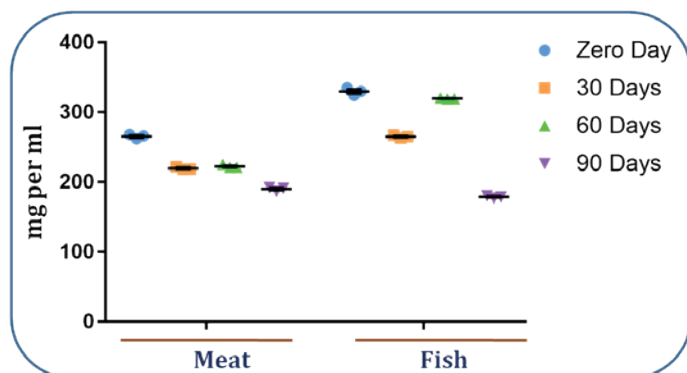


Figure R7. Status of available phosphorus of Kunapajala solution. The available phosphorus content of Kunapajala solution of 0, 30, 60 and 90 days of incubated samples were determined with three replicates with standard error of mean (SEM). The y-axis denotes the concentration of available nitrogen in milli-gram per milli-litre (mg/ml).

7.11.8. Determination of available potassium of Kunapajala:

It has been observed that available potassium gradually decreases in case meat enriched Kunapajala, whereas a more complex dynamics was observed in fish enriched Kunapajala (**Fig. R8**). Potassium mainly depends on metabolic activities as well as maintaining osmotic balance. In this system, it has been observed that the electrical conductivity increases. This suggests the level of soluble salt increases, which in turn favours non-exchangeable K^+ ion formation. In case of fish enriched Kunapajala, the level of available potassium suddenly increases after 60 days of decomposition (**Fig. R8**). Interestingly, we observed that the count of potassium solubilizing



microbes is several fold higher in comparison with other incubated samples. However, it will be interesting to study the dynamics of non-exchangeable to exchangeable K^+ ion in Kunapajala in more details and elucidate its mechanism.

Figure R8. Determination of available potassium of Kunapajala solution. The available potassium content of Kunapajala solution of 0, 30, 60 and 90 days of incubated samples were determined with three replicates with standard error of mean (SEM). The y-axis denotes the concentration of available potassium in milli-gram per milli-litre (mg/ml).

7.11.9. Determination of available micronutrients of Kunapajala:

Micronutrients are chemical elements or substances which are required by the plant in trace amounts for its normal growth and development. Micronutrients play a key role in different metabolic pathways as well as in different cellular functions like energy metabolism, primary and secondary metabolism, cell function, gene regulation, reproduction etc. Thus deficiency of micronutrient may lead to loss of various cell functions as well as may stop different metabolic pathways, resulting in abnormalities in plants.

Copper, iron, manganese are essential for photosynthesis. In addition, copper and manganese are involved in nitrogen metabolism. Manganese also plays important role in various enzymatic activities. Zinc, another micronutrient, plays role in protein synthesis and growth regulation.

It was observed that the available micronutrient concentration in Kunapajala solution decreases upon days of incubation (**Fig. R9**). The possible reason may be due to metabolic activities of microbes. In addition, it was reported previously that the availability of micronutrients depends on pH of the system and it declines gradually in higher pH. As here the pH increases upon days of incubation may be for this reason also the available micronutrient concentration slowly decreased in the system. As micronutrients are required in trace amount,

Kunapajala solution can help in slow release of micronutrients and its availability to the plants.

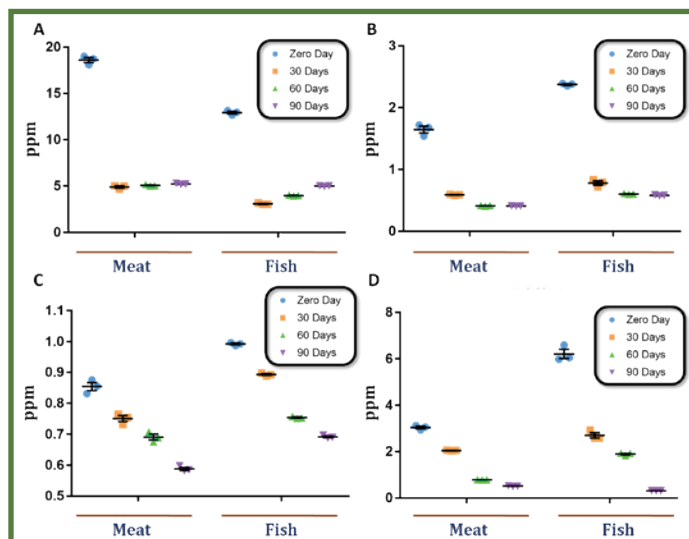


Figure R9. Determination of micronutrients status of *Kunapajala* solution. The available micronutrient content i.e, iron (A), zinc (B), copper (C) and manganese (D) of *Kunapajala* solution of 0, 30, 60 and 90 days of incubated samples were determined with three replicates with standard error of mean (SEM). The y-axis denotes the concentration of available micronutrient in parts per million (ppm).

7.11.2. Studies on microbial dynamics present in *Kunapajala*:

For estimation of microbial diversity, the *Kunapajala* samples from both fish and meat were serially diluted up to 10^{-8} and were plated over different selective nutrient agar medium. It was observed that total bacterial count remains more or less unchanged in the population but actinomycetes and fungal population gradually decreased in case of *Kunapajala* meat (Table R1). However, the population of actinomycetes and fungi in case of *Kunapajala* fish remains unchanged (Table R1). This suggests that the decomposition rate gradually increased and this happened due to the presence of organic matter and cow dung in *Kunapajala*. This study may be well correlated with increasing concentration of available nitrogen and available phosphorus upon days of incubation.

	Days	Total Bacteria (10^8)	Total Fungi (10^4)	Total Actinomycetes (10^6)
Meat	Zero Day	333.33 $\pm$ 8.82	220.00 $\pm$ 11.54	460.00 $\pm$ 11.55
	30 Days	276.67 $\pm$ 14.53	420.67 $\pm$ 8.82	163.33 $\pm$ 14.53
	60 Days	326.67 $\pm$ 18.56	60.00 $\pm$ 5.77	83.33 $\pm$ 8.82
	90 Days	280.00 $\pm$ 17.32	26.67 $\pm$ 3.33	133.33 $\pm$ 6.67
Fish	Zero Day	80.00 $\pm$ 20.82	123.33 $\pm$ 6.67	530.00 $\pm$ 51.32
	30 Days	93.33 $\pm$ 8.82	136.67 $\pm$ 6.67	163.33 $\pm$ 14.53
	60 Days	33.33 $\pm$ 13.33	146.67 $\pm$ 20.27	73.33 $\pm$ 3.33
	90 Days	33.33 $\pm$ 3.33	70.00 $\pm$ 15.27	50.00 $\pm$ 5.77

Table R1. Microbial population and its dynamics present in *Kunapajala* solution. The population of different microbes were estimated with three replicates. Here, means with standard error has been shown.

7.11.2.1. Studies on plant-beneficial bacteria present in *Kunapajala*:

Bacteria, which help and promote plant growth, can be termed as plant beneficial microbes and it mainly includes free living nitrogen fixer, phosphate solubilizer, potassium solubilizer and IAA producer. Here, we restricted our study on nitrogen fixer and phosphate solubilizer and their ability to produce growth hormones like IAA. Our study reveals that the population of N-fixers gradually increases with days of decomposition in both meat and fish based *Kunapajala* solutions (Fig. R10A). This is quite astonishing as *Kunapajala* solution is known to be rich in nitrogen. However, our result can nicely correlate with the increasing level of available nitrogen in *Kunapajala* solution. Taken together, our study demonstrates the possible role of microbes in the mechanism of mineralization and ammonification of nitrogen in the system.

We extend our study on phosphate solubilising bacteria (PSBs) to elucidate its role in P-solubilization. We have shown in this study that the level of available phosphorus content in *Kunapajala* increases gradually. Surprisingly, we observed that the population of PSBs increases with days of incubation (Fig. R10B). This result can well be correlated with the level available phosphorus

content in the system. Taken together, this study demonstrates that *Kunapajala* solution is a rich source of several plant-beneficial bacteria and its role in nutrient availability to the plants.

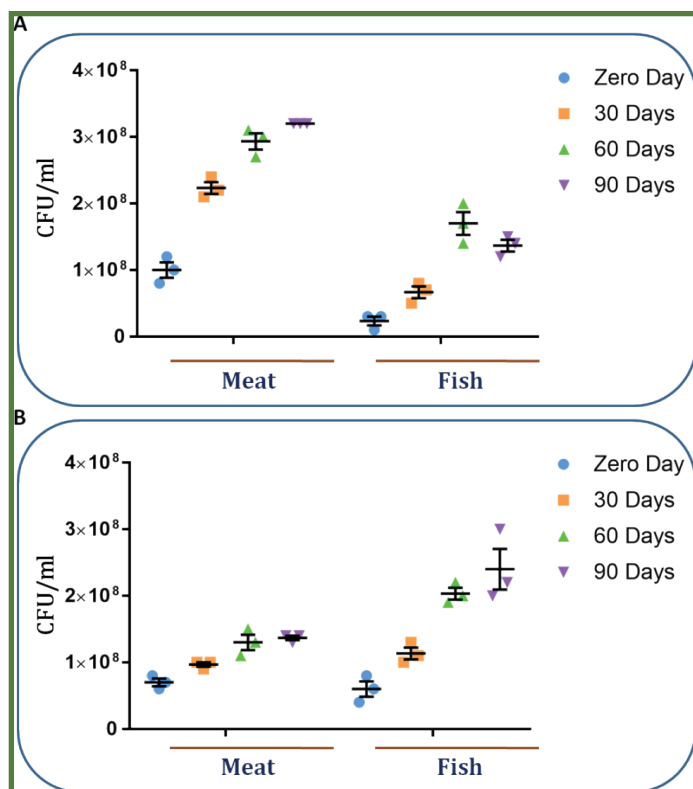


Figure R10. Diversity and dynamics of plant-beneficial bacteria isolates present in *Kunapajala* solution. (A) The bacterial isolates were screened for nitrogen fixation in Jensen's media and its population was counted based on its growth in this nitrogen depleted media. (B) The bacterial isolates were screened for phosphate solubilization in Pivoskaya's media and its population was counted based on its P-solubilization in this media.

The experiment in both these cases was performed in three different plates and the colonies were counted with three replicates with standard error of mean (SEM). The y-axis denotes the number colonies appeared on growth media (CFU/ml).

7.11.2.3. Isolation and selection of plant beneficial bacteria:

Isolation of plant beneficial bacteria was done by streak plate method. Pure colony was isolated for

phosphate solubilizers and free living nitrogen fixers from Pikovskaya's and Jensen's media respectively.

7.11.3.1. Selection of free living nitrogen fixer:

Among the thirty colonies, ten morphologically distinct colonies were selected for further quantification. Total nitrogen fixing capacity of bacterial isolates was checked by Kjeldahl method. The result indicates that AKP 85 showed the highest nitrogen fixing ability among other bacterial isolates and one bacteria showed false positive result (Fig. R11). The highly efficient nitrogen fixer, AKP 85 needs further investigation in future to understand in detail the mechanism of its nitrogen fixation.

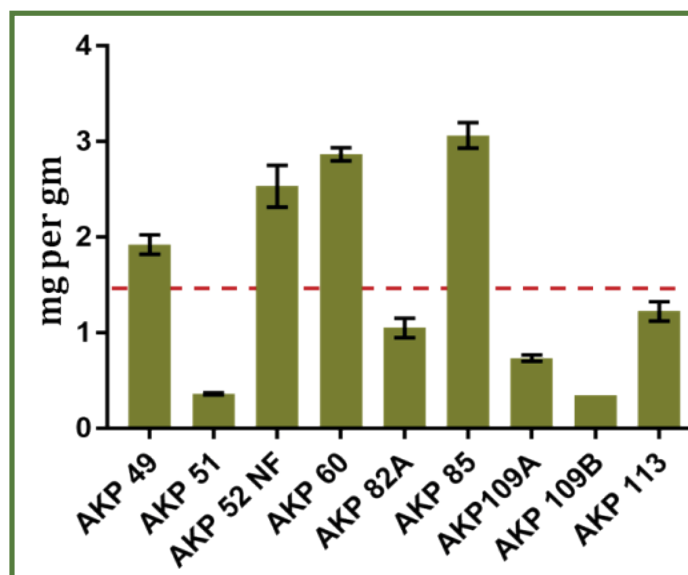


Figure R11. Nitrogen fixing efficiency of bacterial isolates present in *Kunapajala* solution. The bacterial isolates were grown in Jensen's media and measure its nitrogen fixing efficiency by Kjeldahl method as described before. The y-axis denotes the amount of total nitrogen fixed in milli-gram per gram of sucrose consumed. The red dotted line represents the criteria to select the best N-fixers.

7.11.3.2.1. Selection of phosphate solubilizing bacteria (PSB) by qualitative method:

To select the best PSBs, efficiency of phosphate solubilizing bacterial isolates were determined (Ramachandran, 2002). The result indicates that AKP 19 showed highest solubilizing zone among other

bacterial isolates, whereas no solubilizing zone was observed in negative control (Fig. R12).

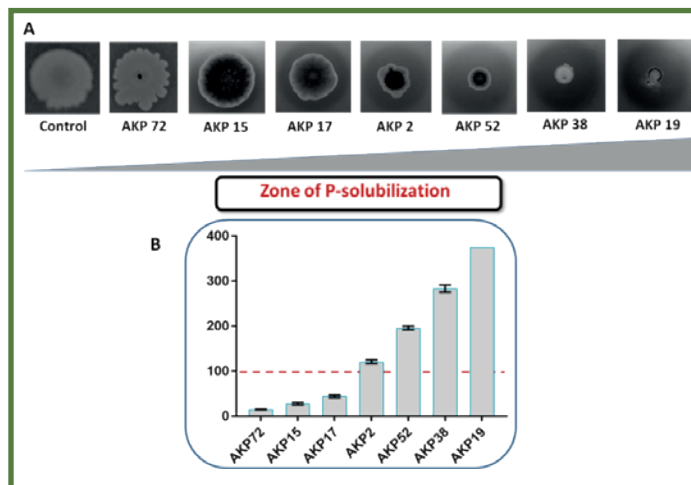
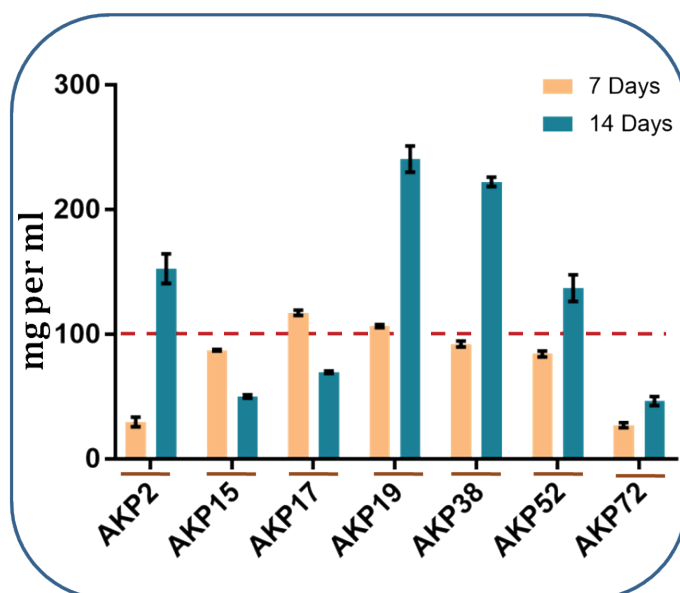


Figure R12. An assay to determine the phosphate solubilising efficiency of bacterial isolates present in *Kunapajala* solution. (A) The bacterial isolates were spotted on Pivovskaya's media and incubate it for 21 days to measure the zone of P-solubilization. **(B)** The zone of P-solubilization efficiency was measured as described before. The y-axis denotes the P-solubilization efficiency in percentage. The red dotted line represents the criteria to select the best P-solubilizer.

7.11.3.2.2. Selection of phosphate solubilizing bacteria (PSB) by quantitative method:

Efficacy of those phosphate solubilizing bacterial isolates were measured by quantitative method as mentioned in materials and methods section. Phosphate solubilizing capacity of these bacterial isolates was determined after 7 and 14 days of incubation. This result indicates that AKP 19 is the best phosphate solubilizing bacteria among others (Fig. R13). The highly efficient PSB, AKP 19 needs further investigation in future to understand in detail the mechanism of its phosphate solubilisation and can be an ideal one for the preparation of bio-fertilizer.

Figure R13. Phosphate solubilizing efficiency of bacterial isolates present in *Kunapajala* solution. The bacterial isolates were grown in Pivovskaya's

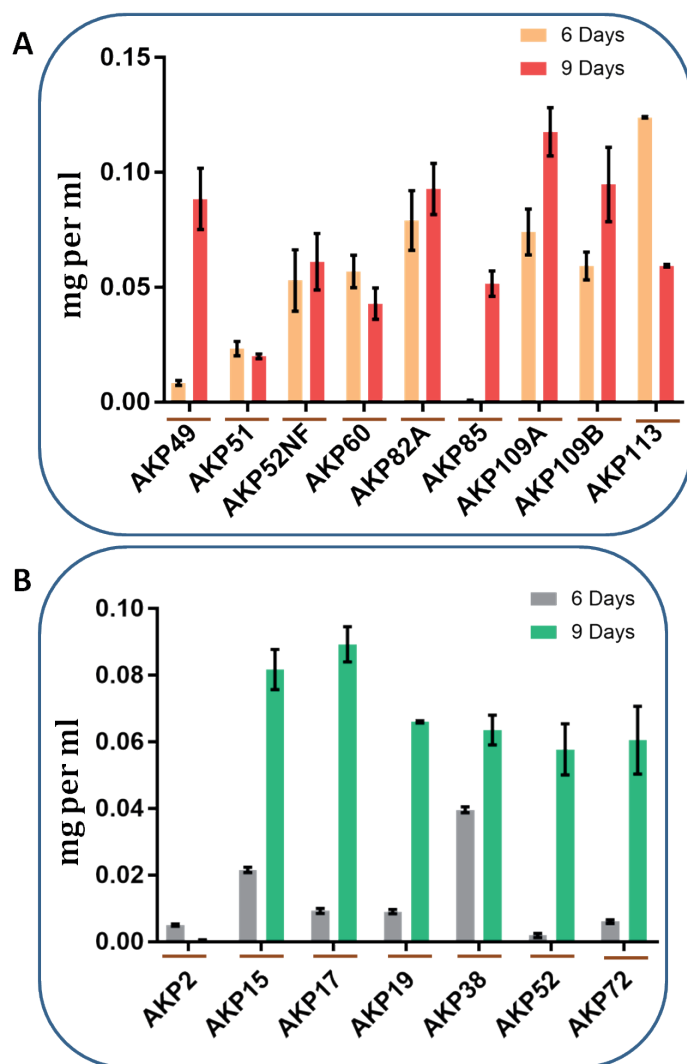


media and measure its phosphorus solubilising efficiency by spectrophotometric method as described before. The y-axis denotes the amount of phosphorus in milli-gram per milli-litre (mg/ml). The dotted line represents the criteria to select the best P-solubilizers.

7.11.4. Indole acetic acid (IAA) production assay of selected bacterial isolates:

Indole acetic acid (IAA) is a well-known growth promoting hormone in plants. It actually helps in cell elongation and cell division (Uggla et.al., 1996). To validate *Kunapajala* as a bio-stimulant, IAA production efficiency of bacterial isolates (efficient nitrogen fixer and phosphate solubilizer) was studied. IAA production assay was performed with ten morphologically distinct nitrogen fixers and seven phosphate solubilizing bacteria. This result pointed out that among nitrogen fixing bacteria, AKP 109A and AKP 113 are the two best IAA producers (Fig. 14A) while AKP 15 and AKP 17 are showing best IAA production among phosphate solubilizing bacteria (Fig. 14B).

Figure R14. The IAA production efficiency of plant-beneficial bacterial isolates present in *Kunapajala* solution. The selected nitrogen fixers (A) and phosphate solubilizers (B) were grown and measure its IAA production efficiency by spectrophotometric



method as described before. The y-axis denotes the concentration of IAA in milli gram per milli-litre (mg/ml).

7.11.5. Molecular characterization of selected plant-beneficial bacteria:

For identification of plant beneficial bacterial isolates bacterial genomic DNA was isolated (Moore et al, 1999), and DNA was then amplified using PCR using 16S rDNA as a primer-pair. Amplified product was then purified by Qiagen gel extraction kit and was then run on 1.2% agarose gel and a clear 1.5 kb band was observed (Fig. R15). These PCR amplified PCR product was sequenced by Sanger method and the generated sequences were used to identify these bacterial strains in NCBI BLAST analysis. We found that the bacterial strains AKP2 and AKP19 show 100%

match in the DNA sequence with *Bacillus subtilis* (Table R2). On the other hand, strains AKP38 and AKP60 show 99.9% match with *Bacillus tequilensis* and *Bacillus subtilis* respectively (Table R2). The AKP85 strain shows identity with *Pseudomonas chlororamphus* at the DNA level (Table R2). This study clearly indicates that *Kunapajala* solution is a rich source of several plant-beneficial bacteria such as *Bacillus* and *Pseudomonas* groups.

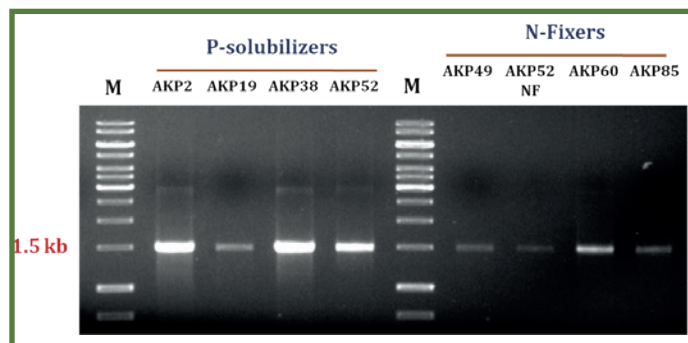


Figure R15. PCR amplification of 16S rDNA of plant-beneficial bacterial isolates present in *Kunapajala* solution. The genomic DNA from selected bacteria was isolated using a standard protocol as described before. PCR was performed using genomic DNA of selected bacteria. PCR products were run on 1.2% agarose gel and stained with EtBr before taking the image in Gel documentation system (Bio-Rad).

Bacterial isolates	Identification	Percent in match
AKP2	<i>Bacillus subtilis</i>	100
AKP19	<i>Bacillus subtilis</i>	100
AKP38	<i>Bacillus tequilensis</i>	99.9
AKP60	<i>Bacillus subtilis</i>	99.9
AKP85	<i>Pseudomonas chlororamphus</i>	87

Table R2. Identification and characterization of the selected plant-beneficial bacterial isolates present in *Kunapajala* solution. PCR amplified DNA was sequenced by Sanger method and generated sequence was used in NCBI BLAST analysis to identify those bacterial isolates.



7.12 Evaluation of weed management practices under organic production system

Objectives

- To evaluate the cultural and mechanical weed management practices under organic production system.
- To study the efficacy of non-conventional approaches of weed management using oilcakes under organic production system.
- To find out the economically viable and practically applicable alternative to hand weeding for

organic weed management in different cropping systems

Year of start: The experiment was planned and finalized in Annual Group Meeting held during 2016-17 and start in 2017-18.

Locations: Bajaura, Bhopal, Calicut, Coimbatore, Dharwad, Jabalpur, Karjat, Ludhiana, Modipuram, Pantnagar, Raipur, Ranchi, Umiam

Treatments: The treatments may be differed from centre to centre as per their respective cropping systems based on the overall treatment structure given below

Organic weed management treatments		Treatment details (To be imposed in all crops in the cropping system)
T ₁	:	Hand weeding (Two)
T ₂	:	One mechanical weeding + one hand weeding
T ₃	:	Intercropping with pulses/green manure (location and crop specific intercropping)
T ₄	:	Stale seed bed + reduced spacing (up to 22-25%) + mulching with previous crop residues + one HW
T ₅	:	Locally available weed mulch (water hyacinth/lantana etc) + one hand pulling
T ₆	:	Incorporation of any one of castor / mahua / mustard seed meal / neem cake/ karanj / tumbha cake/sal de-oiled cake 15 days before planting/sowing @ 5 t/ha + one hand weeding
T ₇	:	Soil solarization with 8-25 microns polythene mulch during summer + one HW
T ₈ (optional)	:	ITK treatment on weed control practiced by farmers (like mulching with leaf of mango/jackfruit etc.)

Results

The results of 2017-18 for each centre are presented and discussed.

Bhopal (Table 7.12.1.1 – 7.12.1.4)

Evaluation of weed management practices for maize-mustard production system under organic conditions.

Maize (Table 7.12.1.1)

Maize grain yield and total biomass yield significantly differed under the different weed management practices under organic management practices in Vertisols. Further, results revealed that maize grain yield was significantly affected by non-chemical weed management practices. Incorporation of

cotton seed cake + one hand weeding (T6) treatment was recorded significantly highest grain yield (4215 kg ha⁻¹) and it was at par with intercropping with cowpea (T3) treatment followed by two hand weeding at 25 and 50 DAS (T1), one mechanical weeding at 25 DAS + one hand weeding at 50 DAS (T2) as compared to control (T9). However, the weed management practices, weed mulch (water hyacinth 4 t/ha dwb) + one hand pulling at 40 DAS (T5) and mulching with dried leaf of mango @ 5t/ha (T8) was recorded the grain yield similar to control treatment (T9). Total yield of maize was significantly influence with the different weed management practices and highest grain yield was recorded under T6 treatment i.e. incorporation of cotton seed cake + one hand

weeding and it was on par with intercropping with cowpea (T3) followed by two hand weeding at 25 and 50 DAS (T1), one mechanical weeding at 25 DAS + one hand weeding at 50 DAS (T2). Among all weed control methods, weed mulch (Water hyacinth 4 t/ha dwb) + one hand pulling at 40 DAS (T5) and mulching with dried leaf of mango @ 5t/ha (T8) showed poor performance than rest of the treatments, but was statistically on par with control (T9).

Mustard (Table 7.12.1.1)

Mustard grain and total biomass yield were significantly affected by non-chemical weed management practices under organic production system. Incorporation of cotton seed cake + one hand weeding (T6) recorded significantly highest grain yield (4215 kg ha⁻¹) but it was at par with intercropping with chickpea treatment (T3) followed by two hand weeding at 25 and 50 DAS (T1), one

mechanical weeding at 25 DAS + one hand weeding at 50 DAS (T2), compared to control (T9). However, the weed management practice weed mulch (water hyacinth 4 t/ha dwb) + one hand pulling at 40 DAS (T5) and mulching with dried leaf of mango @ 5t/ha (T8) on par with control (T9). The effect of different weed control methods on total biological yield of mustard was statistically significant and highest were recorded under treatment 6 (T6 Incorporation of cotton seed cake + one hand weeding) and it was at par with intercropping with Cowpea (T3) followed by two hand weeding at 25 and 50 DAS (T1), one mechanical weeding at 25 DAS + one hand weeding at 50 DAS (T2). Among all weed control methods, weed mulch (Water hyacinth 4 t/ha dwb) + one hand pulling at 40 DAS (T5) and mulching with dried leaf of mango @ 5t/ha (T8) showed poor performance than rest of the treatments, but was statistically on par with control (T9).

Table 7.12.1.1: Effect of different weed management practices on grain and total biomass yield of maize and mustard under organic production system.

Treatments Seed Yield (kg /ha)		Maize		Mustard	
		Total bio-mass yield (kg /ha)	Seed yield (kg /ha)	Total bio-mass yield (kg /ha)	
T1	Hand weeding (Two) at 25 and 50 days after sowing	3881	8660	1507	5330
T2	One mechanical weeding at 25 days after sowing + One Hand weeding at 50 days after sowing	3777	8399	1473	5273
T3	Intercropping with Chickpea (1:1)	4140	8751	1570	5493
T4	Stale seed bed + reduced spacing (45 × 20 cm) + mulching with maize straw + one Hand weeding at 40 DAS	3595	8193	1427	4990
T5	Locally available weed mulch (Water hyacinth 4 t/ha dwb) + one hand pulling at 40 DAS	2504	6260	905	3727
T6	Incorporation of cotton seed cake 15 days before planting/sowing @ 5t/ha + one hand weeding at 40 DAS	4215	8963	1607	5627
T7	Soil solarization with 110 microns poly-thene mulch during summer + one hand weeding at 40 DAS	3487	7833	1380	4860



Treatments Seed Yield (kg /ha)		Maize		Mustard	
		Total bio-mass yield (kg /ha)	Seed yield (kg / ha)	Total bio-mass yield (kg /ha)	
T8	ITK treatment on weed control practiced by farmers (mulching with dried leaf of mango @ 5t/ha)	2493	6103	883	3467
T9	Control	2387	5537	853	3437
CD (0.05)		110	360	74	225

Weed species in the experimental field were identified in both *kharif* and *rabi* season are given below

Major weed flora during *kharif* season

Sl. No.	Botanical name	Common Name	Family	Habit
1	Cynodon dactylon	Bermuda grass, Dhoob	Poaceae	Perennial grass.
2	Echinochloa colonum	Sanwa, jungle rice, deccan grass, or Awnless barnyard grass	Poaceae	annual grass
3	Cyperus rotundus	Motha or Nut Grass	Cyperaceae	perennial sedge
4	Commelina benghalensis	Benghal dayflower, blue commelina	Commelinaceae	annual herb
5	Euphorbia geniculata	dudhi, Wild poinsettia	Euphorbiaceae	annual herb
6	Alternanthera sessilis	Joyweed	Amaranthaceae	annual herb
7	Digra arvensis	Lahsua	Amaranthaceae	Annual herb
8	Palmer amaranth	pigweed, carelessweed	Amaranthaceae	Annual herb

Major weed flora of *rabi* season

Sl. No.	Botanical name	Common Name	Family	Habit
1	Chenopodium album	Bathua, Lambs quarters and Goosefoot	Chenopodiaceae	Annual herb
2	Echinochloa colonum	Sawa, jungle rice, Awnless barnyard grass	Poaceae	annual grass
3	Chloris barbata	finger grass	Poaceae (Gramineae)	Perennial grass
4	Cyperu srotundus	Motha or Nut Grass	Cyperaceae	perennial sedge
5	Medicago denticulata	medick or burclover	Fabaceae	Annual herb
6	Ageratum conyzoides	Billygoat-weed	Asteraceae (Composite)	Annual herb
7	Convolvulus arvensis	Field bindweed	Convolvulaceae	perennial herb
8	Vicia birsata	vetch	Fabaceae (Leguminosae)	Annual herb
9	Cichoriam intybus	blue daisy	Asteraceae	Annual herb

Weed population (weed dry weight (g /0.5 M²))

All the weed management practices were effective in suppressing total weed density and dry matter as compared to weedy check. Minimum weed population and dry weight at 25 and 50 DAS were

recorded under treatment (two hand weeding) followed by stale seed bed + reduced spacing (45 × 20 cm) + mulching with mustard straw + one hand weeding at 40 DAS and soil solarization with 110 microns polythene mulch during summer + one

hand weeding at 40 DAS). Treatment having one mechanical weeding at 25 days after sowing + one hand weeding at 50 DAS was also found effective in reducing weed as compared to control (Table 7.12.1.2).

Weed control efficiency (WCE %)

Adoption of different weed management practices controlled the weed efficiency as evident from the weed control efficiency, which range from 22.3 to 92.8 per cent at 25 DAS, 20.7 to 93.5 per cent at 50 DAS during *kharif* and 29.1 to 92.6 per cent at 25 DAS, 24.9 to 91.4 per cent at 50 DAS, during *rabi*. Weed control efficiency (WCE) indicates the magnitude of effective reduction of weed dry weight by weed

control treatments over un-weeded check. WCE was highly influenced by different weed control treatments. Two hand weeding at 25 and 50 DAS (T_1) recorded higher weed control efficiency of 92 and 93.5 percent during *kharif* and 92.6 and 91.4 during *rabi* respectively at 25 and 50 DAS and it was at par with treatments (T_4 stale seed bed + reduced spacing (45×20 cm) + mulching with mustard straw + one hand weeding at 40 DAS) followed by T_7 (soil solarization with 110 microns polythene mulch during summer + one hand weeding at 40 DAS and T_2 (One mechanical weeding at 25 days after sowing + one hand weeding at 50 DAS) (Table 7.12.1.2).

Table 7.12.1.2: Weed control efficiency (WCE %) in *kharif* and *rabi* crops

Treatments	weed dry weight (g / 0.5 M ²) at 25 DAS		Weed Control Efficiency (%) (WCE) at 25 DAS		weed dry weight (g / 0.5 M ²) at 50 DAS		Weed Control Efficiency (%) (WCE) at 50 DAS	
	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi
T1	17.78	21.34	92.8	92.6	11.3	16.3	93.5	91.4
T2	34.94	48.00	85.9	83.4	28.4	25.5	83.7	86.5
T3	36.81	52.00	85.1	82.0	29.6	27.9	83.0	85.2
T4	22.53	32.79	90.9	88.7	15.2	18.8	91.3	90.1
T5	79.01	82.00	68.0	71.6	30.0	28.0	82.8	85.2
T6	90.85	96.00	63.2	66.8	35.0	32.0	79.9	83.1
T7	27.89	34.07	88.7	88.2	23.3	19.8	86.6	89.5
T8	191.88	205.00	22.3	29.1	138.0	142.0	20.7	24.9
T9	246.95	289.00	0.0	0.0	174.0	189.1	0.0	0.0

Calicut (Table 7.12.2.1)

Weed management practices in turmeric crop during *kharif* was evaluated. Among the treatments, maximum yield was recorded with application of green leaves mulch at, 45 & 90 DAP + hand weeding

at 45 & 90 DAP (control) after planting, however treatment consisting intercropping cowpea + incorporation of biomass of cow pea at 45 DAP, green leaf mulching at 90 DAP, hand weeding at 90 DAP recorded maximum net return per ha of Rs. 5,80,004.

Table 7.12.2.1: Effect of different treatments on yield and economics of turmeric under organic farming.

Treatments	Dry yield turmeric (t/ha)	Cost of cultivation (Rs/ha)	Net returns (Rs/ha)
Green leaves mulch at the time of planting, 45 & 90 DAP + Hand weeding at 45 & 90 DAP (Control)	6.28	1,78,996	574604
Intercropping cow pea + Incorporation of cow pea at 45 DAP, Green leaf mulching 90 DAP, + Hand weeding 45 & 90 DAP	6.04	1,68,996	555804



Treatments	Dry yield turmeric (t/ha)	Cost of cultivation (Rs/ha)	Net returns (Rs/ha)
Intercropping cowpea +Incorporation of cow pea at 45 DAP, Green leaf mulching 90 DAP, Hand weeding at 90 DAP	6.20	1,63,996	580004
Soil solarisation + Green leaves application 45& 90 DAP, Hand weeding at 45&90 DAP	5.92	1,88,996	521404
Soil solarisation + Green leaves application 45&90 DA, Hand weeding at 90 DAP	5.88	1,83,996	521604
Dried coconut leaf application at the time of planting, Hand weeding at 45&90 DAP	2.84	1,70,996	510604

Karjat (Table 7.12.3.1–7.12.3.3)

Different weed management practices were evaluated in rice-groundnut system under organic

management. Treatments used during *kharif* and *rabi* is given as under. Rice variety Karjat-9 and groundnut variety SB-11 were grown.

Treatments

Treatments	Kharif	Rabi
T1	Two hand weeding (HW) at 30 and 50 DAT	Two hand weeding (HW) at 25 and 50 DAS
T2	One mechanical weeding (cono-weeder-30DAT) + one HW at 50 DAT	One mechanical weeding (Dry land weeder-20 DAS) + one HW at 30 DAS
T3	Inter cropping with green manure – <i>Sesbania rostrata</i> (TSR)	Inter cropping (1:1) with pulses –Cowpea var. <i>K. sadabahar</i>
T4	Reduced spacing (up to 25% -15x15 cm) + incorporation of previous crop residue + HW at 30 DAT	Stale seedbed + Reduced spacing (up to 25% - 20 x 15 cm) + mulching with previous crop residue + one HW at 30 DAS
T5	Locally available weed mulch (mix weed flora) + one hand pulling at 30 DAT	Locally available weed mulch + one hand pulling at 30 DAS
T6	Incorporation of neem cake 15 days before planting @ 5 t ha ⁻¹ + one HW at 40 DAT	Incorporation of neem cake 15 days before sowing @ 5 t ha ⁻¹ + one HW at 30DAS
T7	Soil solarization with 25-micron polythene mulch during summer + one HW at 30 DAT	Soil solarization with 8.25-micron polythene mulch during summer + one HW at 30 DAS
T8	ITK treatment on weed control practiced by farmer (mulching with mixed leaves)	ITK treatment on weed control practiced by farmer (mulching with mixed leaves)

There were not any significant differences between weed management practices under organic production system on rice and groundnut for yield. Among the weed management practices in rice and groundnut, treatment T4: reduced spacing (up to 25% -15x15 cm) + incorporation of previous crop residue + HW at 30 DAT during *kharif* and stale seedbed + reduced spacing (up to 25% - 20 x 15 cm) + mulching with previous crop residue + one HW at 30 DAS during *rabi* recorded maximum grain and straw yield

of 4223 and 4772 respectively followed by treatment T2 compare to other weed management practices. Rice equivalent yield, Net return and B:C ratio of the system recorded significantly higher with T7 which is closely followed by T4 (Table 7.12.3.1).

The soil chemical properties measured after completing of cropping cycle showed that soil pH and EC did not influenced significantly whereas, organic carbon, available N, P and K recorded significant difference. Among the different weed management

practices, weed management practice T6 recorded significantly higher organic carbon 1.20 (%) followed by T3 and T5. Maximum and significantly higher organic carbon content (1.20 & 1.18%), available N (286.75 & 285.91 Kg ha⁻¹), P₂O₅ (23.23 & 22.97 Kg ha⁻¹) and K₂O (406.78 & 402.75 Kg ha⁻¹) were also observed

under T6 which was at par with T3 (Table 7.12.3.2). Uptake of nutrients N, P and K with response to the weed management practices was not found to be significant effect in rice-groundnut system however, treatment T4 removed maximum nutrients from the soil followed by T2 (Table 7.12.3.3).

Table 7.12.3.1: Performance of weed management practices on rice and groundnut and their economics under organic management

Treatments	Rice yield (kg/ha)		Ground nut yield (kg/ha)		system rice equivalent yield (kg/ha)	Gross returns of the system (Rs. ha ⁻¹)	Net returns of the system (Rs. ha ⁻¹)	B:C ratio of the system
	Grain	Straw	Dry pods	Haulm				
T ₁	3954	3954	2466	3290	21150	342630	180095	2.11
T ₂	4096	4096	2608	3479	22395	362797	208862	2.36
T ₃	3387	3387	1899	2533	16824	272549	121591	1.81
T ₄	4223	4223	2735	3649	23304	377526	212321	2.29
T ₅	3104	3104	1616	2300	14801	239771	10250	1.04
T ₆	3926	3926	2438	3252	20968	339685	176900	2.09
T ₇	3812	3812	2324	3101	23443	379781	213946	2.29
T ₈	3529	3529	2041	2722	17542	284188	123603	1.77
C.D. at 5%	NS	NS	NS	NS	5634	91265	91265	0.55

Table 7.12.3.2: Chemical properties of soil after completion of crop cycle of rice-groundnut system

Treatment Symbol	Soil pH	Soil EC (dSm ⁻¹)	Organic carbon (%)	Available Nitrogen (Kg ha ⁻¹)	Available P ₂ O ₅ (Kg ha ⁻¹)	Available K ₂ O (Kg ha ⁻¹)
T ₁	6.79	0.411	1.13	270.03	19.10	380.80
T ₂	6.76	0.416	1.14	278.39	19.87	392.90
T ₃	6.79	0.400	1.18	285.91	22.97	402.75
T ₄	6.63	0.394	1.16	282.57	21.94	396.03
T ₅	6.74	0.411	1.17	284.24	22.71	399.62
T ₆	6.74	0.428	1.20	286.75	23.23	406.78
T ₇	6.83	0.387	1.12	268.36	18.32	377.22
T ₈	6.85	0.401	1.08	263.34	17.55	369.15
C. D. at 5%	NS	NS	0.05	6.47	1.58	12.32

Table 7.12.3.3: Effect of different treatments on N, P and K uptake by rice and groundnut

Tr.	N Uptake (Kg ha ⁻¹)			P Uptake (Kg ha ⁻¹)			K Uptake (Kg ha ⁻¹)		
	Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total
T ₁	67.00	82.36	149.36	29.22	15.04	44.26	68.82	64.15	132.98
T ₂	69.03	88.75	157.78	30.46	15.98	46.44	70.46	67.33	137.79



Tr.	N Uptake (Kg ha ⁻¹)			P Uptake (Kg ha ⁻¹)			K Uptake (Kg ha ⁻¹)		
	Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total
T ₃	58.24	62.48	120.72	25.29	11.92	37.21	58.27	49.27	107.54
T ₄	70.68	92.68	163.36	30.30	17.28	47.58	72.06	70.48	142.54
T ₅	54.37	56.33	110.70	22.33	10.32	32.64	53.17	43.04	96.21
T ₆	68.93	81.11	150.05	28.18	15.03	43.21	67.34	62.69	130.03
T ₇	64.20	77.86	142.07	27.83	14.10	41.94	65.37	60.22	125.58
T ₈	58.93	67.32	126.25	25.40	12.42	37.83	60.65	52.51	113.17
C. D. at 5 %	NS	NS	NS	NS	4.11	NS	NS	NS	NS

Ludhiana (Table 7.12.4.1)

Soybean variety SL 958 and cowpea variety CL 367 were evaluated in response to weed management practice with three replications. Cowpea was sown as intercrop in soybean. *Itsit* (*Trianthema portulacastrum*) was the major weed in initial growth period, however *Takri grass* (*Digitaria sanguinalis*) and *rice motha* (*Cyprus iria*) were predominant in later stages of crop growth which infested the crop. The samples were sun dried and then oven dried at 60±2°C. Dry matter of weeds was expressed as g/m²

Weed dry matter accumulation

The maximum weed dry matter accumulation at 5 weeks after sowing was observed in un-weeded control: T5 (220.4 g/m²) which was significantly higher than all the other treatments. However, minimum weed dry matter (68.8 g/m²) was observed in T1 which was statistically at par with T2 and T4

but was significantly lower than other treatments. At harvest, the maximum weed dry matter accumulation was observed in cowpea intercropping T3 (38.2 g/m²) which was statistically at par with unweeded control T5 but was significantly higher than all other treatments. However, T1 and T2 recorded no weed at harvest stage and hence no weed dry matter accumulation at this stage

Soybean seed yield

Straw mulch @ 6 t/ha followed by one hand weeding at 6 weeks after sowing (T2) gave the highest seed yield (2260 kg/ha), which was statistically at par with T1 and T4 and significantly higher than all other treatments. The lowest seed yield was obtained in T5 (un-weeded control) and it was followed by T3 (Cowpea intercropping). The results indicated that weeds in organic soybean can be managed by applying 6 t/ha rice straw mulch followed by hand weeding of escaped weeds.

Table 7.12.4.1: Effect of treatments on weed dry matter accumulation and soybean seed yield

Treatment	Weed dry matter accumulation (g/m ²)		Soybean seed yield (kg/ha)
	5 WAS	at harvest	
T1: Straw mulch @ 6 t/ha	68.8	1.0 (0.0)	2110
T2: Straw mulch @ 6 t/ha followed by one hand weeding at 6 weeks after sowing (WAS)	73.4	1.0 (0.0)	2260
T3: Cowpea intercropping (cowpea and soybean 1:1) and harvesting at 6 WAS	188.0	38.2 (1459.8)	1250
T4: Hand weeding at 2, 5 and 8 WAS	80.2	3.7 (12.8)	2160
T5: Un-weeded Control	220.4	36.0 (1300.5)	960
CD (P =0.05)	21.6	2.0	230

Data subjected to square root transformation and original values are given in parenthesis

Modipuram (Table 7.12.5.1 & 7.12.5.2)

Weed management practices under organic maize-mustard cropping system was evaluated. Among the different treatments, weed density were significantly affected due to different weed management

practices in maize. Lowest weed density at 20 and 40 days after sowing, cob yield, stover yield and net returns of maize was also found to be highest under soil solarization with 25 μ polythene mulch during summer + one hand weeding at 40 DAS. However, highest cost of cultivation was obtained under Incorporation of mustard seed meal 15 days before sowing @ 5t/ha + one hand weeding at 40 DAS.

Table 7.12.5.1: Effect of different treatments on weed density, yield and economics of maize under organic farming.

Treatments	Weed density (no./m ²)		Cob yield (kg/ha)	Stover yield (kg/ha)	COC (Rs./ha)	Net return (Rs./ha)
	20 DAS	40 DAS				
Hand weeding at 25 and 50 DAS	299	198	4159	6933	25480	23047
One mechanical weeding at 25 days after sowing+ One Hand weeding at 50 DAS	249	187	4421	7600	23480	28333
Intercropping with Green gram (1:1)	405	287	3104	5733	23580	13193
Stale seed bed + reduced spacing (45×20 cm) + mulching with mustard straw + one Hand weeding at 40 DAS	232	168	4760	8400	28660	27340
Locally available weed mulch (Water hyacinth 4 t/ha dwb) + one hand pulling at 40 DAS	329	161	3308	4933	24480	13533
Incorporation of mustard seed meal 15 days before sowing @ 5t/ha + one hand weeding at 40 DAS	518	317	4059	6133	122880	-76160
Soil solarization with 25 μ polythene mulch during summer + one hand weeding at 40 DAS	197	113	7936	12133	42680	48813
ITK for weed control (mulching with eucalyptus leaves @ 5t/ha dwb) and one hand weeding at 40 DAS	354	173	4107	6533	24480	23120



Soil solarization



Stale seedbed



Evaluation of weed management practices in mustard crop under organic farming

Among the different weed management treatments in mustard crop, lowest weed density at 20 and 45 DAS was found under soil solarization with 25 μ polythene mulch during summer + one hand weeding at 40 DAS. However highest weed density was recorded under Incorporation of mustard seed meal 15 days before sowing @ 5t/ha + one hand weeding at 40 DAS. Highest biological yield and seed yield was recorded under treatment Incorporation of mustard seed meal 15 days before sowing @ 5t/ha + one hand weeding at 40 DAS. Application of mustard seed meal

increased seed yield about 3 times as compared to hand weeding and mechanical weeding. Application of mustard seed meal might have contributed in better crop nutrition over weed and led to better yield attributes and yield. Mustard equivalent yield was found highest under Incorporation of mustard seed meal 15 days before sowing @ 5t/ha + one hand weeding at 40 DAS followed by Intercropping with chickpea (1:1). Incorporation of mustard seed meal 15 days before sowing @ 5t/ha + one hand weeding at 40 DAS in mustard crop resulted in higher seed and stover yield whereas, net return was higher in intercropping with chickpea (1:1) of Rs. 83,376/ha

Table 7.12.5.1: Effect of different treatments on weed density, productivity and profitability in organic mustard

Treatments	Weed density (no./m ²)						Seed yield (kg/ha)	Stov-er yield (kg/ha)	COC (Rs./ha)	Net return (Rs./ha)
	20 DAS			45 DAS						
	Cype-rus	Oth-er	To-tal	Cyper-us	Oth-er	To-tal				
Hand weeding at 25and 50 DAS	194	68	262	124	76	200	1251	6215	19,880	35,140
One mechanical weeding at 25 days after sowing+ One Hand weeding at 50 DAS	240	39	279	118	64	181	1290	6043	17,880	38,560
Intercropping with Chickpea (1:1)	208	162	370	180	149	329	2447	4231	17,880	83,376
Stale seed bed + reduced spacing (30× 10 cm) + mulching with maize straw + one Hand weeding at 40 DAS	72	66	139	151	85	236	1221	6113	24,060	29,662
Locally available weed mulch (Water hyacinth 4 t/ha dwb) + one hand pulling at 40 DAS	123	70	193	175	71	246	1604	6263	18,880	50,290
Incorporation of mustard seed meal 15 days before sowing @ 5t/ha + one hand weeding at 40 DAS	316	59	374	293	73	367	3592	11874	117,280	35,910
Soil solarization with 8-25 microns polythene mulch during summer (only in kharif) + one hand weed-ing at 40 DAS	60	36	96	79	71	150	1271	7396	17,080	39,674
ITK for weed control (mulching with eucalyptus leaves @ 5t/ha dwb) and one hand weeding at 40 DAS	140	80	220	165	62	227	1225	4908	18,880	34,060



Hand weeding



Mulching with water hyacinth



Mustard + chickpea



Mustard cake applied

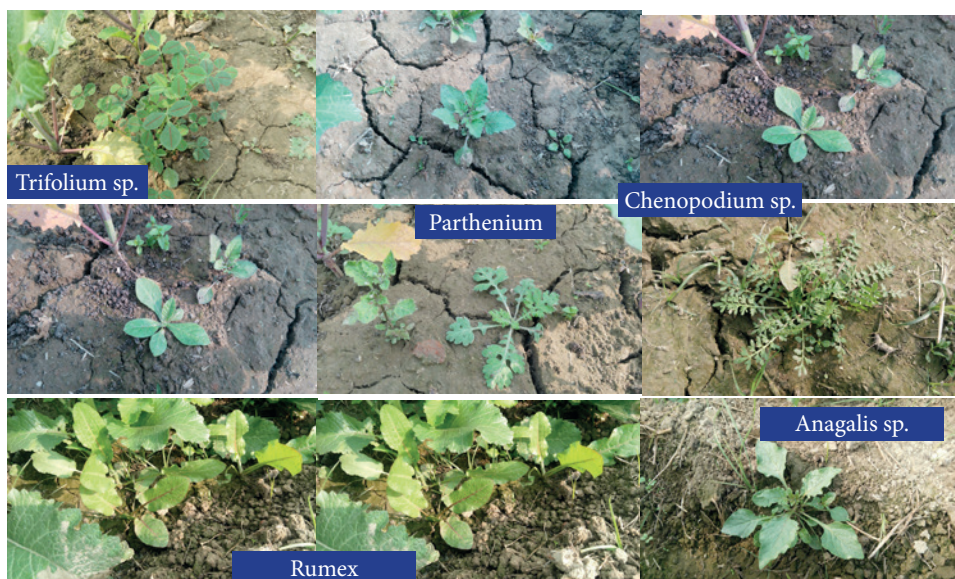


Eucalyptus Leaves applied



Soil solarization

Overview of mustard field



Weed species found in mustard field



Pant Nagar (Table 7.12.6.1–7.12.6.7)

Weed management practices were evaluated in rice-wheat system under organic production. Intercropping in direct seeded rice (DSR) with soybean (2:1 row) for incorporation after 30-35 DAS were taken. During *kharif* in rice, plant height (139 cm) was found maximum under sesbania + 2 MW (one way) while lowest plant height (103 cm) was observed in stale bed + 25 % reduce spacing. Effective tillers/m² (310) was found higher under DSR + Soybean + 1 MW (30 -35 DAT) while minimum was found under NC @5 t/ha + 1 HW. Grain weight/

panicle (1.99g) was found highest under 2HW (20 & 40 DAT) and soil solarization + 1 HW and minimum grain weight/panicle (1.49g) was observed under DSR + soybean + 1MW (30 -35 DAT) and test weight (27.1g) was observed maximum with 2HW (20 & 40 DAT) whereas lowest (24.6g) was found with stale bed + 25 % reduced spacing. The maximum, grain and straw yield (4472 and 5420 kg/ha) was recorded under 2HW (20 & 40 DAT) with 1 MW & 1HW (20 & 40 DAT) weed management practice while highest harvest index was observed with NC @5 t/ha + 1 HW (Table 7.12.6.1).

Table 7.12.6.1: Yield attributes, yield and harvest index of rice (var. Pusa-1121) as influenced by different weed management practices under organic production system.

Treatments	Plant height (cm)	Effective tillers/m ²	Grain wt./ panicle(g)	1000-grain wt. (g)	Grain yield (Kg/ha)	Straw yield (Kg/ha)	Harvest Index
2HW (20 & 40 DAT)	115	252	1.99	27.1	4472	5373	0.45
1 MW & 1HW (20 & 40 DAT)	106	232	1.91	25.9	4222	5420	0.44
DSR + Soybean + 1MW (30 -35 DAT)	114	310	1.49	24.8	4205	5267	0.44
Stale bed + 25 % reduce spacing	103	234	1.83	24.6	3663	4472	0.45
Sesbania + 2 MW (one way)	139	251	1.89	25.2	4370	5066	0.46
Neem-cake @5 t/ha + 1 HW	101	230	1.67	24.9	3492	3865	0.47
Soil solarization + 1 HW	106	245	1.99	25.8	4290	4968	0.47
Eucalyptus oil spray @ 5%	108	240	1.69	25.1	3667	4315	0.46
CD(p=0.05)	5.47	27.7	0.31	NS	459	NS	NS

Echinochloa colona, *Eleusine indica*, *Molugo stricta*, *Cyperus iria*, *Cyperus rotundus* and other weed density (number/ m²) at various growth stages of crop significantly influenced by different weed management practices (Table 7.12.6.2). Minimum *E. colona* (0.9/m²) and other weed density (2.2/ m²) was observed in T₇ (Soil solarization + 1 HW) followed by T₈ (Eucalyptus oil spray@ 5%) while weed density of *E. indica* (0.1 /m²) was recorded minimum with T₄ (Stale bed + 25 % reduced spacing) and weed density of *E. indica* was not observed under T₁ (2HW at 20 & 40 DAT) and T₂ (1 MW & 1HW at 20 & 40 DAT). Weed density of *M. stricta* (0.5/ m²) was found lowest with T₂ (1 MW & 1HW at 20 & 40 DAT) followed

by T₁ (2HW at 20 & 40 DAT) and weed density of *C. iria* (1.2 / m²) was recorded minimum under T₇ (Soil Solarization + 1 HW). Although weed density of *C. rotundus* (1.5 / m²) was recorded minimum in T₅ (Sesbania + 2 MW) and T₆ (NC @5 t/ha + 1 HW) weed management practices. Dry weight of weeds increases with advancement of crop age. Dry weight of weeds was significantly influenced by different weed management practices. Minimum dry weight of weed was recorded in T₆ (NC @5 t/ha + 1 HW; 26.7 g/m²) at 60 days after transplanting and maximum weed dry weight was observed under T₃ (DSR + soybean + 1MW at 30 -35 DAT; 43 g/ m²).

Table 7.12.6.2: Weed density (number/m²) and dry weight (g/m²) in rice at 60 DAS as influenced by different weed management practices under organic production system.

Treatments	Echinochloa colona	Eleusine indica	Molugo stricta	Cyperus iria	Cyperus rotundus	Other weed spp.	Weed dry weight (g)
2HW (20 & 40 DAT)	4.0	-	0.6	9.9	5.8	11.8	32.3
1 MW & 1HW (20 & 40 DAT)	5.6	-	0.5	9.2	10.0	6.0	32.5
DSR + Soybean + 1MW (30 -35 DAT)	4.4	0.8	1.6	8.5	8.7	9.5	43.0
Stale bed + 25% reduce spacing	1.9	0.1	3.1	1.9	9.8	3.4	33.8
Sesbania + 2 MW (one way)	8.7	2.3	1.9	2.7	1.5	8.8	27.3
Neem-cake @5 t/ha + 1 HW	8.9	6.4	1.9	2.6	1.5	8.2	26.7
Soil solarization + 1 HW	0.9	5.8	2.8	1.2	9.6	2.2	30.5
Eucalyptus oil spray @ 5%	1.5	1.6	2.9	1.4	10.3	2.8	27.1
CD (p=0.05)	0.61	0.55	0.46	1.01	0.62	0.86	2.76

Economic analysis of different cropping system managed under varying weed management practices revealed that highest net return (Rs. 86691/

ha) and B: C ratio (3.45) was found in T1 (2HW at 20 & 40 DAT) with less cost of cultivation (Table 7.12.6.3).

Table 7.12.6.3: Relative economics of organic rice cultivation as influenced by different weed management practices.

Treatments	Cost of cultivation (Rs./ha)	Net Return (Rs./ha)	B:C Ratio
2HW (20 & 40 DAT)	25115	86691	3.45
1 MW & 1HW (20 & 40 DAT)	26515	79041	2.98
DSR + Soybean + 1MW (30 -35 DAT)	29985	75154	2.51
Stale bed + 25% reduce spacing	25675	65904	2.57
Sesbania + 2 MW (one way)	29895	79364	2.65
Neem-cake @5 t/ha + 1 HW	30215	57104	1.89
Soil solarization + 1 HW	25395	81851	3.22
Eucalyptus oil spray @ 5%	25815	65852	2.55

Weed management in wheat: In *rabi*, plant height (88cm) and grain weight/ spike (1.30g) in wheat was recorded higher with Bio-fuming mustard (30 DAS) + 1MW whereas, spikes/m² (329) was found maximum under 2HW (30 & 50 DAS). While test weight i.e.1000-grains weight (43.5g) was observed under 1 manual weeding + 1 hand weeding (Table 7.12.6.4). All the yield attribute significantly influenced by different weed management practices except harvest

index. However, maximum grain yield (3793 kg/ha) and straw yield (4007 kg/ha) was recorded in Bio-fuming mustard (30 DAS) + 1 MW while minimum grain yield (3034 kg/ha) and straw yield (3357 kg/ha) was observed under Stale bed + 25 % red. Spacing+ mulching+ 1 HP (30-45 DAS). While highest harvest index (0.49%) was observed under Bio-fuming mustard (30 DAS) + 1 MW.



Table 7.12.6.4: Growth, yield attributes and yield of wheat (Var. UP 2565) as influenced by different weed management practices under organic production system

Treatments	Plant height (cm)	Spikes/ m ²	Grain wt. spike (g)	1000-grain wt. (g)	Grain yield (Kg/ ha)	Straw yield (Kg/ ha)	Harvest Index
2HW (30 & 50 DAS)	81	329	1.22	42.7	3682	3906	0.48
1 MW & 1HW (30 & 50 DAS)	81	301	1.27	42.6	3238	3484	0.48
Wheat + Kas. methi. + 1MW (30 -35 DAS)	85	310	1.27	42.8	3412	3764	0.47
Stale bed + 25 % red. Spacing+ mulching+ 1 HP (30-45 DAS)	77	294	1.21	42.6	3034	3357	0.47
Biofuming mustard (30 DAS) + 1MW	88	331	1.30	41.2	3793	4007	0.49
NC @5 t/ha + 1 HW	82	303	1.27	41.9	3412	3730	0.47
1 MW + 1 HW	79	306	1.25	43.5	3476	3647	0.48
Eucalyptus oil spray@ 5%	85	295	1.19	42.8	3206	3502	0.48
CD (p=0.05)	6.11	NS	NS	NS	352	392	NS

Data showed that weed density (number/m²) at various growth stages of crop was significantly influenced by different weed management practices in *Phalaris minor*, *Coronopus didymus*, *Melilotus indica*, *Fumaria parviflora*, *Anagallis arvensis*, *Chenopodium album*, *Vicia sativa* and *Cyperus rotundus*. Minimum weed density of *Phalaris minor* (1.5/ m²) was recorded in T5 (Biofuming mustard at 30 DAS + 1 MW) followed by T6 (NC @5 t/ha + 1 HW) and under T7, no weed density of *P. minor* was observed. However, weed density of *C. didymus* and *M. indica* was found lowest with T1 (2HW at 30 & 50 DAS) which were 9.8/ m² and 13.3/m², respectively. Although weed density of *F. parviflora* (1.4 / m²) was observed minimum with T1 (2HW at 30 & 50 DAS) and T2 (1 MW & 1HW at 30

& 50 DAS) and weed density of *F. parviflora* was not observed under T5, T6 and T8 weed management practices in wheat. Weed density of *Anagallis arvensis* (3.2/ m²) was found minimum with T6 (NC @5 t/ha + 1 HW) followed by T7 (1 MW + 1 HW) however, weed density of *Chenopodium album* (2.7/ m²) was recorded minimum under T4 while it was not found in T1, T2, T5 and T8 weed management treatments. Weed density of *Vicia sativa* (4.2 /m²) was recorded lowest in T7 (1 MW + 1 HW) and no weed density of this weed was observed under T1, T2 and T6 weed management practices in wheat. Although, weed density of *Cyperus rotundus* (4.1 / m²) was observed minimum with T8 followed by T5 weed management practices (Table 7.12.6.5).

Table 7.12.6.5: Weed density (number/m²) in wheat at 60 DAS as influenced by different weed management practices under organic production system

Treatments	Phalaris minor	Coronopus didymus	Melilotus indica	Fumaria parviflora	Anagallis arvensis	Chenopodium album	Vicia sativa	Cyperus rotundus
T1: 2HW (30 & 50 DAS)	3.4	9.8	13.3	1.4	8.6	-	-	9.4
T2: 1 MW & 1HW (30 & 50 DAS)	2.7	10.6	13.7	1.4	8.6	-	-	12.3
T3: Wheat + Kas. methi + 1MW (30 -35 DAS)	11.3	60.7	25.2	6.9	20.8	4.7	8.0	-

Treatments	Phalaris minor	Coronopus didymus	Melilot indica	Fumaria parviflora	Anagallis arvensis	Chenopodium album	Vicia sativa	Cyperus rotundus
T4: Stale bed + 25 % red. Spacing+ mulching+ 1 HP (30-45 DAS)	8.0	53.4	22.7	5.2	17.8	2.7	5.2	-
T5: Biofuming mustard (30 DAS) + 1 MW	1.5	57.9	17.6	-	9.0	-	5.9	4.1
T6: NC @5 t/ha + 1 HW	1.7	77.1	14.8	-	3.2	5.1	-	5.2
T7: 1 MW + 1 HW	-	11.9	14.8	4.8	5.9	5.6	4.2	6.8
T8: Eucalyptus oil spray@ 5%	1.8	54.6	17.3	-	9.7	-	6.8	3.0
CD(p=0.05)	0.46	3.08	1.60	0.37	1.25	0.75	0.47	1.04

Dry weight of weeds (g/m²) at 60 DAS as influenced by different weed management practices increased with advancement of crop age. Minimum dry weight (46.1 g/m²) of wheat was recorded with T1 (2HW at 30 & 50 DAS) at 60 days after sowing. Among

the weed management practices, 2 hand weeding at 30 & 50 DAS (T1) resulted best practice of weed management. Maximum dry weight (137.7 g/m²) of wheat was recorded under T3 (Wheat + Kasuri methi + 1MW at 30 -35 DAS).

Table 7.12.6.6: Dry weight of weeds (g/m²) at 60 DAS as influenced by different weed management practices under organic production system

Treatments	Weed dry weight (g)
T1: 2HW (30 & 50 DAS)	46.1
T2: 1 MW & 1HW(30 & 50 DAS)	49.3
T3: Wheat + Kas. methi. + 1MW (30 -35 DAS)	137.7
T4: Stale bed + 25 % red. Spacing+ mulching+ 1 HP(30-45 DAS)	135.3
T5: Biofuming mustard (30 DAS) + 1 MW	96.1
T6: NC @5 t/ha + 1 HW	107.3
T7: 1 MW + 1 HW	54.2
T8: Eucalyptus oil spray@ 5%	93.4
CD(p=0.05)	23.3

Economic analysis revealed that net returns of Rs. 47154/ha and B: C ratio (1.67) was found maximum in T₇ (1 MW + 1 HW) with less cost of cultivation.

Table 7.12.6.7: Relative economics of organic wheat cultivation as influenced by different weed management practices.

Treatments	COC (Rs./ha)	Net Return (Rs./ha)	B:C Ratio
T1: 2HW(30 & 50 DAS)	41340	38534	0.93
T2: 1 MW & 1HW(30 & 50 DAS)	39940	30294	0.76
T3: Wheat + Kas. methi. + 1MW(30 -35 DAS)	38140	35881	0.94
T4: Stale bed + 25 % red. Spa.+ mulching+ 1 HP(30-45 DAS)	29925	35893	1.20
T5: Biofuming mustard (30 DAS) + 1 MW	37140	45144	1.22



Treatments	COC (Rs./ha)	Net Return (Rs./ha)	B:C Ratio
T6: NC @5 t/ha + 1 HW	34185	39836	1.17
T7: 1 MW + 1 HW	28245	47154	1.67
T8: Eucalyptus oil spray@ 5%	29785	39761	1.33

Raipur (Table 7.12.7.1:)

Effect of weed management practices on growth, yield attributes and yield of sweet corn under organic production system:

The plant height of sweet corn was affected significantly due to weed management practices. The maximum plant height was recorded in straw mulch @ 40 q ha⁻¹ which was on par with black plastic mulch @0.4q ha⁻¹. Cob length and weight was also higher under straw mulch @ 40 q ha⁻¹ which

was comparable with black plastic mulch, motorized weeding twice at 20 and 40 DAS, mechanical weeding (wheel hoe) twice, mechanical weeding (wheel hoe at 20 DAS followed by hand weeding at 40 DAS and hand weeding twice at 20 and 40 DAS) whereas number of rows cob⁻¹ was significantly higher in block plastic mulch which was on par with all weed management practices. All these parameters were found significantly inferior in weedy check (Table 7.12.7.1).

Table: 7.12.7.1: Effect of different weed management practices on growth and yield attributes of sweet corn under organic production system

Treatments	Plant height (cm)	Cob length (cm)	Cob weight (g)	No. of rows cob ⁻¹	No. of grains cob ⁻¹
T ₁ - Black plastic mulch @ 0.4q/ha	277	20.83	347	16.67	653
T ₂ - Paddy straw mulch @ 40 q/ha	279	20.97	365	16.00	613
T ₃ - Live mulch with cowpea (1:1)	225	16.53	275	12.67	439
T ₄ - Live mulch with green gram (1:1)	241	17.33	262	13.33	470
T ₅ - Motorized weeding twice at 20 & 40 DAS	244	17.50	310	14.67	507
T ₆ - Mechanical weeding (wheel hoe) twice	235	18.23	293	14.67	526
T ₇ - Mechanical weeding (wheel hoe) at 20 DAS and 1 hand weeding at 40 DAS	238	19.17	316	14.67	447
T ₈ - Hand weeding at 20 & 40 DAS	251	18.57	297	15.33	531
T ₉ - Weedy check	191	14.33	233	10.67	363
CD (P=0.05)	18.17	3.17	74	1.90	69

Production and profitability: Green cob yield and fodder yield of sweet corn was significantly influenced by weed management practices under organic production system. The highest green cob yield was obtained in black plastic mulch @ 0.4 q ha⁻¹ followed by paddy straw mulch @ 40 q ha⁻¹ (10250 and 9618 kg ha⁻¹) green cob yield and 30317 and 28900 kg ha⁻¹ fodder yield respectively) both the weed management practices were comparable. Rest of

the weed management practices were significantly inferior in producing green cob yield and fodder yield over Black plastic mulch. The minimum yield was recorded in weedy check. The highest net return and B: C ratio was recorded in straw mulch @ 40 Q ha⁻¹ (Rs. 210401) and 5.73 respectively. The net return of black plastic mulch was next in order but due to higher cost of cultivation the B: C ratio was reduced to 3.39 (Table 7.12.7.2).

Table 7.12.7.2: Effect of different weed management practices on yield and economics of sweet corn under organic production system

Treatments	Green Cob yield (kg ha ⁻¹)	Fodder yield (kg ha ⁻¹)	Cost of cultivation (Rs ha ⁻¹)	Net return (Rs ha ⁻¹)	B:C ratio
T ₁ - Black plastic mulch @ 0.4q/ha	10250	30317	80000	191408	3.39
T ₂ - Paddy straw mulch @ 40 q/ha	9618	28900	44500	210401	5.73
T ₃ - Live mulch with cowpea (1:1)	4271	10478	41000	71003	2.73
T ₄ - Live mulch with green gram (1:1)	6507	23889	41500	133118	4.21
T ₅ - Motorized weeding twice at 20 & 40 DAS	7540	25350	41700	159482	4.82
T ₆ - Mechanical weeding (wheel hoe) twice	8097	26805	45000	170833	4.80
T ₇ - Mechanical weeding (wheel hoe) at 20 DAS and 1 hand weeding at 40 DAS	7979	21327	47500	162643	4.42
T ₈ - Hand weeding at 20 & 40 DAS	8375	27194	52500	170472	4.25
T ₉ - Weedy check	3474	8028	40000	50861	2.27
CD (P=0.05)	1506	2235	-	37552	0.86

Weed dry weight and weed control efficiency:

Data on weed dry weight recorded at 40 and 60 DAS revealed that maximum dry weight of weeds was recorded in weedy check at both stages which was significantly higher over rest of the weed management practices. On the contrary the lowest

dry weight of weeds was observed in block plastic mulch which was on par with straw mulch @ 40 q ha⁻¹. The weed control efficiency was maximum in Block plastic mulch (97.35 %) followed by straw mulch (93.12%) at 40 DAS. Similar trend was also observed at 60 DAS towards WCE (Table 7.12.7.3).

Table 7.12.7.3: Effect of different weed management practices on total weed dry weight and weed control efficiency in sweet corn under organic production system

Treatments	Total weed dry weight (gm ⁻²)		Weed control efficiency (%)	
	40 DAS	60 DAS	40 DAS	60 DAS
T ₁ - Black plastic mulch @ 0.4q/ha	0.00	0.00	97.35	100.00
T ₂ - Paddy straw mulch @ 40 q/ha	0.80	4.15	93.12	95.14
T ₃ - Live mulch with cowpea (1:1)	42.27	53.23	27.51	37.62
T ₄ - Live mulch with green gram (1:1)	29.47	38.07	66.14	55.38
T ₅ - Motorized weeding twice at 20 & 40 DAS	5.36	8.53	52.91	90.00
T ₆ - Mechanical weeding (wheel hoe) twice	4.91	7.34	64.55	91.40
T ₇ - Mechanical weeding (wheel hoe) at 20 DAS and 1 hand weeding at 40 DAS	4.79	5.50	62.96	93.55
T ₈ - Hand weeding at 20 & 40 DAS	4.21	5.69	66.93	93.33
T ₉ - Weedy check	63.23	85.33	-	-
CD (P=0.05)	3.49	5.6	-	-



Effect of weed management practices on growth and yield of tomato under organic production system

Growth, yield attributes and yield of tomato (Table 7.12.7.4): Weed management practices showed significant effect on plant height of tomato under organic farming. The maximum plant height (54.97 cm) was observed under black plastic mulch @ 0.4 q ha⁻¹ which was on par with straw mulch @ 40 q ha⁻¹. Significantly higher number of fruits/plant and fruit weight was achieved also in black plastic mulch @ 0.4 q/ha (42.85 g/plant and 47.27 g/plant respectively)

which was comparable with straw mulch @ 40 q/ha (41.39 g/plant and 46.57 g/plant respectively). The lowest number of fruits plant⁻¹ and fruit weight/plant was produced under weedy check. The fruit yield of tomato showed similar trend and maximum fruit yield was showed similar trend and maximum fruit yield was recorded under Block plastic mulch followed by straw mulch (234.33 and 225.33 q/ha respectively). Both the treatments were significantly superior over other weed management practices. The lowest fruit yield was obtained under weedy check (7067 kg/ha).

Table 7.12.7.4 Effect of different weed management practices on growth and yield of tomato under organic production system

Treatments	Plant height (cm)	No. of fruits plant ⁻¹	Fruit weight (g)	Fruit yield (kg ha ⁻¹)
Black plastic mulch @ 0.4q/ha	54.97	42.85	47.27	23433
Paddy straw mulch @ 40 q/ha	53.57	41.39	46.57	22533
Live mulch with coriander (1:1)	42.18	30.94	35.33	15033
Live mulch with spinach (1:1)	42.66	30.00	35.47	15200
Motorized weeding twice at 20 & 40 DAT	46.13	32.20	36.83	17833
Mechanical weeding (wheel hoe) twice	48.00	33.63	39.40	19100
Mechanical weeding (wheel hoe) at 20 DAT and 1 hand weeding at 40 DAT	48.54	33.17	38.60	18800
Hand weeding at 20 & 40 DAT	49.88	35.20	40.30	19733
Weedy check	32.63	20.83	25.77	7067
CD	3.79	2.99	2.60	1594

Economics (Table 7.12.7.5): The maximum net return was achieved under paddy straw mulch @ 40 q/ha (Rs 170833) with highest B: C ratio (4.13). black plastic

mulch @ 40 q/ha was next in order and gave net return of Rs 144333 /ha but the B: C ratio was quite low (2.60) due to higher cost of cultivation.

Table 7.12.7.5: Effect of different weed management practices on economics of tomato under organic production system

Treatments	Cost of cultivation (Rs ha ⁻¹)	Net return (Rs ha ⁻¹)	B:C ratio
Black plastic mulch @ 0.4q/ha	90000	144333	2.60
Paddy straw mulch @ 40 q/ha	54500	170833	4.13
Live mulch with coriander (1:1)	51500	137947	3.68
Live mulch with spinach (1:1)	51500	117667	3.28
Motorized weeding twice at 20 & 40 DAT	51700	126633	3.45
Mechanical weeding (wheel hoe) twice	55000	136000	3.47



Treatments	Cost of cultivation (Rs ha ⁻¹)	Net return (Rs ha ⁻¹)	B:C ratio
Mechanical weeding (wheel hoe) at 20 DAT and 1 hand weeding at 40 DAT	57500	130500	3.27
Hand weeding at 20 & 40 DAT	62500	134833	3.16
Weedy check	50000	20667	1.41
CD	-	15939	0.28

Weed dry weight and weed control efficiency (Table 7.12.7.6): Weed dry weight in organically grown tomato crop was affected significantly due to weed management practices. Significantly lower weed dry weight was recorded under Black plastic mulch @ 40 q/ha at both the observations stages of

40 and 60 DAT. Similar trend was observed with weed control efficiency. Which was maximum in black plastic mulch @ 40 q/ha (100%) followed by paddy straw mulch (98.98 and 96.42 % at 40 and 60 DAT respectively).

Table 7.12.7.6: Effect of different weed management practices on total weed dry weight and weed control efficiency in tomato under organic production system

Treatments	Total weed dry weight (gm ⁻²)		Weed control efficiency (%)	
	40 DAT	60 DAT	40 DAT	60 DAT
Black plastic mulch @ 0.4q/ha	0.00	0.00	100.00	100.00
Paddy straw mulch @ 40 q/ha	0.69	4.42	98.98	96.42
Live mulch with coriander (1:1)	39.07	56.67	42.35	54.16
Live mulch with spinach (1:1)	40.63	61.63	40.05	50.15
Motorized weeding twice at 20 & 40 DAT	13.20	5.92	80.52	95.21
Mechanical weeding (wheel hoe) twice	13.13	9.07	80.63	92.66
Mechanical weeding (wheel hoe) at 20 DAS and 1 hand weeding at 40 DAT	16.57	5.47	75.55	95.58
Hand weeding at 20 & 40 DAT	12.35	4.97	81.78	95.98
Weedy check	67.77	123.63	-	-
CD	7.12	8.80	-	-

Ranchi (Table 7.12.8.1–7.12.8.5)

Evaluation of weed management practices in rice (Birsamati)-wheat (K-9107) system under organic production system

Treatments

Treatments	Rice (Direct seeded)	Wheat
T ₁	Hand weeding (Two) at 25 and 50 DAS	Hand weeding (Two) at 25 and 50 DAS
T ₂	One mechanical weeding at 25 DAS+ One Hand weeding at 50 DAS	One mechanical weeding at 25 DAS + One Hand weeding at 50 DAS
T ₃	Intercropping with Dhaincha (broadcasting @50 kg/ha)	Intercropping of Wheat + lentil intercropping



Treatments	Rice (Direct seeded)	Wheat
T ₄	Stale seed bed + 25% higher seed rate + mulching with wheat straw + one Hand weeding at 25 DAS	Stale seed bed + 25% higher seed rate + mulching with rice straw + one Hand weeding at 25 DAS
T ₅	Locally available weed mulch + one hand pulling at 25 DAS	Locally available weed mulch + one hand pulling at 25 DAS
T ₆	Incorporation of karanj cake 15 days before planting/sowing @ 5t/ha + one hand weeding at 25 DAS	Incorporation of karanj cake 15 days before planting/sowing @ 5t/ha + one hand weeding at 25 DAS
T ₇	Soil solarization with 8-25 microns polythene mulch during summer + one hand weeding +25 DAS	Soil solarization with 8-25 microns polythene mulch during summer + one hand weeding at 25 DAS
T ₈	ITK treatment mulching with Karanj leaves etc.	ITK treatment mulching with Karanj leaves etc.
T ₉	Without weed control	Without weed control

Rice (Table 7.12.8.1): Yield and yield attributing character of rice was significantly higher under hand weeding (two) at 25 and 50 DAS followed by one mechanical weeding at 25 DAS+ one hand weeding at 50 DAS followed by intercropping with *dhaincha* (broadcasting @50 kg/ha /intercropping of wheat + lentil intercropping and stale seed bed + 25%

higher seed rate + mulching with wheat straw + one hand weeding at 25 DAS. Maximum grain yield of rice (2850 kg/ha) was obtained with 2 Hand weeding at 25 & 50 DAS which was significantly superior over all the weed management practices except intercropping with *dhaincha* (broadcasting @50 kg/ha) 2700 kg/ha which was on par with each other.

Table 7.12.8.1: Rice yield, rice equivalent yield, system rice (Birsamati) equivalent yield under different weed management practices in rice wheat cropping system.

Treatments	Effective tillers/m ²	Panicle length (cm)	Filled grain/panicle	1000- grains wt. (g)	Rice yield (kg/ha)
Hand weeding (Two) at 25 and 50 DAS	267	17.2	80	20.41	2850
One mechanical weeding at 25 DAS+ One Hand weeding at 50 DAS	263	16.4	73	20.26	2592
Intercropping with <i>Dhaincha</i> (broadcasting @50 kg/ha)	265	16.7	76	20.35	2700
Stale seed bed + 25% higher seed rate + mulching with wheat straw + one Hand weeding at 25 DAS	242	16.1	70	20.18	2217
Locally available weed mulch + one hand pulling at 25 DAS	237	15.8	68	20.13	2125
Incorporation of karanj cake 15 days before planting/sowing @ 5t/ha + one hand weeding at 25 DAS	202	15.5	65	19.93	1733
Soil solarization with 8-25 microns polythene mulch during summer + one hand weeding +25 DAS	198	15.2	63	19.88	1642
ITK treatment mulching with Karanj leaves etc	143	14.7	59	19.56	1067
Without weed control	123	14.2	55	19.37	858
CD (P=0.05 %)	26.55	1.49	8.65	NS	322

Selling price of organic produce i.e. rice and wheat Rs. 1987.50 and 1906.25/q respectively

Wheat (7.12.8.2): Yield and yield attributing character of wheat was also following the similar trends in rice and significantly higher under hand weeding (Two) at 25 and 50 DAS) followed by one mechanical weeding at 25 DAS+ one hand weeding at 50 DAS, intercropping with *Dhaincha* (broadcasting @50 kg/ha) /intercropping of wheat + lentil intercropping) and stale seed bed + 25% higher seed rate + mulching

with wheat straw + one Hand weeding at 25 DAS) management practices. Weed management practice in wheat with 2 Hand weeding at 25 & 50 DAS produced higher grain yield (2188 kg/ha) which was statistically at par with one mechanical weeding at 25 DAS+ one hand weeding at 50 DAS (1988 kg/ha) and

Table 7.12.8.2 : Yield and yield attributing characters of wheat crop under different weed management practices in rice wheat cropping system.

Treatments	No. of spike/m ²	Spike length (cm)	No. of grains/spike	1000-grains wt. (g)	wheat Yield (q/ha)
Hand weeding (Two) at 25 and 50 DAS	272	7.9	32	42.44	21.88
One mechanical weeding at 25 DAS+ One Hand weeding at 50 DAS	270	7.3	31	42.38	19.88
Intercropping with <i>Dhaincha</i> (broadcasting @50 kg/ha)	240	6.0	26	42.14	16.30
Stale seed bed + 25% higher seed rate + mulching with wheat straw + one Hand weeding at 25 DAS	278	6.0	30	41.68	18.62
Locally available weed mulch + one hand pulling at 25 DAS	245	6.2	27	42.21	17.25
Incorporation of karanj cake 15 days before planting/sowing @ 5t/ha + one hand weeding at 25 DAS	195	5.5	23	41.88	13.42
Soil solarization with 8-25 microns polythene mulch during summer + one hand weeding +25 DAS	200	5.7	24	41.93	14.79
ITK treatment mulching with <i>Karanj</i> leaves etc.	140	4.7	21	41.55	11.81
Without weed control	122	4.4	19	41.32	8.13
CD (P=0.05 %)	25.49	1.02	3.44	1.66	2.30

Weed dry matter accumulation in *kharif* and *rabi* season were similar and given in table 7.12.8.3 Dry matter accumulation of weeds per unit area under different weed management practice in *kharif* and

rabi was minimum in hand weeding (two) at 25 and 50 DAS and maximum was in weedy check plot at 25 and 40 DAS/DAT.

Table 7.12.8.3: Dry matter accumulation of weeds (g/m²) in rice-wheat cropping system under different weed management practices.

Treatments	Kharif		Rabi	
	Weed dry wt. (g/m ²) 25 DAT	Weed dry wt. (g/m ²) 40 DAT	Weed dry wt. (g/m ²) 25 DAT	Weed dry wt. (g/m ²) 40 DAT
Hand weeding (Two) at 25 and 50 DAS	19.59	27.14	8.69	16.23
One mechanical weeding at 25 DAS+ One Hand weeding at 50 DAS	23.91	31.09	10.46	25.34
Intercropping with <i>Dhaincha</i> (broadcasting @50 kg/ha) /Intercropping of Wheat + lentil intercropping	21.72	30.58	14.82	28.07



Treatments	Kharif		Rabi	
	Weed dry wt. (g/m ²) 25 DAT	Weed dry wt. (g/m ²) 40 DAT	Weed dry wt. (g/m ²) 25 DAT	Weed dry wt. (g/m ²) 40 DAT
Stale seed bed + 25% higher seed rate + mulching with wheat straw + one Hand weeding at 25 DAS	25.87	32.94	12.10	22.52
Locally available weed mulch + one hand pulling at 25 DAS	27.11	35.11	13.04	26.54
Incorporation of karanj cake 15 days before planting/sowing @ 5t/ha + one hand weeding at 25 DAS	30.19	37.65	15.49	30.87
Soil solarization with 8-25 microns polythene mulch during summer + one hand weeding +25 DAS	32.07	38.00	15.49	29.31
ITK treatment mulching with Karanj leaves etc.	35.03	40.13	21.92	33.70
Weedy check	39.24	45.20	23.47	37.44
CD (P=0.05 %)	3.24	3.24	2.12	3.59

Soil nutrient status under different weed management practices in rice-wheat cropping system (Table 7.12.8.4): There was improvement in soil pH, organic carbon, available N, P and K in both rice-wheat systems from their initial values. Weed management practices there was buildup of soil pH, organic carbon available N, P and K in all weed management practices from its initial values.

However, weedy check plot recorded the least buildup in soil nutrient status i.e. soil pH, organic carbon, available N, P and K after end of crop cycle (Table 33). Weed management practice hand weeding (two) at 25 and 50 DAS buildup the maximum organic carbon (0.62%) and enrich the soil 14.8% more to their initial value.

Table 7.12.8.4: Soil nutrient status under different weed management practices in rice-wheat cropping system end of cropping cycle.

Treatments	pH	Organ carbon (%)	Available N	Available P	Available K
Hand weeding (Two) at 25 and 50 DAS	6.09	0.62	234.70	26.45	172.22
One mechanical weeding at 25 DAS+ One Hand weeding at 50 DAS	5.98	0.60	241.83	29.41	173.93
Intercropping with Dhaincha (broadcasting @50 kg/ha) / Intercropping of Wheat + lentil intercropping	5.94	0.58	245.89	31.48	180.07
Stale seed bed + 25% higher seed rate + mulching with wheat straw + one Hand weeding at 25 DAS	5.96	0.59	244.89	30.82	176.11
Locally available weed mulch + one hand pulling at 25 DAS	5.94	0.58	245.66	31.18	179.73
Incorporation of karanj cake 15 days before planting/sowing @ 5t/ha + one hand weeding at 25 DAS	5.87	0.55	253.16	32.28	186.36
Soil solarization with 8-25 microns polythene mulch during summer + one hand weeding +25 DAS	5.90	0.57	251.60	32.03	185.92
ITK treatment mulching with Karanj leaves etc.	5.85	0.54	255.15	34.25	195.46
Weedy check	5.82	0.51	230.75	22.58	169.53
CD (P=0.05 %)	NS	0.05	7.88	3.00	5.12
Initial	5.85	0.54	236.34	25.95	165.56

System productivity and profitability (Table 7.12.8.5): In terms of system productivity, hand weeding (Two) at 25 and 50 DAS recorded higher system productivity (5151 kg/ha) which was statistically at par with one mechanical weeding at 25 DAS + one hand weeding at 50 DAS (4682 kg/ha). Among the weed management practices, treatment T₁ (Hand weeding 2 at 25 and 50 DAS) resulted in significantly higher net returns

and benefit: cost ratio but it remained at par with T₃ and T₂ treatments during *kharif* and *rabi*. Treatment T₁ registered significantly higher net returns of Rs. 44,739/ha with maximum benefit: cost ratio (0.69) as a system whole which was statistically at par with T₂ (Rs 38514/ha & 0.62) and T₃ net return of Rs.38828/ha and B:C ratio of 0.67..

Table 7.12.8.5: System productivity, net return and B: C ratio of rice-wheat cropping system under different weed management practices

Rice (Direct seeded)	Wheat	System productivity (kg/ha)	Kharif		Rabi		System	
			Net returns (Rs./ha)	B:C ratio	Net returns (Rs./ha)	B:C ratio	Net returns (Rs./ha)	B:C ratio
Hand weeding (Two) at 25 and 50 DAS	Hand weeding (Two) at 25 and 50 DAS	5151	38377	1.30	19087	0.18	44739	0.69
One mechanical weeding at 25 DAS + One Hand weeding at 50 DAS	One mechanical weeding at 25 DAS + One Hand weeding at 50 DAS	4682	34220	1.22	12884	0.12	38514	0.62
Intercropping with Dhaincha (broadcasting @50 kg/ha)	Intercropping of Wheat + lentil intercropping	4414	37968	1.42	2580	0.03	38828	0.67
Stale seed bed + 25% higher seed rate + mulching with wheat straw + one Hand weeding at 25 DAS	Stale seed bed + 25% higher seed rate + mulching with rice straw + one Hand weeding at 25 DAS	4175	24816	0.87	6875	0.07	27108	0.43
Locally available weed mulch + one hand pulling at 25 DAS	Locally available weed mulch + one hand pulling at 25 DAS	3939	23706	0.86	324	0.00	23814	0.39
Incorporation of karanj cake 15 days before planting/sowing @ 5t/ha + one hand weeding at 25 DAS	Incorporation of karanj cake 15 days before planting/sowing @ 5t/ha + one hand weeding at 25 DAS	3144	-15130	-0.27	-110532	-0.58	-51974	-0.43
Soil solarization with 8-25 microns polythene mulch during summer + one hand weeding +25 DAS	Soil solarization with 8-25 microns polythene mulch during summer + one hand weeding at 25 DAS	3197	11814	0.42	-16960	-0.16	6161	0.10
ITK treatment mulching with Karanj leaves etc.	ITK treatment mulching with Karanj leaves etc.	2309	-1555	-0.06	-30321	-0.30	-11663	-0.19
Without weed control	Without weed control	1714	-3559	-0.14	-42041	-0.45	-17572	-0.31
CD (P=0.05 %)		-	6863	0.22	4018	0.11	8418	0.12



Umiam (Table 7.12.9.1)

Weed management practices in maize under organic production system: Major weed species observed before weeding in the various treatments were *Echinochloa colonum*, *Centella asiatica*, *Ambrosia*, *Ageratum conyzoides*, *Enhydra fluctans*, *Cyperus kyllinga*, *Cynodon dactylon*, *Commelina bengalensis*, *Parthenium hysterophorus*, *Dicanthium annulatum*, *Amaranthus viridis*, *Sida acuta*, etc. Since there was

a wide variability for the data on weed density, weed fresh weight and weed dry weight within the treatments square root transformation was used for normalizing the distribution of data. The treatment (T6) i.e., incorporation of neem cake @ 5t/ha+one hand weeding recorded more weed density (Mg/m^3), fresh weight (Mg/m^3) and dry weight (Mg/m^3) and the treatment (T1) i.e., hand weeding recorded less weed density (Mg/m^3), fresh weight (Mg/m^3) and dry weight (Mg/m^3).

Table 7.12.9.1: Weed management practices under organic production system

Treatments	Weed density (Mg/m^3)	Fresh weight (g/m^3)	Dry weight (g/m^3)	Green cob yield (t/ha)	Kernel yield (t/ha)
Hand weeding	11.55(133.67)**	16.89(284.54)	11.31(128.05)	3.93	3.93
One mechanical weeding +one hand weeding	19.47(379.26)	18.53(343.95)	13.12(172.66)	4.28	4.28
Intercropping with soybean	14.71(218.21)	18.28(334.48)	13.83(195.09)	5.00	5.00
Stale seed bed+reduced spacing(upto 25%) +mulching with previous crop residues+one hand weeding	19.42(378.42)	17.66(312.05)	12.99(168.94)	4.24	4.24
Locally available weed mulch+one hand pulling	19.05(364.06)	17.26(299.02)	13.11(172.12)	4.10	4.10
Incorporation of neem cake @ 5t/ha +one hand weeding	19.46(382.59)	20.55(422.66)	15.62(245.38)	3.81	3.81
Soil solarization +one hand weeding	17.05(293.20)	18.31(335.26)	12.97(168.24)	4.81	4.81
ITK treatment on weed control practiced by farmers	15.50(240.33)	17.91(320.87)	13.14(173.10)	4.88	4.88
CD (p=0.05)	NS	NS	NS	NS	NS

** : values in parentheses correspond to original values

Udaipur (Table 7.12.10.1)

Weed flora and Weed density: The major broadleaf weeds in the experimental fields were *Chenopodium album*(39.9%), *Chenopodium murale* (29.9%), *Fumaria parviflora* (16.6%), *Convolvulus arvensis*(5.6%), The grassy weed and sedges were *Phalaris minor*(4.0%) and *Cyperus rotundus* (3.9%). Weed density recorded at 60 DAS and at harvest of fennel was significantly influenced by organic weed management practices. Weed density of grassy and broad leaf weeds were recorded significantly lower in plastic mulch either with summer ploughing, sowing after stale seed bed

preparation or soil solarization. All these treatments of plastic mulch were at par and significantly superior over other treatments like soil solarization with one hand weeding either with or without straw mulch(10t/ha), *Sesbania* as smothering crop with hand weeding or pre-emergence application of herbicide with straw mulch (10 t/ha), summer ploughing and stale seed bed with one hand weeding at 20 DAS (Table 7.12.10.1 & 2).

Weed dry matter: Weed dry matter recorded at 60 DAS and at harvest (Table 7.3) was significantly influenced by organic weed management practices.

The broad leaf weeds contributed about 90 % of total dry matter at both the stages and major weed is *Chenopodium* sp. in the field during *rabiseason*. All the three treatments of plastic mulch either with soil solarization, summer ploughing and stale seed bed techniques proved equally effective in reduction of weed dry matter. Plastic mulch in different combinations proved most effective and recorded 95-100 % per cent reduction in total weed dry matter at 60 DAS and at harvest, in comparison to weedy check (Table 7.12.10.3).

Yield attributes and yield (Table 7.12.10.4): Growth and yield attributes of fennel was significantly affected by organic weed management practices. Tallest plants of the crop was recorded when weeds were managed by soil solarization with plastic mulch at sowing (145.3 cm) and this was found at par with plastic mulch at sowing after summer ploughing and stale seed bed preparation. Among various organic weed management treatments, maximum number of branches per plant (6.5), number of umbels per plant (13.5) and number of umbelets per umbel (20.0) were recorded with soil solarization with plastic mulch, results of all these attributes were found at par with summer ploughing + plastic mulch, stale seed bed

preparation + plastic mulch. These three treatments of plastic mulch at sowing with different agronomic practices were found significantly superior over other treatments of experiment.

Among different organic weed management treatments, maximum values of seed yield (1264 kg/ha) of fennel was recorded with crop sown with treatment of summer ploughing with plastic mulch, which was at par with plastic mulch with soil solarization and stale seed bed and pre emergence application of pendimethalin 1000 g/ha with straw mulch (Table 7.5). Application of plastic mulch with summer ploughing, stale seed bed and soil solarization recorded 227.4, 216.0 and 204.4% respectively, increase in yield over weedy check (386 kg/ha). A similar trend of superiority of plastic mulch with different agronomic practices was observed in straw yield of fennel. All the organic weed management treatments proved statistically superior over weedy check.

Economics (Table 7.12.10.5): Among organic weed management practices, highest net return (Rs. 132609/ha) was recorded with soil solarization with plastic mulch and B: C of 4.45 was obtained with soil solarization with one hand weeding.

Table 7.12.10.1: Effect of organic weed management practices on weed density at 60 DAS in fennel

Treatment	Weed density (No./m ²)					
	<i>Chenopodium album</i>	<i>Chenopodium murale</i>	<i>Fumaria parviflora</i>	<i>Convolvulus arvensis</i>	<i>Phalaris minor</i>	<i>Cyperus rotundus</i>
SP + 1 HW at 20 DAS	3.53 (12.00)	2.98 (8.40)	1.58 (2.00)	1.30 (1.20)	1.70 (2.40)	1.30 (1.20)
SP + SM (10 t/ha) at 20 DAS + 1 HW at 40 DAS	4.30 (18.00)	2.55 (6.00)	1.58 (2.00)	1.30 (1.20)	0.71 (0.00)	1.30 (1.20)
SP + PM at sowing	0.71 (0.00)	0.76 (0.08)	1.87 (3.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)
SSB + 1 HW at 20 DAS	4.16 (16.80)	2.30 (4.80)	1.58 (2.00)	1.30 (1.20)	1.30 (1.20)	1.30 (1.20)
SSB + SM (10 t/ha) at 20 DAS + 1 HW at 40 DAS	4.44 (19.20)	2.30 (4.80)	1.58 (2.00)	1.30 (1.20)	0.71 (0.00)	1.30 (1.20)
SSB + PM at sowing	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)
SS + 1 HW	4.16 (16.80)	2.02 (3.60)	1.87 (3.00)	1.70 (2.40)	1.30 (1.20)	1.30 (1.20)



Treatment	Weed density (No./m ²)					
	Chenopodium album	Chenopodium murale	Fumaria parviflora	Convolvulus arvensis	Phalaris minor	Cyperus rotundus
SS + SM (10 t/ha) at 20 DAS+1 HW at 40 DAS	3.70 (13.20)	2.30 (4.80)	1.87 (3.00)	1.30 (1.20)	0.71 (0.00)	1.30 (1.20)
SS + PM at sowing	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)
Sesbania as smothering crop in between rows and used same Sesbainia as mulch after 30 days + 1 HW at 40 DAS	3.86 (14.40)	2.98 (8.40)	2.12 (4.00)	1.30 (1.20)	1.30 (1.20)	1.70 (2.40)
Pendimethalin 1000 ml / atrazine 500g fb SM (10 t/ha) at 20 DAS	3.18 (9.60)	2.30 (4.80)	1.87 (3.00)	1.30 (1.20)	1.70 (2.40)	1.70 (2.40)
Weedy check	4.92 (24.00)	4.30 (18.00)	3.24 (10.00)	2.02 (3.360)	1.70 (2.40)	1.70 (2.40)
LSD (P= 0.05%)	0.32	0.13	0.08	0.05	0.05	0.06

Data subjected to $\sqrt{x + 0.5}$ transformation and figures in parenthesis are original weed count per sq.m

Table 7.12.10.2: Effect of organic weed management practices on weed density at harvest in fennel

Treatment	Weed density (No./m ²)					
	Chenopodium album	Chenopodium murale	Fumaria parviflora	Convolvulus arvensis	Phalaris minor	Cyperus rotundus
SP + 1 HW at 20 DAS	4.70 (21.60)	3.36 (10.80)	3.86 (14.40)	1.70 (2.40)	1.70 (2.40)	3.15 (9.44)
SP + SM (10 t/ha) at 20 DAS+1 HW at 40 DAS	4.15 (16.80)	3.17 (9.60)	4.70 (21.60)	1.30 (1.20)	1.70 (2.40)	3.83 (14.56)
SP + PM at sowing	1.70 (2.40)	1.70 (2.40)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)
SSB + 1 HW at 20DAS	4.57 (20.40)	2.77 (7.20)	4.54 (20.16)	1.70 (2.40)	2.02 (3.60)	3.71 (13.26)
SSB + SM (10 t/ha) at 20 DAS +1 HW at 40 DAS	4.44 (19.20)	2.77 (7.20)	4.85 (23.04)	1.30 (1.20)	1.70 (2.40)	3.95 (15.13)
SSB + PM at sowing	1.70 (2.40)	1.70 (2.40)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)
SS + 1 HW	4.57 (20.40)	2.55 (6.00)	4.55 (20.16)	1.70 (2.40)	2.02 (3.60)	3.71 (13.25)
SS + SM (10 t/ha) at 20 DAS+1 HW at 40 DAS	4.30 (18.00)	3.18 (9.60)	4.04 (15.84)	1.70 (2.40)	2.02 (3.60)	3.30 (10.39)
SS + PM at sowing	1.70 (2.40)	1.70 (2.40)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)
Sesbania as smothering crop in between rows and used same Sesbainia as mulch after 30 days + 1 HW at 40 DAS	4.70 (21.60)	3.36 (10.80)	4.22 (17.28)	1.70 (2.40)	1.70 (2.40)	3.44 (11.35)
Pendimethalin 1000 ml / atrazine 500g fb SM (10 t/ha) at 20 DAS	3.53 (12.00)	3.70 (13.20)	3.47 (11.52)	1.30 (1.20)	2.02 (3.60)	2.84 (7.55)
Weedy check	5.73 (32.40)	4.70 (21.60)	5.39 (28.80)	2.02 (3.60)	2.98 (8.40)	4.37 (18.74)

Treatment	Weed density (No./m ²)					Cyperous rotundus
	Chenopodium album	Chenopodium murale	Fumaria parviflora	Convolvulus arvensis	Phalaris minor	
SEm ±	0.09	0.06	0.12	0.02	0.03	0.09
LSD (P= 0.05%)	0.26	0.17	0.35	0.07	0.09	0.26

Data subjected to $\sqrt{x + 0.5}$ transformation and figures in parenthesis are original weed count per sq.m

Table 7.12.10.3: Effect of organic weed management practices on weed dry matter of fennel

Treatments	60 DAS			At harvest		
	Grassy	BLW	Total	Grassy	BLW	Total
SP + 1 HW at 20 DAS	1.62 (2.13)	3.83 (14.15)	4.09 (16.28)	4.48 (19.56)	7.81 (60.57)	8.98 (80.13)
SP + SM (10 t/ha) at 20 DAS+1 HW at 40 DAS	1.06 (0.62)	4.11 (16.40)	4.18 (17.02)	5.32 (27.77)	7.80 (60.46)	9.42 (88.22)
SP + PM at sowing	0.71 (0.00)	1.55 (1.90)	1.55 (1.90)	0.71 (0.00)	2.55 (5.99)	2.55 (5.99)
SSB + 1 HW at 20DAS	1.37 (1.37)	3.93 (14.96)	4.10 (16.33)	5.31 (27.70)	7.87 (61.52)	9.47 (89.22)
SSB + SM (10 t/ha) at 20 DAS +1 HW at 40 DAS	1.06 (0.62)	4.11 (16.43)	4.19 (17.04))	5.4 (29.41)	7.91 (62.11)	9.59 (91.52)
SSB + PM at sowing	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	2.55 (5.99)	2.55 (5.99)
SS + 1 HW	1.37 (1.37)	4.00 (15.52)	4.17 (16.89)	5.31 (27.70)	7.78 (60.00)	9.39 (87.70)
SS + SM (10 t/ha) at 20 DAS+1 HW at 40 DAS	1.06 (0.62)	3.73 (13.38)	3.81 (14.00)	4.82 (22.77)	7.54 (56.37)	8.92 (79.15)
SS + PM at sowing	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	2.55 (5.99)	2.55 (5.99)
Sesbania as smothering crop in between rows and used same Sesbainia as mulch after 30 days + 1 HW at 40 DAS	1.58 (1.99)	4.17 (16.86)	4.40 (18.85)	4.83 (22.84)	8.03 (64.07)	9.35 (86.91)
Pendimethalin 1000 ml /atrazine500g fb SM (10 t/ha) at 20 DAS	1.80 (2.75)	3.42 (11.19)	3.80 (13.93)	4.28 (17.85)	6.88 (46.89)	8.07 (64.73)
Weedy check	1.80 (2.75)	5.81 (33.38)	6.04 (36.12)	6.64 (43.84)	10.34 (106.44)	12.27 (150.27)
SEm ±	0.02	0.08	0.08	0.12	0.12	0.16
LSD (P= 0.05%)	0.06	0.23	0.24	0.36	0.36	0.46

Data subjected to $\sqrt{x + 0.5}$ transformation and figures in parenthesis are original weed count per sq.m

Table 7.12.10.4: Effect of organic weed management practices on growth & yield attributes of fennel

Treatments	Plant height at harvest (cm)	No. of branches per plant	No. of umbels per plant	No. of umbels per umbel
SP + 1 HW at 20 DAS	109.36	4.88	8.31	16.13
SP + SM (10 t/ha) at 20 DAS+1 HW at 40 DAS	122.63	5.47	10.42	17.56



Treatments	Plant height at harvest (cm)	No. of branches per plant	No. of umbels per plant	No. of umbels per umbel
SP + PM at sowing	137.31	6.13	12.39	19.10
SSB + 1 HW at 20DAS	116.06	5.18	9.54	16.84
SSB + SM (10 t/ha) at 20 DAS +1 HW at 40 DAS	125.69	5.61	10.83	17.97
SSB + PM at sowing	139.53	6.23	12.69	19.14
SS + 1 HW	119.59	5.34	10.02	17.25
SS + SM (10 t/ha) at 20 DAS+1 HW at 40 DAS	122.99	5.49	10.47	17.82
SS + PM at sowing	145.32	6.49	13.46	19.97
<i>Sesbania</i> as smothering crop in between rows and used same <i>Sesbainia</i> as mulch after 30 days + 1 HW at 40 DAS	108.99	4.87	8.60	16.55
Pendimethalin 1000 ml /atrazine500g fb SM (10 t/ha) at 20 DAS	109.25	4.88	8.63	16.48
Weedy check	42.77	1.91	3.23	12.00
SEm ±	4.30	0.19	0.60	0.43
LSD (P= 0.05%)	12.61	0.56	1.77	1.28

Data subjected to ($\sqrt{x + 0.5}$) transformation and figures in parenthesis are original weed count per sq.m

Table 7.12.10.5: Effect of organic weed management practices on yield and economics of fennel

Treatments	Seed yield (kg/ha)	Straw yield (kg/ha)	Biological yield (kg/ha)	Harvest index	Cost of cultivation (Rs/ha)	Net Returns	B/C Ratio
SP + 1 HW at 20 DAS	851	2304	3154	26.91	30430	102901	3.66
SP + SM (10 t/ha) at 20 DAS+1 HW at 40 DAS	907	2379	3286	27.63	40430	106562	3.22
SP + PM at sowing	1264	3093	4357	28.97	44650	146129	3.04
SSB + 1 HW at 20DAS	899	2287	3185	28.18	30430	110079	3.91
SSB + SM (10 t/ha) at 20 DAS +1 HW at 40 DAS	877	2313	3190	27.50	40430	106913	3.80
SSB + PM at sowing	1220	3309	4529	26.93	44650	139794	2.90
SS + 1 HW	995	2657	3652	27.25	30430	125063	4.45
SS + SM (10 t/ha) at 20 DAS+1 HW at 40 DAS	843	2144	2987	28.25	40430	96522	2.91
SS + PM at sowing	1175	2968	4143	28.31	47280	132609	2.76
<i>Sesbania</i> as smothering crop in between rows and used same <i>Sesbainia</i> as mulch after 30 days + 1 HW at 40 DAS	850	3358	4207	20.20	30930	92359	2.30
Pendimethalin 1000 ml /atrazine500g fb SM (10 t/ha) at 20 DAS	1079	2945	4024	26.79	36900	133567	4.08
Weedy check	386	1113	1499	25.75	25500	36839	1.62
SEm ±	72	176	244	0.47	-	11002	0.31
LSD (P= 0.05%)	210	515	717	1.37	-	32269	0.91



Field view of experiment



Soil solarization + plastic mulch at sowing



Sesbania as green manuring 30 DAS + 1 HW at 40 DAS



Stale seed bed + plastic mulch at sowing in Sweet corn



Summer ploughing + straw mulch (10 t/ha) at 20 DAS+1 hand weeding at 40 DAS



Summer ploughing + plastic mulch at sowing

Effect of Organic weed management practices on sweet corn and fennel at Udaipur



7.13: Evaluation of concoctions of Natural Farming in Basmati Rice-Wheat system

Objectives

- To study the natural farming practices on productivity and economics of basmati rice-wheat system
- To evaluate the natural farming practices on soil health and environment

Year of Start: Rabi 2017-18.

Locations: Ludhiana (Punjab), Modipuram (Uttar Pradesh), Pantnagar (Uttarakhand) under AI-NPOF and Kurukshetra (Haryana) under AICRP-IFS

Cropping system: Basmati rice-wheat at Ludhiana, Modipuram and Pantnagar and coarse rice-wheat at Kurukshetra

Treatment details

The following six common treatments were evaluated with four replications.

T1: Control

T2: AI-NPOF developed package

T2 : Gurukul package (Beejamrit, jeevamrit and Ghanjeeamrit) product supplied by Gurukul Kurukshetra

T4 : Locally prepared Gurukul products (Beejamrit, jeevamrit and Ghanjeevamrit) (Prepared at centre)

T5 : Location specific improved Gurukul products (Beejamrit, jeevamrit and Ghanjeevamrit) (prepared at centre)

T6: Integrated crop management (50% organic + 50% inorganic)

Major practices adopted under natural farming (T3 to T 5)

Rice

- Green manuring with moong/ dhaincha during summer season.
- Ghanjeevamrit @ 250 kg/ha.
- Jeevamrit application at one week after

transplanting and 30 days after first application with irrigation water.

- One time cow urine (1:1 cow urine and water) application.
- One foliar spray of Agniastra at 75 DAT.

Wheat

- Ghanjeevamrit @ 250 kg/ha.
- Jeevamrit (200 lit./acre) with irrigation water for 2 to 3 times.
- Cow urine (1:1) application at maximum tillering stage.
- Fermented lassi spray at 15 days before harvesting.

Results

The results of 2017-18 for each centre are presented and discussed

Ludhiana (Table 7.13.1.1)

The experiment was started from *rabi* 2017-18. The Gurukul products i.e Ghanjeevamrit, Beejamrit, Jeevamrit, cow urine and biopesticides (Agniastra, Neem astra) were taken from Gurukul, Kurukshetra, Haryana. The local organic inputs were prepared at research farm of the School of Organic Farming. The local organic products were enriched with bio-fertilizers to obtain the improved organic products. In integrated nutrient management, 50% N to wheat was applied through FYM and 50% through fertilizer whereas in pesticide free treatment, no synthetic pesticides were used. Wheat variety PBW 725 as test variety was used. The weed management was done through manual weeding. No-significant variation was found among natural farming practice in wheat for all the variables, which might be due to green manuring in *kharif* season which mitigated the treatment effects during first season. Among natural farming practices, integrated nutrient management & pesticide free treatment followed by integrated crop management perform better in term of effective tillers/m² (379.2 & 378.3), ear length (9.7 & 9.8 cm), grains/ear (46.8), 1000-grans-weight (43.6 & 43.0 g)

and grain yield (5270 & 5200 kg/ha) of wheat. In the first year, only 3.22% yield difference was observed between Gurukul and NPOF package.

Table 7.13.1.1: Evaluation of different natural farming concoctions on growth and yield of wheat.

Treatment	Plant height (cm)	Effective tillers/m ²	Ear length (cm)	Grains/ear	1000-Grain/weight (g)	Economic yield (kg/ha)	Straw/ yield (kg/ha)
Control	94.9	351.0	9.3	43.4	41.3	4750	6670
AI-NPOF Package	99.4	370.3	9.6	44.2	43.5	5130	7350
Gurukul package (from Kurukshetra)	99.4	359.2	9.5	44.5	43.0	4970	7160
Gurukul package– Locally prepared	98.7	355.3	9.4	43.7	43.2	4840	6800
Gurukul package– Improved	96.8	363.5	9.6	45.9	43.1	4900	6890
Integrated Crop Management (50% organic+:50% inorganic)	98.1	378.3	9.8	46.8	43.3	5200	7350
INM+ Pesticide free	98.4	379.2	9.7	46.8	43.6	5270	7680
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS

Without pesticide: Better organic carbon was recorded in ICM and AI-NPOF package (0.57) and it was minimum under the control. The soil available nitrogen was highest in AI-NPOF package and was followed by ICM and Gurukul package (Improved).

The soil available phosphorous was highest in AI-NPOF package and was lowest in control. The soil available potassium was highest in NPOF and was lowest in control.

Table 7.13.1.2: Effect of natural farming concoctions on soil chemical properties (0-15cm) after harvest of wheat

Treatment	EC (mmhos/cm)	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
Control	0.28	0.52	90.7	90.4	282.2
AI-NPOF Package	0.28	0.57	112.7	99.6	306.4
Gurukul package (from Kurukshetra)	0.27	0.54	98.2	90.8	297.1
Gurukul package– Locally prepared	0.30	0.55	100.7	90.7	292.0
Gurukul package– Improved	0.27	0.53	110.2	91.8	297.9
Integrated Crop Management (50% organic+:50% inorganic)	0.29	0.57	111.1	97.4	294.2
INM+ Pesticide free	0.29	0.56	107.4	98.8	298.4

Modipuram (Table 7.13.2.1)

Significant variation was observed for growth and yield characters except ear length. Taller plant height at harvest was found under integrated crop management. Yield attributing characters such as effective tillers/m², spike length and no. of grains/spike were recorded better under integrated crop management treatment. Similarly, highest grain

(5408 kg/ha) and biological yield (13600 kg/ha) was also recorded under integrated crop management. Grain yield under remaining treatments was found statistically identical except control. Biological properties of soil were significantly influenced by different treatments. Highest bacterial (2.36×10^7 CFU/g soil) and fungal population (7.2×10^4 CFU/g) in soil was found under AI-NPOF package.

Table 7.13.2.1: Growth, yield attributes, yield and biological properties of soil after harvesting of wheat with natural farming concoctions.

Treatments	Plant height at harvest (cm)	Effective tillers/m ²	Ear length (cm)	No of Grains/ear	Biological yield (kg/ha)	Grain yield (kg/ha)	Bacteria ($\times 10^7$ CF/g soil)	Fungi ($\times 10^4$ CFU/g soil)	Actinomyces ($\times 10^6$ CFU/g soil)
Control	74.5	289	10.0	31.6	5700	2193	1.07	5.0	1.9
AI-NPOF Package	76.5	324	9.8	40.7	6100	2513	2.36	7.2	2.4
Gurukul package (from Kurukshetra)	73.3	352	9.2	34.9	6550	2662	1.57	6.6	2.1
Gurukul package- Locally prepared	72.4	333	9.5	35.5	6100	2456	1.83	5.7	2.5
Gurukul package- Improved	82.5	280	8.7	35.9	6600	2760	1.80	6.6	3.0
Integrated Crop Management (50% organic+50% inorganic)	93.3	433	10.7	41.2	13600	5408	1.76	5.4	2.1
CD at 5%	9.88	42.3	NS	6.06	765	377	-	-	-



Overview of wheat under natural farming experiment at Modipuram

Pantnagar (Table 7.13.3.1)

Wheat variety UP 2565 was taken in the experiment. Highest plant height (99.3 cm) and spikes/m² were recorded in integrated crop management. However, test weight (1000-grains) 43.3g was observed

maximum with control. Among evaluated practices, maximum grain yield (3250 kg/ha) and straw yield (6292 kg/ha) was recorded also under integrated crop management. AI-NPOF package resulted in 24.5% higher yield than Gurukul package.

Table 7.13.3.1: Growth and yield attributes of wheat (UP 2565) as influenced by different natural farming concoctions

Treatments	Plant height (cm)	Spikes/m ²	Grain weight (g)	Grain Yield (kg/ha)	Straw yield (kg/ha)	Harvest index
Control	95.7	215	43.3	2542	4167	0.38
AI-NPOF Package	96.7	241	42.6	2751	5146	0.34
Gurukul package (from Kurukshetra)	92.3	260	42.3	2209	3834	0.36
Gurukul package- Locally prepared	93.2	263	42.8	2355	4208	0.36
Gurukul package- Improved	92.2	266	41.3	2229	4146	0.35
Integrated Crop Management (50% organic+50% inorganic)	99.3	310	41.8	3250	6292	0.34
CD(p=0.05)	NS	NS	NS	NS	NS	NS

Kurukshetra (Table 7.13.4.1)

Yield attribute characters, effective tiller/meter row length (74 nos.) and 1000-grains weight (49.8g) resulted in higher with AI-NPOF package. Among evaluated practices, maximum grain yield (3785

kg/ha) and straw yield (5148 kg/ha) was recorded under integrated crop management. Improved Gurukul package outperformed after integrated crop management. ICM package resulted in 49.2% higher yield than Gurukul package whereas AINPOF been on par with Gurukul.

Table 7.13.4.1: Growth and yield attributes of wheat as influenced by different natural farming concoctions

Treatments	Ear head length (cm)	Effective tillers/meter row length.)	1000 grain weight (g)	Grain yield (kg/ha ⁻¹)	Straw yield (kg/ha ⁻¹)
Control	9.6	45	46.2	2160	2805
AI-NPOF Package	10.1	74	49.8	2555	3475
Gurukul package (from Kurukshetra)	9.8	48	48.4	2537	3350
Gurukul package- Locally prepared	8.6	51	48.2	2508	3512
Gurukul package- Improved	9.4	54	49.4	2632	3554
Integrated Crop Management (50% organic+50% inorganic)	10.2	68	46.8	3785	5148



7.14 Cluster based demonstration of Organic Farming Package under Tribal Sub Plan (TSP)

Location: Umiam

Organic food production through integrated farming system- cluster approach

ICAR Research Complex for NEH Region has initially selected a village "Mynsain" of Ri-Bhoi District, Meghalaya in the year 2013 for disseminating organic production technology in cluster approach. Mynsain village is located in Umsning Tehsil of Ri-Bhoi district in Meghalaya and is situated 15 km away from ICAR Research Complex, Umiam. The village lies between 25°42'45.4"N and 92°01'04.3"N. The improved seeds like maize, groundnut, frenchbean and some other vegetables seeds were distributed to the farmers. The Survey (PRA) and farmers training were conducted to initiate the programme. As there is much awareness among the public about the organic produce, the adopted farmers may get premier price say 10% higher than the conventionally produced items. 100 farmers were selected in first phase in a compact area for demonstration of organic farming practices through a model village concept. Considering the overwhelming response of farmers of the mentioned village, we have expanded the coverage area by including two more nearby villages (Pynthor and Umden Umbathiang) in the year 2016 in cluster approach under the NPOF Project. The component of the Model village would be as follows-

Base line data: The PRA was conducted to collect basic information about the village with regards to resources available, type of crops grown, soil quality, livestock, land use, productivity, forest etc. to workout the plan of activities.

Organic food production: Various crops, vegetables and fruits would be cultivated considering the local demand, agro-climatic condition, soil health etc. Efficient cropping systems for the locality will be identified.

Food-FeedCropProduction: Farmers was encouraged

to grow crops such as sweet potato, maize, cucumber etc. as food for consumption purpose and as feed for livestock.

Livestock: As pig farming is mostly followed by the farmers, improved piggery were promoted. Some farmers practiced dairying. The cow dung would be used for vermicomposting, FYM preparation etc. for crop production and organic milk may be sold as comparatively higher price.

Community vermicompost unit: All the wastage, crop residues, weed biomass etc. from the farmers' family and field will be collected and stored near the compost unit. This would help farmers to make quality vermin-compost for organic agriculture. The villagers may also earn from

Selling vermin-compost and earthworm for their livelihood. The additional organic manure may be procured by the Institute for various programmes.

Green manuring for crop production: Green manuring (GM) would be practiced wherever possible. GM crops such as crotalaria, dhaincha, rice bean, soybean, groundnut etc. would be grown in sequence or as intercrop with rice, maize, other drops to enrich soil health and reduce soil loss (as cover crops) and to supply additional nutrient rich pulses to the farm families.

Green leaf manuring trees: Leguminous multipurpose trees such as *Acacia auriculiformis* (Japanese Acacia), *Erythrina indica*, *Samanea saman* (Acacia), *Delonix regia* (Gulmohar), *Pongamia glabra* (Pogamia) and *Azadirachta indica* (Neem) would be grown in wasteland, degraded community lands for green leaf manuring. Growing of leguminous tree in wastelands would rehabilitate the wastelands and make them productive.

Hedge row intercropping: In hill slopes, leguminous hedge row species such as *Tephrosia*, and *Crotalaria* spp. etc was grown at regular interval (10 to 20 m) depending upon the slope of the land. The hedge row species would be also grown around the farm to serve as fencing, conserve soils and water and supply

nutrient rich green leaf manure. The interspaces would be used for crop production.

Low cost polyhouse: The low cost polyhouse is economical for small and marginal farmers, who cannot afford huge cost of high-tech poly house. Many times, farmers produce good amount of cucumber, capsicum and tomatoes during main season, which eventually leads to the market glut and fall in price. On the other hand, due to weather extremes during winter, it is difficult to grow high value vegetables like tomato, capsicum, cucumber, etc. in open condition.

Development of water harvesting structure: Water harvesting structure such as ponds, jal kunds, farm ponds etc. would be developed to provide necessary additional water during off season or lifesaving irrigation for Rabi and pre-kharif crops.

Soil conservation measures: Terracing, half-moon terracing, vegetative barriers etc. would be practiced for conserving soil and water.

Cultivation of fodder crops in degraded lands: Unused land in village would be used for community fodder cultivation (eg. Broom grass, Congo-signal, Napier etc) to supply green fodder to the dairy unit.

Besides, cultivation of fodder in hill slopes would rehabilitate degraded land by reducing soil loss.

Organic outlet: A small low cost shed was constructed near highway for marketing organic produce from the village/Institute.

Soil Fertility status

For determining soil fertility status, 160 soil samples were collected at a depth of 0-15cm and 15-30cm to be analyzed for four soil fertility parameters, viz., available nitrogen, available phosphorus, soil organic matter and pH. The soil samples were collected from both lowland and upland fields located in the villages.

Results: The available N, P, SOC and pH of the soil at lowland condition were recorded to be 212.1 ± 25.6 kg/ha, 9.3 ± 6.0 kg/ha, 15.8 ± 3.4 mg/kg and 4.96 ± 0.65 , respectively for 0-15 cm depth and 185.1 ± 21.6 kg/ha, 11.2 ± 1.5 kg/ha, 12.8 ± 6.3 mg/kg and 4.87 ± 0.65 , respectively for 15-30 cm soil depth. Similarly, the available N, P, SOC and pH of the soil at upland condition were recorded at 205.7 ± 34.5 kg/ha, 21.6 ± 11.8 kg/ha, 13.3 ± 3.6 mg/kg and 4.83 ± 0.68 pH, respectively, for 0-15 cm soil depth and 168.1 ± 62.4 kg/ha, 8.9 ± 2.5 kg/ha, 10.3 ± 0.45 mg/kg and 5.04 ± 0.65 , respectively for 15-30 cm soil depth.

Basic information of the newly adopted villages at Ri-Bhoi District, Meghalaya

Village Name	Pynthor	Umden-Umbathiang
Block	Umsning block	Umsning block
Total number of Household	120 Nos.	88 Nos.
Number of Household for Geo-reference data-	42 Nos.	20 Nos.
Farming Situation	Rainfed	Rainfed
Total Land Holding	13.56 ha	6.27 ha
Area Under Organic Farming	13.56ha	6.27 ha
Year of start organic Farming (Traditionally)	More than 100 years back	More than 100 years back
Year of start organic Farming (Scientifically)	2016	2016
Total Numbers of Farm Animals	150 Nos.	Nil
Numbers/Name of Farm Machinery	Nil	Nil
Organic Inputs (Capacity in t/annum)	Nil	Nil
Crop Residue availability within the farm for recycling (t/year)	Nil	Nil

Progress mode during 2013-17

A. Development of farm pond and composite fish culture

To promote efficient water conservation and its multiple use, construction of farm ponds in farmer's field was initiated. Three approaches were adopted for farm pond development:

- To renovate existing unused ponds
- To develop new ponds for harvesting water
- To add value to other farming activities

The ponds were constructed for adding value to other farming activities in which water from ponds can serve as domestic and livestock water supplies as well as irrigation for high-value crops and vegetables during lean period. The ponds were also developed to promote IOFS models as well as for achieving



diversification of their farm enterprises. Application of lime (2t/ha) and FYM (10t/ha) was performed after the pond was constructed for enhancing the soil fertility. An amount of Rs.50, 000 was incurred for the construction of the pond. As the farmers took keen interest on composite fish culture, a total of 100kg fingerlings consisting of catla (30%), grass carp (30%) and common carp (40%) were released during the year 2017-18, in the existing ponds constructed in Mynsain village in previous years. The number of beneficiaries farmers where pond constructed were 7. The body weight of fingerlings varied from 17-82 g at the time of release. Construction of ponds in the newly adopted villages will also be initiated and the list of beneficiary farmers, village and the geographical coordinates of the demonstration sites have been provided in table below:



Farm pond and beneficiary harvesting the fish from her pond

Growth analysis of fish species (12 Months stocking)

Species	Weight (g)	Total Length (cm)	Girth (cm)
Catla	832.0 ± 121.3	35.23 ± 2.14	14.32 ± 1.23
Grass Carp	723.2 ± 158.3	32.54 ± 1.96	8.97 ± 1.03
Common Carp	986.3 ± 163.5	36.25 ± 2.07	15.12 ± 1.34

The different fish species including of surface feeder (Catla), column feeder (Grass Carp) and bottom feeder (Common carp) were adapted in farmer's pond. After 12 months it was found that common carp attained maximum weight (986.3 ± 163.5) and length (36.25 ± 2.07) whereas minimum weight and length was found in grass carp (723.2 ± 158.3) and length of (32.54 ± 1.96).

B. Low- cost rainwater harvesting structure 'Jalkund'

The NPOF team has initiated an intervention to popularize low-cost rainwater harvesting structures 'Jalkund' (5×4×1.5 m) with silpaulin lining having a storage capacity of 30,000 litres for harvesting rainwater in farmer's fields and the no. of beneficiaries farmers were 19. Jalkunds were

constructed at higher elevations, for easy diversion and collection of rainwater in the *jalkund* that will roughly store adequate amounts of water for the farmers' to utilize for irrigation.

The main goal of introduction of *jalkund* is to secure water supply during the lean period in order to:

- Minimize crop failure during dry months and provide critical irrigation to high value winter crop.
- Supply drinking water and domestic water for animals and people respectively.
- Enhance crop diversification



Farmer releasing fingerlings in jalkund



Growing vegetables over the jalkund



Farmers of stored the rain water directly in the *jalkunds* during the rainy season and the stored water helped the farmers to raise crops for the whole year. Farmers diversified their farming activities throughout the year and cultivated high value crops such as broccoli, tomato, frenchbean etc. The space available along the periphery of the *Jalkund* was utilized efficiently for raising crops which resulted in an increase to their farm income as a whole. The stored water was also used in the daily activities such as cleaning and giving water to their livestock's for which earlier they had to fetch from distant places. Some farmers also used the *jalkunds* for rearing fish which gave them additional income.

C. Composting as a sustainable technology for farm households

Based on this aspect, a community vermicomposting unit (size 6m x 8m x 2.6m) was constructed in Mynsain village with an objective to recycle on-farm biomass to increase the fertility of the soil. Initially eight vermicomposting tanks (size 2m x 1.5m x 0.75m) were constructed using cement brick tanks for greater efficiency. The tanks are filled with organic wastes and composting is taken up. The community collects the biomass from farmer's field and use it for vermicomposting.



Community vermicomposting unit

Vermi-beds

Vermi Beds are unique and latest technology for earthworm farming. It is very portable, low cost, easy to handle and install and provision for collection of Vermi-wash. 30 numbers each of such beds of the size 12'x4' x 2' were distributed to the three (3) villages during the year 2017-18 for vermicomposting, which can produce about 1200kgs to 1500kgs of vermicompost. Vermi-beds can be done on a small scale by farmers with household organic wastes. Crop residues and agricultural wastes are collected by the farmers and filled in the vermibeds for decomposition processes.



Harvesting of vermicompost



Monitoring of vermibeds by scientists

D. Land Development and modification

(i) Terracing

In the NPOF villages, the area is mostly a hilly terrain accompanied with a number of steep slopes. In these villages, abandoned *jhum* lands were left unattended and barren which resulted to soil erosion, depletion of soil fertility and reduction in yield and income. Therefore, the intervention of land development and modification was taken up under the NPOF project. Bench terraces were constructed in farmers field (11) where the land was steeper than 16% and depth of soil was good enough. The terraces were developed

in farmer's field to bring additional area under cultivation. The fairly levelled bench terraces were used to grow crops and the risers were planted with grass. For faster development of soil fertility, newly prepared terraces were incorporated with lime (2t/ha), FYM (15t/ha) and biomass. Also leguminous crops like groundnut, rice bean, green gram, soybean etc. were planned for cultivation in the first year for developing soil fertility. Two bench terraces each were recently constructed in Mynsain and Pynthor village during the year 2017 and construction of bench terraces in Umden Umbathiang village will also be initiated.



Newly constructed terraces



Cultivation of vegetables in terraces

Impact of terrace cultivation

- The land that was left unattended and barren and efficiently used by the farmers for cultivation of crops as compared to the traditional/conventional farming methods.

- Soil erosion was greatly reduced because the flooded water was allowed to come on the plain surface and this helped in gradual absorption of the water by the ground.
- Mono-cropping was practiced in the villages

before the intervention of terrace making. The additional area generated by constructing terraces was efficiently used by the farmers for raising two or more crops in a year and this provided additional income for the farmers.

(ii) Raised and Sunken beds

The *bun* system (raised bed of 1 m width, 8-10 m long and 30-50 cm height) of cultivation is very popular among the farmers of these villages for growing crops like vegetables (tomato, cabbage, cauliflower, carrot, etc.), ginger, turmeric etc., especially in uplands. Normally, farmers raise their crops on the temporary *buns* (raised bed) keeping the sunken area (area between the two raised beds) unutilized. Some farmers also follow *bun* cultivation for growing vegetables after *kharif* rice in lowlands. Here also the sunken area is not utilized for cultivation.

Layout

Surface soil layer of each sunken bed was removed

Land configuration options for different under land situations

Types of configuration	Ratio of raised to sunken beds	Land situation	Remarks
Permanent raised and sunken beds	1:1.25	Depth of waterlogging less than 0.5m	Sunken beds for pre-kharif rice cultivation
Temporary raised beds after <i>kharif</i> rice	2:0.5	Normal depth	20-25% area to drainage channel
Temporary raised beds after <i>kharif</i> rice	1:0.5	Normal depth	30-40% area to drainage channels

and deposited on the adjacent raised beds to a height of about 30cm after that, the raised beds were levelled in such a way that the 50% of run-off water from half of the raised bed will drain off into the intervening sunken beds. Dimensions of the raised bed constructed in villages were 0.75-1m in breadth, 10m in length and 0.3-0.5m in height and the drainage channel (Sunken bed) varied from 0.2-0.5m. A total of 20311.4 m² area had been brought under vegetable cultivation in lowland through raised and sunken beds technique. Raised and Sunken beds were developed after rice harvest in lowland for cultivation of vegetables. Vegetables such as tomato (Var.Avinash, Rocky) french bean (var. Naga local), potato (var. Kufrimegha), carrot (var. New Kuroda), brocolli (var.Green magic) lettuce etc were grown by the farmers on raised beds. A total of number of 10 farmers were selected from the adopted villages for developing the raised and sunken bed technology



Demonstration for preparation of raised and sunken beds



Sowing of frenchbean in raised beds in farmer's field

With the intervention of raised and sunken bed system, it was found that crop production of farmers has been enhanced tremendously as the system was an effective practice for harvesting rainwater for the lean period and also enhancing the productivity of rice during kharif due to prolonged submergence of water in sunken beds. Also, the technology has also provided efficient utilization of land by reducing tillage of the cultivated area thus saving labour, farmer's energy, conservation of moisture and improving soil health as well. The farmers were also able to receive additional income as well as employment generation as two or more crops were raised in a year through the intervention as compared to their traditional practice of monocropping.

E. Fruit trees plantation

(a) Sweet orange and Assam lemon

Farmers from the adopted villages who were interested in fruit production were introduced to the organic farm management practices with emphasis on the organic methods of fruit production. During the year 2017, 300 saplings each of sweet orange and assam lemon were distributed to the farmers.



Fig: Assam lemon in farmer's field

Package of practices

- Pits size -1 x 1x 1 m
- Spacing-5 × 5 m apart.
- Nutrient source- Incorporated with upper 30 cm soil along with 3 to 5 kg FYM + 50g rock phosphate per pit.

In the initial stages, trees were allowed to grow as a single upright stem up to a height of 70 to 80 cm. The shoots emerging from ground level or below the graft/bud union and dried twigs were removed periodically. The survival percentage was about 85%.

(b) Pineapple plantation

A farmer Mrs. Trias Makhroh of Mynsain village having an area of about 1 acre was given two thousand numbers of pineapple suckers (Var. kew) for planting during monsoon of the year 2017. The plantation was carried out across the slope to ensure higher yield by reducing soil loss. Planting was done at a spacing of 30 x 60 x 90 cm in double row method of planting, i.e. suckers were planted at a distance of 30 cm from plant to plant in the line and 60 cm in between two lines and 90 cm between two double rows. Well rotten FYM @ 1kg/pit were applied at the time of planting. Recently, intercropping of greengram in between two rows of pineapple was done to maintain the soil fertility. After the pineapples have ripened, Mrs.



Intercropping of pineapple and greengram in Mrs. Trias Makhroh field

Makhroh narrated that was able to sell around 2500 pineapples at rate of ranging from Rs. 30 to Rs. 50 per pineapple, while 400 to 500 ripe pineapples were evenly sliced, packed and sold at Rs. 10 per packet wherein a single pineapple produces 15 to 18 packets.



Intercropping soybean in between maize rows in farmer's field

G. Low-cost polyhouse

The low cost polyhouse is economical for small and marginal farmers, who cannot afford huge cost of high-tech poly house. Many times, farmers produce good amount of cucumber, capsicum and tomatoes during main season, which eventually leads to the market glut and fall in price. On the other hand, due to weather extremes during winter, it is difficult to grow high value vegetables like tomato, capsicum, cucumber, etc. in open condition. Therefore, for demonstrating low-cost polyhouse technology three beneficiary farmers (*Mrs Skola Kurbah, Mrs Hynniew Rynghang and Mr Jril Makroh*) of Mynsian were selected during the year 2017 for off-season production of vegetable nurseries as well as for raising crops of high value vegetables. Efforts are been taken for expanding the technology in the

Economics of low cost polyhouse (7m×6m)

A. Cost of construction	Amount (Rs)
Bamboo (17) nos.@ Rs 70	1190
UV stabilized polysheet @ Rs 129/m	5418
Labour charge@ Rs 250	2500

F. Improved maize variety

200 kg of improved maize variety developed by ICAR-RC for NEH Region, Umiam viz. DA-61A was distributed to the 30 farmers from each village for intervention and the average yield of 4.45 t/ha (SEm±1.04) was obtained in DA-61- A.



Maize variety DA 61- A

other villages as well. An amount of Rs 10,490/- was incurred for construction of each polyhouse.

Materials and methods: Considering economic condition of farmers, requirement and adaptability, low cost polyhouse of an area 7m×6m was developed with locally available material like bamboo for providing structure and frame of the house. The structure was covered with 200µm UV LDPE film stabilized polythene sheet. The site of construction of polyhouse should be free from any shade. It should be constructed in an East-West orientation to ensure good winter and protection from northern winds. It should also be elevated at a higher elevation to avoid water stagnation. Nursery of vegetables (tomato, cabbage, cauliflower, broccoli, capsicum, lettuce) were raised in the polyhouses.

A. Cost of construction		Amount (Rs)		
Polyhouse Net (50%)		882		
Miscellaneous		500		
Total		10490		
B. Cost of production		C. Return		
	Approx. cost(Rs)		Production (kg)	Income (Rs)
<i>Winter Vegetables</i>				
Tomato	1,100	Tomato	150	4,500
Cabbage	600	Cabbage	200	4,000
Cauliflower	640	Cauliflower	160	6,400
Broccoli	1,100	Broccoli	250	7,500
Lettuce	360	Lettuce	50	4,000
Capsicum	1,100	Capsicum	180	10,800
<i>Summer vegetable</i>				
Brinjal	400	Brinjal	100	2,000
Total	5,300	Total	1,090	39,200
Total(A+B)	15,790			
Net Return	23,410			
B:C Ratio	1.48			



Nursery preparation of cole crops in polyhouse

Their crops were also being protected from harmful pests and insects. Farmers also mentioned that better quality vegetables were being produced by the farmers and labour requirement was also greatly reduced. During winter season, water scarcity is the main problem however farmers did not need plenty of water for cultivating their vegetables and therefore requirement of water and chance of wasting water was less.



Low cost polyhouse in farmer's field

H. Livestock production

(i) Poultry

To improve the socio-economic status of the traditional farmers, backyard poultry is a handy enterprise with low-cost initial investment, but high economic return along with guarantee for improving protein deficiency among the poor. However, the potentiality of indigenous birds in



Beneficiaries benefitted from poultry rearing

terms of egg production is only 70 to 80 eggs/ bird/ year and meat production is also very less. Therefore, during the year 2017-18, 1500 nos. poultry chicks (Breed-Vanaraja & Gramapriya) and 5 bags poultry feed were distributed to 20 beneficiaries in order to increase the socio-economic as well as livelihood and nutritional security condition of the villages. An average of 18-20 eggs were being produced each poultry bird per month. The average weight of the poultry birds were 3 kg. The farmers could also sell the poultry birds for meat purpose at an average price Rs. 300 per kg. On an average expenditure incurred in the investment of poultry house was Rs 8900/-. Selling price of one bird @ Rs 160/kg and average weight of one bird=2.5kg. Selling price of one egg@ Rs 8/kg. The farmers observed the advantage of rearing these birds due to their high annual egg production capacity in which they were able to get 200 to 230 egg/ bird/ year as well as higher gain weight over the local birds.

(ii) Introduction of improved pig variety and low cost housing system

Pig farming under deep litter with low-cost housing system - A total of 15 farmers were selected for the demonstration of the intervention and received 38 nos.improved breeds which gave higher productivity and income. This pig variety is developed by crossing

Khasi local pig (Sniang Megha) with exotic pig Hampshire. It has 25% genetic inheritance of Khasi local and 75% genetic inheritance of Hampshire. Farmers were given training cum exposure visit at the ICAR Animal Division Research Farm to get an idea and develop an understanding about the intervention. In this technology, the institute recommended a pig shed(pigsty) of 10 feet length and 7 feet width for piglets up to fattening stage or a sow with piglets up to weaning stage. A minimum of 1 feet deep litter materials consisting of either saw dust or rice husk is maintained at the floor of the sty. The bedding material is to be maintained for one month after which it should be replaced with fresh bedding material depending upon the state of decomposition of the litter.

The pig variety performed well because of its adaptability in the hill ecosystem and suitability to low input tribal production/backyard pig production system. The pig variety also performed better and gave higher productivity in the low input tribal production system as compared to the local variety. The pig attained higher body weight of 90-100 kg at 12 months of age, besides higher litter size at weaning as compared to local non-descriptive pigs in the low input tribal production system. About 1000 to 1500 kg of well decomposed manure/year was produced by replacing the bedding material in the pigsty.



Improved breed of pig (Lumsniang)



Local breed of Pig



Deep litter pig shelter

I. Improved Rice production

High yielding variety of rice (Shahsarang-1) and improved production technology was intervened in to the farmers field during 2017-18. The purpose was to increase the rice productivity with the aadoption

of improved production technology. Spacing of row to row was 20 cm with two seedlings per hill, 20 days old nursery was used for transplanting. A total area of 4 hectares was brought under organic rice production.



Demonstration online transplanting of rice in farmer's field



Improved rice variety (Shahsarang-1)

J. Organic Vegetables and Crop Production

Under Network Project on Organic Farming, important cropping systems which were found economically better or at par with conventional system were being introduced in the villages. The goal of introduction of cropping systems is to conserve the soil and water and sustain crop production as well as promote crop diversification as an important option in sustainable agricultural system. Some of the cropping systems that were introduced are carrot/ rice (pre *kharif*) – rice (*kharif*), potato/ rice (pre *kharif*) – rice (*kharif*), tomato/ rice (pre *kharif*) – rice (*kharif*), French bean/ rice (pre *kharif*) – rice (*kharif*) etc. For promoting organic food production in the village, the farmers were provided with improved quality of seeds of cereals, pulses, vegetables as well as spices for enhancing their income and productivity.

- Nutrient source: For spices application of FYM



Community nursery for vegetable crops like cabbage, cauliflower, broccoli, chilly etc.

Crops like groundnut, soybean etc. were cultivated in newly constructed terraces to enhance the soil fertility. Groundnut (Var. ICGS 76 @ 100 kg) and Soybean (Var. JS-81 @ 100 kg) were cultivated in farmer's field at various locations and the average yield of groundnut (1.48 ± 1.04 t/ha) was found at farmers field

(b) Spices plantation

Turmeric and ginger are the major spices of the north-eastern region, however turmeric has not occupied a significant area in this region. Although, there are no

was applied @ 2kg/m^2 and for cereals and vegetables application of FYM @ $10\text{-}15$ t/ha. Also vermicompost and pig manure were used by some farmers as nutrient sources for cultivation of crops.

- Weed management: Hand weeding and farmers.
- Pest and disease management: Regular monitoring of the fields were followed and spraying of neem bicidine @ 3ml/litre .

Before the distribution of vegetable seeds, beneficiary farmers were trained for nursery raising and scientific methods of vegetable cultivation. Community nursery were formed in the villages during the year 2015, 2016 and 2017 for raising seedlings of cole crops like cabbage, broccoli and cauliflower. This activity was found to be very crucial for obtaining strong and healthy vegetable seedlings.

(a) Leguminous crops



Groundnut in farmer's field

processing industries however some farmers of the village have started growing turmeric and ginger. About 200 kg each of turmeric rhizomes (Var. Megha Turmeric-1) and ginger (Nadia) were distributed to twelve (12) beneficiary farmers. Most of the turmeric and ginger were planted in raised bed (Bun System)



Turmeric and Ginger crop at farmers field

Frenchbean: A total of 200 kg each of french bean seeds (var. Naga local) were distributed to 21 numbers of beneficiaries of the adopted villages for crop diversification and increasing the income. The seeds were planted at a spacing of 30x15 cm and FYM was incorporated @ 10 t/ha. The average production was found to be (3.15 ± 0.81t/ha).

Bitter gourd: 200g each of Bitter gourd seeds (Var.



French bean at farmer field

Malay 101) was distributed to ten farmers of the adopted villages. The field was thoroughly ploughed (3-4 times) before planting by digging with the help of spades and well rotten FYM @ 15 t/ha was

at a spacing of 30 x 30cm and FYM was applied @ 2kg/m². Average yield of turmeric (24.79 ± 4.66 t/ha) and ginger (16.04 ± 3.10 t/ha) could be achieved of and at farmers field.

(c) Vegetables



incorporated at the time of ploughing. The seeds were planted at the spacing of 1.5 to 2.5m (row to row) x 60 to 120cm (plant to plant). The average yield was found to be (6.11 ± 0.82 t/ha).



Bitter gourd crop

Cucumber: Ten beneficiary farmers from the adopted villages were selected for growing cucumber (Var. Malini). Before planting the soil was thoroughly ploughed (3-4 times) by digging through spades and well rotten FYM @ 15 t/ha was mixed at the time of ploughing. The seeds were planted at a spacing of

1.5 to 2.5m (row to row) x 60 to 90cm (plant to plant).
Average yield was found to be $(7.38 \pm 0.46 \text{ t/ha})$.



Cucumber crop

Lettuce: 100g each of lettuce seeds (Var. Iceberg Cabbage TYP) were distributed to the farmers. The nursery was temporarily prepared on raised beds in paddy fields after rice harvesting and the seedlings were distributed to selected ten farmers. The seedlings were then transplanted at a spacing of 45 x 30 cm and FYM @ 10t/ha was applied at the time of planting. The average yield was found to be $(3.72 \pm 0.76 \text{ t/ha})$.



Lettuce in raised beds

Tomato: 500g of tomato seeds (Var. Rocky) was distributed to 15 farmers. Seedlings were raised temporarily on raised beds after rice harvesting and later were transplanted at a spacing of 60 x 45 cm and FYM was incorporated @ 20t/ha at the time of planting. The average yield was found to be $(17.17 \pm 6.41 \text{ t/ha})$.



Mulching of tomato in farmer's field

Cabbage: Fifteen beneficiaries were selected for raising nursery and planting cabbage (Var. Fiesta). Seedlings were transplanted at the recommended spacing of 45 x 45 cm and FYM @10-15 t/ha was incorporated before transplanting of the seedlings. The average yield was found to be $(4.19 \pm 1.06 \text{ t/ha})$.



Cabbage in raised beds

Broccoli: Ten beneficiary farmers were selected for raising nursery and planting broccoli (Var. Green magic). Nursery preparation and other intercultural practices was carried out and the seedlings were transplanted at a recommended spacing of 45 x 30 cm FYM @10-15 t/ha was incorporated before transplanting of the seedlings. The average yield was found to be $(6.58 \pm 1.00 \text{ t/ha})$.

Chilli: 150g of Chilli seeds (Var. Telwa BSS) were distributed to ten beneficiary farmers. Nursery preparation and other intercultural practices was carried out and the seedlings were transplanted at a recommended spacing of 45 x 30 cm. FYM@10-15 t/ha was incorporated before transplanting of the seedlings. The average yield was found to be $(7.50 \pm 0.93 \text{ t/ha})$



Chilli crop

Carrot: 200g of carrot seeds were distributed to ten farmers. Nursery preparation and other intercultural practices was carried out and the seedlings were transplanted at a recommended spacing of 30 x 30 cm. FYM @10-15 t/ha was incorporated before transplanting of the seedlings. The average yield was found to be $(6.53 \pm 1.72 \text{ t/ha})$.



Carrot in farmer's field

Pea: 300kg of pea seeds were distributed to fifteen farmers. Nursery preparation and other intercultural practices was carried out and the seedlings were transplanted at a recommended spacing of 30 x 30 cm. FYM@10-15 t/ha was incorporated before transplanting of the seedlings. The average yield was found to be $(6.02 \pm 1.37 \text{ t/ha})$.



Pea in rice fallow system

(d) Tuber crops

Potato: 500kg of potato tubers (Var. Kufprimegha) was distributed to twenty beneficiary farmers. The sprouted tubers were planted in temporary raised beds made by the farmers in their paddy fields after rice harvesting. The tubers were planted in furrows at the spacing of 50 x 30cm and FYM @ 10-15 t/ha was applied in the opened furrows before planting. The Average yield was $(7.08 \pm 2.10 \text{ t/ha})$.



Potato in raised beds

Sweet potato: 300 numbers of sweet potato cuttings (Var. Kokrajhar) were planted in fields of four farmers at a spacing of 50 x 50 cm on raised beds. At 30 DAT, intercultural operations (weeding and earthing up) were performed by the farmers and FYM @ 10-15 t/ha was also incorporated. The average yield was found to be $(14.48 \pm 2.13 \text{ t/ha})$.



Sweet potato in farmer's field

K. Hedge row Intercropping

Leguminous hedge row species such as *Tephrosia* sp. was grown at regular intervals across the slope (10 to 20 m depending upon the slope). The hedge row species were also grown around the farm which served as a purpose of fencing, soil and water conservation and supply of nutrient rich green leaf manure. The interspaces would be used for growing crops thereby increasing the production.



Tephrosia as a live fence

Number of farmers and average yield of different crops at farmer's field under organic cluster approach

Sl. No.	Name of crops & variety	Nos. of farmers	Mean yield (t/ha)	SE(m)
1	Maize (DA-61A)	30	4.45	± 1.04
2	Groundnut (ICGS 76)	10	1.48	± 0.48
3	Soybean	10	2500	-
4	Turmeric (Megha Turmeric-1)	6	24.79	± 4.66
5	Ginger (Nadia)	6	16.04	± 3.10
6	Frenchbean (Naga local)	21	3.15	± 0.81
7	Bitter Gourd (Malay 101)	10	6.11	± 0.82
8	Cucumber (Malini)	10	7.38	± 0.46
9	Lettuce (Iceberg Cabbage TYP)	10	3.72	± 0.76
10	Tomato (Rocky)	15	17.17	± 6.41
11	Cabbage (Fiesta)	15	4.19	± 1.06
12	Broccoli seeds (Green magic)	10	6.58	± 1.00
13	Chilli seeds (Telwa BSS)	10	7.50	± 0.93
14	Carrot (var.Kuroda New)	10	6.53	± 1.72
15	Pea (Arkel)	15	6.02	± 1.37
16	Potato (Kufri megha)	20	7.08	± 2.10
17	Sweet potato (kokrajhar)	5	14.48	± 2.13

L. Integrated Organic Farming System (IOFS) Model

The organic farming technology has been demonstrated to 315 households of 3 villages viz., Mynsain, Pynthor and Umden Umbathiang covering an area of about 280 ha. In addition to the existing IOFS models, 3 more beneficiaries were selected during the year 2017-18 for developing the IOFS model. The IOFS model promotes crop diversification thereby providing food security and employment for the farmers round the year.

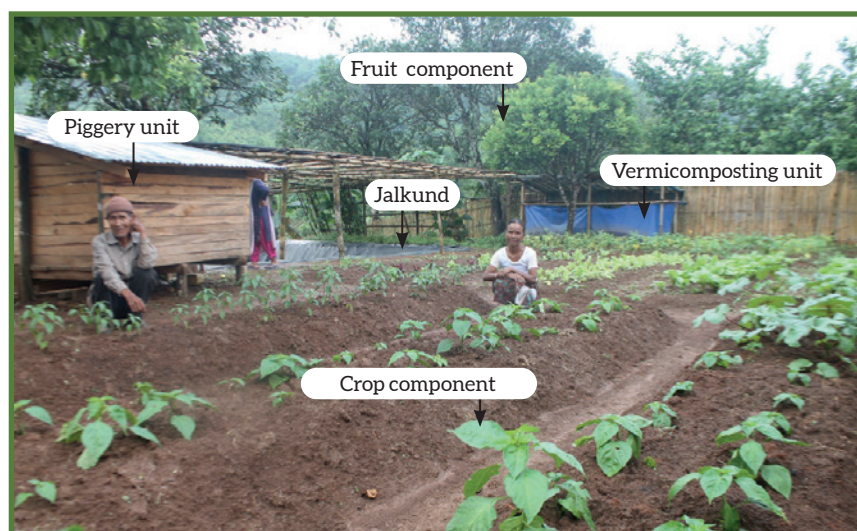
Interventions under IOFS

1. For improving the livelihood of the farmers, technological intervention such as zero tillage for cultivation of crops viz., vegetable pea, mustard, cole crops and introduction of HYV crops (maize var. DA-61A and rice var. Shahsarang and Bhalum-1) were made.
2. Farmers were also encouraged to grow fodder crops such as Napier, Congo signal and Guinea grass on terrace risers. The objective of growing fodder crops is to bring back degraded lands under cultivation for improving the soil fertility and for supplying green fodder as a feed to milch animals, thereby providing required nutrients for milk production and health of dairy animals.
3. Low-cost micro storage structures (*Jalkund*) with 250 GSM Silpaulin linings of 30,000 litres capacity

for live saving irrigation were constructed. These structures were constructed to enable the farmers to harvest rainwater during the rainy season and subsequently use the water during dry periods as well as to provide critical irrigation to high value winter crop.

4. The ponds were constructed for adding value to other farming activities in which water from ponds can serve as domestic and livestock water supplies as well as rearing of fish.
5. Introduction of improved pig varieties (75% Hampshire and 25% mixed local) and poultry birds (Breed-Vanaraja & Gramapriya) which gave higher productivity and income.
6. In addition, fruit tree plantation such as assam lemon and sweet orange were also initiated for enhancing the income of the farmers.
7. A vermicomposting unit was constructed to recycle on-farm biomass to increase the fertility of the soil.

At present ten farmers in the adopted villages have started practicing Integrated Farming System (IFS) + cultivation of crops organically. They have integrated cereal crops (Rice, Maize), Vegetables (Tomato, French bean, Potato, Lettuce, Carrot) along with Livestock (Dairy/ Piggery) and also water harvesting structure (*Jalkund*) etc. in the system.



An IOFS model developed in farmer's field

8

PUBLICATIONS/HUMAN RESOURCE DEVELOPMENT AND WORKSHOPS/ MEETINGS

8.1 Publications

8.1.1 Research Papers

- C.K. Chandrakar*, M.C. Bhambri, G.P. Pali, Sunil Kumar, A. Jangde, K.K. Pandey and Sanjeev Singh. 2017. Response of Plant Nutrients on Soil Fertility, Productivity and Profitability of Rice () -Chickpea () Cropping System in Chhattisgarh Plains. . Vol. 6 (4); 1867-1875.
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- तरुण सूर्यवंशी, श्यामलाल एवं एस.एस.पोर्ते (2017) मृदा

सूर्यकरण खरपतवार नियंत्रण की एक लाभदायक तकनीक पृ.क.28 कृषक बंदना

- लाल, जी., पेखावत नेहा एवं चौधरी महेन्द्र कुमारण 2018ए सौंफ के मूल्य संबंधित उत्पाद तथा उनके विपणन की संभानाएं मसाला सुरभि, भा.कृ.अनु.प.-राष्ट्रीय बीजीय मशाला अनुसंधान केन्द्र तबीजी, अजमेर राजस्थान. (1)रू11.12.

8.1.3 Books/ Book Chapter/ Bulletins/Mannual

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- Amit Kumar Jha, Rajendra Prasad Sahu and Nisha Sapre (2017). avam Phaslon ki Krishi Karyamala. In Jevik Kheti: Tremasik Jevik Kheti Praman Patra Pathaykram 2017. , Madhya Pradesh. pp. 147-173.
- Anup Das, Jayanta Layek, G.I. Ramkrushna, Subhash Babu, Dauni Suting and Utpal Dey (2017). Integrated Organic Farming System (IOFS): Concept and Potential in North East India, Director, ICAR Research Complex for NEH Region, Umiam, Meghalaya.
- Anup Das, Jayanta Layek, Ramkrushna GI and Subhash Babu (2017). Integrated organic farming system in north east India. In: Conservation Agriculture for Advancing Food Security in Changing Climate, Printers and Publishers, New Delhi - 110 002, Vol. 1: 143-153.
- Brij Lal Lakaria, Ramesh K Promod Jha and Singh A B (2017). Organic in Meeting Nutrient Demands of Crops- Content and Use Efficiency. In Book: Enhancing Nutrient Use Efficiency, Concepts, Methods and Management Interventions Editors Kulasekaran Ramesh, Ashis Kumar Biswas, Brij lal Lakaria, Sanjay Srivastava and Ashok Kumar Patra, New India Publishing Agency, New Delhi, pp 153-160.
- Jayanta Layek, Ramkrushna GI, Subhash Babu Anup Das (2017). Weed Management in Organic Farming. In: Organic Farming Crop Production Guide, Network Project on Organic Farming,

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 - Utpal Dey, Jayanta Layek, G.I. Ramkrushna, Subhash Babu, Dauni Suting, R. Krishnappa, Thoithoi Devi, T. Ramesh and Anup Das (2017). Impact of long-term organic management practices on crop productivity and soil properties in North Eastern Hill Region, India- In: Book of lead, invited lectures and abstracts, National Seminar on Smart Farming for Enhancing Input Use efficiency, Income and Environmental Security (SFEIES-2017) September 19-21, 2017, Umiam, Meghalaya (Eds. Das Anup et al.), Indian Association of Hill Farming, Umiam, Meghalaya, pp.101.
 - Lal, G., Meena, N.K., Meena, R.D. and Choudhary, M.K., 2017. Organic farming of coriander. Published by ICAR-NRCSS, Ajmer (India), Pp., 1-14.
 - Lal, G., Meena, N.K., Meena, R.D. and Choudhary, M.K., 2017. Organic farming of seed spices. Published by ICAR-NRCSS, Ajmer (India), Pp., 1.
 - M. C Manna, Asha Sahu, A B Singh, A K Tripathi, Sudeshna Bhattacharjya, Ashok K Patra, S K Chaudhari, A Subba Rao and SS Khanna (2017). Quality Compost Production from Solid Urban Waste for Enhancing Crop Productivity and Soil Health. Scientific bulletin No:02/IISS/2017, ICAR-IISS, Bhopal.
 - S.K. Sharma, Roshan Choudhary, R.S. Choudhary, R.K. Jain & S.K. Yadav (2018). A Guide To Know About Organic Farm Plan & Organic Production Requirements, DOR, MPUAT, June, 2018.
 - S.K. Sharma, Roshan Choudhary, R.S. Choudhary, GajanandJat, R.K. Jain, S.K. Yadav & Neha (2018). Technical Manual on Soil Health Management under Organic Farming, DOR, MPUAT, June, 2018.
 - S.K. Sharma, Roshan Choudhary, GajanandJat and R.S. Choudhary (2018). Compendium on approaches and strategies for higher profitability and sustainability in organic production system, DOR, MPUAT, Udaipur 1-21 June.
 - S.K. Sharma, Roshan Choudhary, D. K. Jajoria, Amit Trivedi and B.G. Chippa (2017). Compendium on Organic production management: Approaches and practices, DOR, MPUAT, Udaipur, 11 Sept. to 12 December 2017.
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 - Singh A B, Ramesh K, Brij Lal lakaria and Thakur, J K (2017). Organic Package of practices for Madhya Pradesh. In: Organic farming Crop Production Guide. Edited by Ravisankar N, A S Panwar, Kamta Prasad, Vipin Kumar and S Bhaskar, ICAR-IIFSR, Modipuram, pp, 212-225.

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- V.K. Shukla, R.P. Sahu, and S.K. Vishwakarma 2017. Brief summary of the results on "Development of region specific ifs Models" chapter in IFS bulletin will be published by ICAR Indian Institute of Farming Systems Research, Modipuram, Meerut-250 110, Uttar Pradesh, India.
- गोपाल लाल, एस.एन. सक्सेना, वाई.के. शर्मा, सुमेर सिंह मीना, शिवलाल, मुरलीधर मीणा, ए.के. वर्मा एवं नरेन्द्र चौधरी (2019) बीजीय मसालों की जैविक एवं आधुनिक उत्पादन तकनीकियाँ पेज नं. 1-104.
- Dr. S.K. Sharma & Dr. Roshan Choudhary participated in 32nd Biennial Conference of Home Science Association of India organized by Home Science Association of India, Udaipur Chapter, MPUAT, Udaipur during 01 to 03 Feb., 2018.
- Dr. S.K. Sharma & Dr. Roshan Choudhary attended one-day State level workshop on "Biosafety Capacity Building" held on 27 April, 2018 at DoR, MPUA, Udaipur.
- Dr. S.K. Sharma & Dr. Roshan Choudhary attended QRT of NPOF during 10 to 11 October, 2018 at RARI, Durgapura.
- G. Lal, N. K. Meena, M.K. Choudhary and Neha Shekhawat (2018). Evaluation of green gram cultivars for their suitability under organic production system. In: Seminar on "Sustainable Agricultural Practices for Seed Spices" February 24-25, 2018, jointly organized by ICAR-NRCSS, Ajmer and DASD, Calicut. Pp. 250.
- Lal, C.B. Harisha, M. K. Choudhary, Naresh Kumar and G.K. Tripathi (2017) Performance of different fennel (Mill) varieties under organic production system, International Symposium on Horticulture: Priorities and emerging trends, IIHR, Bengaluru, India, September 5-8, 2017
- L. Ditzler, T.A. Breland, C. Francis, M. Chakraborty, D.K. Singh, A. Srivastava, F. Eyhorn, J.C.J. Groot, J. Six, C. Decock. 2017. Identifying viable nutrient management interventions at the farm level: the case of smallholder organic Basmati rice production in Uttarakhand, India. *Agricultural Systems* (Springer). 161: 61-71
- R.P. Sahu participated Integrated farming system based organic farming for ecological agriculture during the 21 days CAFT Agronomy training at JNKVV, Jabalpur w.e.f. 09.01.2018 to 29.01.2018.
- Sharma, S. K., Choudhary, R. and Trivedi, A. 2017. Evaluation of Nutrient Management Practices for Organic Chickpea (). Scientific Track "Innovative Research for Organic Agriculture 3.0", India,

8.1.4 Participation in International/ National Conferences/Paper presented/ Abstracts Meeting /Seminar/Symposium/ / Workshop.

- B.M. Maurya, Vinod Kumar, D. N. Shrivastava, B. D. Ghode and Sahu, R. P. attended the Annual Group Meet (IFSAGM-2017) of AICRP on Integrated Farming Systems scheduled held at Rajasthan Agriculture Research Institute, Durgapura Jaipur (Rajasthan) 3-5 November 2017.
- Dr. S.K. Sharma & Dr. Roshan Choudhary participated in Organic World Congress during 09 to 11 Nov., 2017 held at Greater Noida, New Delhi.
- Dr. S.K. Sharma & Dr. Roshan Choudhary participated in the 'Permaculture Design Introduction Programme' held on April 30, 2018 organized by Big Medicine Charitable Trust, Udaipur & MPUAT, Udaipur.

- November 9-11, 2017 Organized by ISO FAR, NCOF and TIPI. Pp. 426-429.
- Sharma, S.K., Choudhary, Roshan, Jat, Gajanand and Ravishankar, N. Strategies for achieving sustainable food systems through organic agriculture. , 24-26 October, 2018 at MPUAT, Udaipur, Rajasthan. Page no. 96-103.
 - Sharma, S.K., Choudhary, Roshan, Yadav, S. K. and Jain, Ravindra. Productivity and economics of maize based cropping systems under organic farming. , 24-26 October, 2018 at MPUAT, Udaipur, Rajasthan. Page no. 526-528
 - Singh, A.B. (2017) Methodological framework for implementation of FFP, ICAR-IISS, Bhopal, 18-21 September.
 - Singh, A.B.(2017) National sabgosthi on organic farming, CTAE, Udaipur, Rajasthan, 10-11 June.
 - Singh, A.B. (2017) 12th Annual group meeting of NPOF, ICAR-IIFSR, Modipuram, 18-19 December.
 - Singh, A.B.(2017) National symposium on food and nutritional security through vegetable crop in relation to climate change, IIVR, Varanasi, 9-11 December.
 - Singh, A.B.(2017) International Conference on Advance Research in Applied Sciences, Environment, Agriculture Entrepreneurship Development, Noor-us Sabha, Bhopal, 4-6 December.
 - Singh, A.B.(2017) National Agri-Business Summit-2017 for Farmer Producer Organization, Start Up, Agri-Enterprise and Academia, SIAET, Bhopal, 9-10 December.
 - Singh, A.B.(2017) Stability/Combined Analysis Methodology for Network Project on Organic Farming Experimental data, ICAR-IIFSR, Modipuram, 25-26 July.
 - Singh, A.B.(2017) Methodological Framework for Implementation of FFP, ICAR-IISS, Bhopal, 18-21 September.
 - Singh, A.B.(2017) Kisan Sammelan, KVK, Rajgarh, Madhya Pradesh, 18 September.
 - Singh, A.B. (2018) State Level Organic Expo, ATMA-KVK, Balaghat, 7-8 March.
 - Shyam Lal, S.S. Porte and Tarun suryavanshi ,(2017) Integrated farming systems: An strategy for resource conservation and environmental sustainability, October 28-29, pp 51.
 - S.S. Porte Shyam Lal, Tarun suryavanshi, G.Jatav and Phoolchand Kanwar (2017) Vermi composting and its role in the integrated nutrient management, , pp 52.
 - S.S.Porte, B.Sachidanand and H.K.Rai (2017) Effect of targeted yield based nutrient application on potassium fractions in a vertisol under rice-wheat cropping sequence, October 28-29, pp 50-51.
 - Tarun suryavanshi, Shyam Lal, S.S. Porte (2017) Effective irrigation management for wheat crops, October 28-29, pp 52-53.
 - V.K. Shukla attended the 12th Annual Group Meeting (held at Modipuram) of All India Network Programme on Organic Farming (AI-NPOF) 18-19 December 2017.
 - Yadav, S. K., Babalad, H. B., Sharma, S. K., Yadav, M. K. and Choudhary, R. 2017. Total dry matter, nutrient uptake and yield of summer mungbean as influenced by organic management practices. Scientific Track "Innovative Research for Organic Agriculture 3.0", India, November 9-11, 2017 Organized by ISO FAR, NCOF and TIPI. Pp. 321-324.

Training/workshop /programme conducted:

- Organized ICAR sponsored 21 days training programme on "Innovative approaches and strategies for higher profitability and sustainability in organic production system" during 1-21 June, 2018 at, MPUAT, Udaipur Dr. S.K. Sharma was Course Director and Dr. Roshan Choudhary, Dr. Gajanand Jat & Dr. R.S. Choudhary were Course Co-ordinator.



- Organized ICAR sponsored 21 days training programme on "Recent advances and innovation in organic agriculture" during 5-25 september, 2018 at, MPUAT, Udaipur Dr. S.K. Sharma was Course Director and Dr. Roshan Choudhary, Dr. B.G. Chhipa & Dr. Amit Trivedi were Course Co-ordinator.
- Organized one day Permaculture Design Introduction Programme' on April 30, 2018 in collaboration with Big Medicine Charitable Trust, Udaipur & MPUAT, Udaipur.
- Dr.E.Somasundaram, Dr.R.Jansirani, Dr. A. Bharani, Dr. S.K. Manoranjitham and Dr. K. Ganesan (2017). New Vistas of Vegetable Research at TNAU, Coimbatore, 6-9 Dec.
- Dr.E.Somasundaram (2017) National workshop on organic vegetable farming.
- Dr. A. Bharani Role of Panchagavya in organic farming, 19 December, 2018.
- Dr. K. Ganesan Pest management in organic farming, 19 December, 2018.
- Dr. K. Ganesan, 21 days Refresher course on Organic agriculture in tis Relevance in Present day Agriculture, 9 to 29 January, 2018.
- Dr.E.Somasundaram (2018), Organic agriculture.
- Dr.E.Somasundaram (2018). State level seminar on organic agriculture.
- Dr.R.Jansirani (2018) Higher education at Global level meet.
- S.K.Manoranjitham (2018) State level Biosafety capacity building workshop.
- S.K.Manoranjitham Dr.K.Ganesan and Dr.A.Bharani (2018) National seminar on fungal diversity conservation and exploration of fungal Mycomolecules.
- Dr. S.K. Sharma, PI-NPOF conducted one day training programme on Organic Management Strtegies for Higher Profitability at Farmers Field on 16 July, 2018 under TSP, ICAR-Network Project on Organic Farming, MPUAT, Udaipur.
- Dr.S.K.Sharma, PI-NPOF acted as Course Director of two 21 days ICAR training programme on organic farming.
- Dr S.K. Sharma, PI-NPOF was appointed as Technical Advisor to Vice-Chancellor, MPUAT, Udaipur.
- S.K.Sharma, PI-NPOF was nominated as member, Academic Council for 2017-18 & 2018-19 of SKRAU, Bikaner (Rajasthan).
- Dr. Roshan Choudhary, Co-PI-NPOF acted as Course Co-ordinator of two 21 days ICAR training programme on organic farming.
- Dr.R.Subashini, ICAR-CAF Training on 'Food Safety and Quality Management Systems for a Farm to Fork Approach' at Dept. of Agrl. Microbiology, TNAU, Coimbatore, 1-21 Nov., 2017.
- Dr. S.K. Manoranjitham, What every teacher should know for bringing out the best from students IRMA, Anand, Gujarat, 23-25 Nov., 2017.

AWARDS

- Dr. E. Somasundaram, Honoured on the occasion of World Tourism Celebration 2017 for Sustainable Ecotourism to Organic Farms on 27, September 2017, Dept. of Tourism Management, Avinashilingam University, and Coimbatore.
- Dr. E. Somasundaram, Award of appreciation for undergoing transformation of organic farm extension towards sustainable development during INTFES-18, 9-10 March 2018. Extension Education Society, TNAU, Coimbatore.
- Dr. E. Somasundaram, Awarded as best speaker on Integrated Farming System by Rorary Club, Tirupur, Tamil Nadu during the National Conference on Projectable Agriculture during 10-11, March 2018, Rorary Club, Tirupur, Tamil Nadu.
- Dr. E. Somasundaram, Recognized for the special lecture on organic production of cereals and millets during the National Seminar on Prospects of Organic Farming at Gandhigram University, Tamil Nadu, School of Agriculture and Animal

Sciences, Gandhigram University.

- Dr. E. Somasundaram, Dr. K. Ganesan, Dr. R. Subhashini and Dr. A. Bharani) Oral presentation Award presentation for the paper entitled "Evaluation of Organic Production Management Practices in Green manure - Beetroot - Maize Cropping System in the National Conference on New Vistas in Vegetable Research towards Nutritional Security under changing Climate Scenario held between 6th and 9th December 2017 held at HC & RI, TNAU, Coimbatore.
- Dr. E. Somasundaram, Awarded for the (Best presentation) on Scientific evaluation of organic paddy varieties at Paddy Festival - CREARE, Thiruthuraiipoondi, Tamil Nadu during 21-22, May, 2018, CREARE, Tamil Nadu.
- Dr. S.K. Sharma, P.I. NPOF receiving (Best Paper Presentation Award) for paper entitled "Productivity and economics of maize based cropping systems under organic production system in India" in 5th International Conference on Agriculture (Agri.), on innovations in agriculture for a sustainable future held during 16-17 August, 2018, Colombo, Sri Lanka.
- Dr. S.K. Sharma & Dr. Roshan Choudhary (Best poster award) for research paper entitled "Organic food: Emerging trends in environment sensitization and challenges" in the 32nd Biennial conference of Home Science Association of India organized by Home Science Association of India, Udaipur Chapter, MPUAT, Udaipur during 01 to 03 Feb., 2018.
- Dr. R. Kuttamani for the paper entitled "Evaluation of Organic Production Management Practices in Green manure - Beetroot - Maize Cropping System in the National Conference on New Vistas in Vegetable Research towards Nutritional Security under changing Climate Scenario held between 6th and 9th December 2017 held at HC & RI, TNAU, Coimbatore.
- S. K. Sharma, Roshan Choudhary, S. K. Yadav and R. K. Jain (Best poster award) for paper entitled "Human welfare without farming the environment" in National Science Day Workshop held at MNIT, Jaipur during 26-28 Feb., 2018.
- S. K. Yadav, S. K. Sharma, Roshan Choudhary, Amit Trivedi and R. K. Jain (Best poster award) for paper entitled "Productivity and profitability of different types of maize wheat grown under organic farming" in National Science Day workshop held at MNIT, Jaipur during 26-28 Feb., 2018.
- to R. K. Jain, S. K. Yadav, S. K. Sharma, Roshan Choudhary and Amit Trivedi (Best poster award) for paper entitled "Organic weed management: An alternate way to minimize health hazard" in National Science Day workshop held at MNIT, Jaipur during 26-28 Feb., 2018.

Lead paper

- Sharma, S.K., Choudhary, Roshan and Jat, Gajanand. Productivity and economics of maize based cropping systems under organic production system in India. : future during 16-17 August, 2018, Colombo, Sri Lanka.

Lecturers

S. No.	Lecture delivered/ topic	Under the scheme	Name of place/ village	Month/ year
Dr. S. K. Sharma				
1.	Organic Agriculture: History, Concept and Principles	Advance Faculty Training on Innovative Approaches and Strategies for Higher Profitability and Sustainability in Organic Production System 01-21 June, 2018	CAFT on Organic Farming Directorate of Research, MPUAT, Udaipur (Rajasthan)	01/06/2018



S. No.	Lecture delivered/ topic	Under the scheme	Name of place/ village	Month/ year
2	Organic Agriculture: Global and Indian overview	Advance Faculty Training on Innovative Approaches and Strategies for Higher Profitability and Sustainability in Organic Production System 01-21 June, 2018	CAFT on Organic Farming Directorate of Research, MPUAT, Udaipur (Rajasthan)	01/06/2018
3	Organic Certification: Concept & Strategies	Advance Faculty Training on Innovative Approaches and Strategies for Higher Profitability and Sustainability in Organic Production System 01-21 June, 2018	CAFT on Organic Farming Directorate of Research, MPUAT, Udaipur (Rajasthan)	06/06/2018
4	Organic Agriculture: Global and Indian Overview	Advance Faculty Training on Innovative Approaches and Strategies for Higher Profitability and Sustainability in Organic Production System 01-21 June, 2018	CAFT on Organic Farming Directorate of Research, MPUAT, Udaipur (Rajasthan)	07/06/2018
5	Biodynamic Farming: Concept, Principle & Practices	Advance Faculty Training on Innovative Approaches and Strategies for Higher Profitability and Sustainability in Organic Production System 01-21 June, 2018	CAFT on Organic Farming Directorate of Research, MPUAT, Udaipur (Rajasthan)	15/06/2018
6	World Organic Agriculture: Current Status and Recent Advances	Advance Faculty Training on Recent Advances and Innovations in Modern Organic Agriculture 05-25 September, 2018	CAFT on Organic Farming Directorate of Research, MPUAT, Udaipur (Rajasthan)	05/09/2018
7	Zero Budget Natural Farming	Advance Faculty Training on Recent Advances and Innovations in Modern Organic Agriculture 05-25 September, 2018	CAFT on Organic Farming Directorate of Research, MPUAT, Udaipur (Rajasthan)	15/09/2018
8	Organic Certification: Ways and Means	Advance Faculty Training on Recent Advances and Innovations in Modern Organic Agriculture 05-25 September, 2018	CAFT on Organic Farming Directorate of Research, MPUAT, Udaipur (Rajasthan)	17/09/2018
9	The Potential of Sustainable Agriculture for Climate Change Adoption	Advance Faculty Training on Recent Advances and Innovations in Modern Organic Agriculture 05-25 September, 2018	CAFT on Organic Farming Directorate of Research, MPUAT, Udaipur (Rajasthan)	19/09/2018
10	Different types of organic farming methods- Homa farming	Advance Faculty Training on Recent Advances and Innovations in Modern Organic Agriculture 05-25 September, 2018	CAFT on Organic Farming Directorate of Research, MPUAT, Udaipur (Rajasthan)	21/09/2018

S. No.	Lecture delivered/ topic	Under the scheme	Name of place/ village	Month/ year
11	Standards on organic farming	Advance Faculty Training on Recent Advances and Innovations in Modern Organic Agriculture 05-25 September, 2018	CAFT on Organic Farming Directorate of Research, MPUAT, Udaipur (Rajasthan)	23/09/2018
Dr. Roshan Choudhary				
12	Organic production of polyhouse growing vegetables	RKVY (Two days training prog. On Organic Production technology of polyhouse grown vegetables)	Hi-tech, DoR, MPUAT, Udaipur	22/05/2018
13	Organic production of polyhouse growing vegetables	RKVY (Two days training prog. On Organic Production technology of polyhouse grown vegetables)	Hi-tech, DoR, MPUAT, Udaipur	09/02/2018
14	Practical Exercise on Cow based Liquid Manures & Herbal Pesticides	Advance Faculty Training on Recent Advances and Innovations in Modern Organic Agriculture 05-25 September, 2018	CAFT on Organic Farming, MPUAT, Udaipur (Rajasthan)	21/06/2016
15	Methodology of vermicompost, panchgavya, jeevamruth and vermiwash	Advance Faculty Training on Recent Advances and Innovations in Modern Organic Agriculture 05-25 September, 2018	CAFT on Organic Farming, MPUAT, Udaipur (Rajasthan)	08/09/2018
Dr. V. K. Shukla				
16	जैविक खेती की आवश्यकता	Five lectures	BPD, JNKVV, Jabalpur	10/29-1-2018 to 12/22/23-3-2018
Dr. R.P.Sahu				
17	Importance of Jaivik Kheti	Kishan Sanghosthi	Pantnagar and FTC, Jabalpur	19-2-2018

Details of M.Sc. degree awarded based on the project work

S. No.	Name of student	Chairman/ Co-chairman	Title of research work	Remark
M.Sc. student guided by Dr. R. P. Sahu				
1	Mr. Mahendra Anjana	Co-chairman	Productivity and grain quality parameters of different varieties of rice	Continue
2	Mr. Kuldeep Sallam	Chairman	Screening of Suitable Rice Varieties under Organic Production system.	Continue



8.2 Human Resource Development

8.2.1 Sponsored training organised for farmers

A. Visits: During 2017-18, Farmers Trainings, Jabalpur

Particulars	Date	Topic	Place	Participants	Concerned
Training of Agri. Extension workers/Krishak mitra	25/08/17	Contingent planning of crop production	Farmers Training Centre, Adhartal, Jabalpur	55	Deptt. of Agri. Welfare & Development M.P.
Training of Agri. Extension workers	21/09/17	Organic farming	Farmers Training Centre, Adhartal, Jabalpur	35	Deptt. of Agri. Welfare & Development M.P.
Training of trainers	07/11/2017	Integrated Farming Systems	DES hall	45	DES, JNKVV Jabalpur
Training of manage trainees	30/1/2018	Improved production technology of oilseed crops	DRS hall	30	DRS, JNKVV Jabalpur
Krishi Mahotsava celebration under Gramodaya se Bharatodaya in MP programme	15 April to 02 May 2017	Improved technologies for agriculture	37 gram panchayat of Kundam Block Jabalpur	1850 approx.	Deptt. of Agri. Welfare & Development M.P.

During 2017-18, 50 exposure visits Udaipur and training of farmers, extension functionaries and other stakeholders were conducted and 1585 stakeholders participated in these programmes.

Table: Technology dissemination (visits)

S. No.	Date	Visitors address/ Institutes / Place	Type of Beneficiaries (Farmers/Govt. Officials/Scientist)
1	13 th July 2017	Agriculture Office, Garooth, Mandasour (M. P.)	35 Officers
2	24 th July 2017	ATMA, Jodhpur	20 farmers
3	10 th August 2017	ATMA, Jodhpur	50 farmers
4	22 nd August 2017	BISLD (BAIF), Debari, Udaipur	25 farmers
5	22 nd August 2017	HZL & BAIF, Zawar Mines, Udaipur	5 beneficiaries
6	22 nd August 2017	HZL & BAIF, Chanderiya Chittorgarh	33 farmers
7	18 th September 2017	ATMA, Jamnagar, Gujrat	40 farmers
8	19 th September 2017	AGRI, New Delhi	40 farmers
9	05 th October 2017	ATMA, Narmada	43 farmers
10	06 th October 2017	AGRI, New Delhi	49 farmers
11	12 th October 2017	Dahod, Gujrat	52 farmers
12	27 th October 2017	NREGA, Zila Parishad Udaipur	10 executive engineers
13	03 rd November 2017	ATMA, Dev Bhumi & Dwarika Jamnagar (Gujrat)	40 farmers
14	08 th November 2017	Mukhyamantri Khet Reerth Yojana, Mandasour (M.P.)	54 farmers
15	07 th December 2017	ATMA, Tonk	35 farmers
16	07 th December 2017	Polyhouse training on HiTech Horticulture RCA Udaipur	15 participants

S. No.	Date	Visitors address/ Institutes / Place	Type of Beneficiaries (Farmers/Govt. Officials/Scientist)
17	20 th December 2017	Agriculture Department Jalore (Raj.)	50 farmers
18	20 th December 2017	Agriculture Department Bundi (Raj.)	35 farmers
19	21 st December 2017	ATMA, Morbi,(Gujrat)	40 women farmers
20	22 th December 2017	ATMA, Rajkot (Gujrat)	30 farmers
21	27 th December 2017	ATMA, Aligarh (U.P.)	48 farmers
22	27 th December 2017	ATMA, Sikar, (Raj.)	10 staff
23	29 th December 2017	DFRS, Bhilwara, (Raj.)	25 participants
24	04 th January 2018	ATMA, Jalore, (Raj.)	24 farmers
25	09 th January 2018	ATMA, Jaipur, (Raj.)	46 farmers
26	11 th January 2018	Farmer Training Programme, Surendra Nagar,(Gujrat)	35 farmers
27	17 th January 2018	ATMA, Sikar, (Raj.)	50 participants
28	20 th January 2018	Rohit Jain, Banyan Roots, Udaipur, (Raj.)	5 beneficiaries
29	27 th January 2018	ATMA, Surendra Nagar,(Gujrat)	35 farmers
30	01 st February 2018	Farmer Training Programme, Jamnagar,(Gujrat)	35 farmers
31	05 th February 2018	ATMA, Jamnagar, (Gujrat)	45 farmers
32	08 th February 2018	Farmer Training Programme, Rajkot (Gujrat)	25 farmers
33	09 th February 2018	ATMA, Hisar, (Haryana)	10 farmers
34	09 th February 2018	Polyhouse training on HiTech Horticulture RCA Udaipur, (Raj.)	15 participants
35	10 th February 2018	RACP Yojana, Alwar, (Raj.)	25 farmers
36	11 th February 2018	ATMA Aravali (Gujrat)	35 women farmers
37	13 th February 2018	ATMA, Beawar, Ajmer, (Raj.)	50 women farmers
38	17 th February 2018	Sirohi, (Raj.)	32 farmers
39	22 th February 2018	IFFCO, Udaipur, (Raj.)	35 farmers
40	24 th February 2018	Merhargarh, (Raj.)	14 farmers
41	06 th March 2018	Bundi, (Raj.)	40 farmers
42	06 th March 2018	Farmer Training Center, Narmada, (Gujrat)	25 farmers
43	07 th March 2018	Surendranagar, (Gujrat)	35 farmers
44	17 th March 2018	Rai University, Saroda Ahmedabad, Gujrat	83 students
45	22 nd March 2018	ATMA, Neemach, M.P.	35 farmers
46	22 nd March 2018	Mt. Abu, Rajasthan	22 farmers
47	24 th March 2018	CCS HAU, Hisar, Hariyana	45 farmers
Total		1585	



Farm women from ATMA, Aravali (Gujrat)
11th February 2018



Farmers of ATMA Jodhpur (Raj)
24th July 2017



Farmers of ATMA Jalore (Raj)
04th January 2018



Farmers of Vanbandh Yojna, Mt. Abu (Raj)
22nd March 2018



Student tour from Rai University, Saroda, Ahmedabad
(Gujarat) 17th March 2018



Farmers from Surendra Nagar (Gujarat)
07th March 2018

Technology Dissemination (Visits) in Rajasthan

Dignitaries visits: The details of dignitaries visiting organic farming experiments and unit are given in Table.

Table: Dignitaries visits

S. No.	Date	Govt. Officials/Scientist
	16 th March 2018	Dr. Sompal Shastri, Ex-State Agriculture Minister, GOI
	22 nd March 2018	Dr. A.S.Panwar, Director, ICAR-IIFSR, Modipuram, U.P
	27 th March 2018	Ms. Priyanka Jodhawat, Registrar, MPUAT, Udaipur, Rajasthan.



Dr. Sompal Shastri, Ex-State Agriculture Minister,
Govt of India



Ms. Priyanka Jodhawat, Registrar, MPUAT, Udaipur,
(Rajasthan)



Dr. A. S. Panwar, Director, ICAR-IIFSR, Modipuram,
Merrut (U.P.) visiting AI-NPOF centre Uadipur



Scientist from CIMMYT and IFS project

Farmers Training TNAU, Coimbatore centers

Name of the trainings/ workshops/ seminars	Date & duration	Beneficiaries	Number of participants
Paid training on organic agriculture	7 th of every month	Farmers	655
Organic agriculture and PGS	9.10.2017	Farmers	35



Name of the trainings/ workshops/ seminars	Date & duration	Beneficiaries	Number of participants
Organic Agriculture to ATMA farmers from Andaman & Nicobar	12.2.18 to 17.2.18	Farmers	17
Skill training on Organic Agriculture	19.02.18 to 24.02.18	Farmers	28
Awareness on organic agriculture and disease management	24.11.17	Extension officials of Andhra Pradesh	34
composting and disease management using organic approaches to	28.11.17	Students of Massey University, New Zealand	70
Panchagavya preparation and Herbal leaf extract	22.1.18	Students Avinashilingam University	65
Delivered lecture on Organic cultivation practices to farmers	6.3.18	Farmers of Chittoor, Andhra Pradesh	50
Organic cultivation practices to farmers	27.3.18	Farmers	100

Coimbatore center-Training programme organic farming system





Training cum awareness
programme on Role of
organic farming system



Linkage and collaborations

S. No.	Collaboration with	Purpose
1.	AICRP on Weed Management, MPUAT, Udaipur, Rajasthan	Experiment on organic weed management in sweet corn & fennel.
2.	AICRP on IFS	Geo-referenced on - farm characterization of organic growers of Rajasthan.
3.	All India Network Project on Soil Biodiversity and Biofertilizers	Demonstration on effect of bio-fertilizers on root nodulation of Sesbania, clusterbean, blackgram and soybean.
4.	Rajasthan College of Agriculture, MPUAT, Udaipur	Productivity, profitability, seed and soil quality of different types of maize and wheat varieties grown under organic farming (Ph.D.).
5.	Big Medicine Charitable Trust	Organization of training/capacity building on organic farming and permaculture.
6.	Banyan Roots	Farmer capacity building and promotion of organic farming among farmers and consumers.
7.	RKVY, State Government, Rajasthan	Research and training on various aspects of organic farming during 2017-18.
8.	Global Rajasthan Agritech Meet, Udaipur, 7-9 November, 2017	Technical input for exhibition and publication on organic farming.
9.	Seema Metals & Minerals, Udaipur	Research and awareness on use of silica in organic agriculture.



9

APPENDIX

Details of crops and varieties used in evaluation of organic, inorganic and integrated production systems for crops and cropping systems at various locations

Crop	Variety
Bajaura	
Black gram (<i>Kharif</i>)	Palampur - 93
Lady's Finger (<i>Kharif</i>)	P-8
Tomato(<i>Kharif</i>)	Hybrid 2853
Cauliflower (<i>Rabi</i>)	PSBK-1
Pea(<i>Rabi</i>)	Azad P-1
French bean (<i>Summer</i>)	Vaishnavi 264
Tomato(<i>Summer</i>)	Hybrid Himalaya
Summer Squash (<i>Summer</i>)	Australian Green
Bhopal	
Soybean	JS-335
Durum wheat	HI-8498 (Malwa Shakti)
Mustard	Pusa Bold
Chickpea	JG-130
Linseed	JL-9
Calicut	
Ginger	Varada, Rejatha and Mahima
Turmeric	Prathibha , Alleppey Supreme,Varna, Sobha, Sona, Kanthi, Suvarna, Sudarsana, Kedaram, Prabha, Pragathi
Black Pepper	Sreekara, Panniyur-1
Coimbatore	
G M (Daincha)	Local
Cotton	Suraj
Maize	COH(M)6
Chillies	KI
Sunflower	CoSFV5
Beetroot	Ruby queen
Maize	COH(M)6
Dharwad	
Pigeonpea	ICP-8863
Greengram	DGGV 2
Sorghum	SPV 2217



Crop	Variety
Groundnut	GPBD 4
Hy. cotton	DCH-32
Maize	DWR 2006
Soyabean	DSB 21
Karjat	
Rice	Karjat-4
Brinjal	Krishna F1
Chickpea	Vijay
Field bean	Konkan wal-1
Onion (White)	Alibag local
Jabalpur	
Basmati rice	Pusa Basmati -1
Wheat	MPO-JW-1215
Chickpea	JG-14
Berseem	J B - 1
Vegetable pea	Arkel
Maize fodder	TKG-54
Sorghum fodder	MP Chari
Sunhemp	Local
Ludhiana	
Basmati rice	Panjab basmati 3
Clusterbean	HG 365
Summer Moong	SML 668
Soyabean	SL 744
Wheat	PBW725
Chickpea	PBG 7
Modipuram	
Basmati rice	PB-6
Rice	Saket-4
Maize Grain	Bajaura pop corn/Madhuri sweet corn
Green cob	Madhuri
Wheat	HI - 8498
Okra	Arka Anamika
Potato	Chipsona-3
Barley	DWRB-91
Green gram	Pusa vishal
Mustard	Pusa bold
Pantnagar	
Sesbania	Ses pant-1





Crop	Variety
Basmati rice	Pusa basmati-1
Wheat	UP-2572
Chickpea	Pant kabuli chana-1
Vegetable Pea	Arkel
Potato	Kufri jyoti
Coriander	Harit RS-5
Sesbania	Pant Ses-1
Rice	Pusa-1509
Soybean	PS 1347
Maize	PSM-3
Pigeon pea	UPAS 120
Cowpea	PL-3
Mustard	Toria
Raipur	
Soybean	JS - 9752
Maize	Sugar-75
Vegetable pea	Pant sabji matar" (PSM 3)
Chilli	Agnirekha
Onion	Nasik red
Sweet corn	Sugar-75
Tomato	Laxmi
Ranchi	
Rice	Birsamati
Wheat	K- 9107
Lentil	PL 406
Potato	Kufri Ashoka
Linseed	Shekhar
Umiam	
Rice (sunken bed) <i>kharif</i>	Megha Aromatic-2, Lampnah, Ngoba, Shahsarang-1
Broccoli	Green Magic
Carrot	New Koroda
Potato	Kufri jyoti
French bean	Naga local
Tomato	Rocky
New Centres	
Ajmer	-
Green gram	SML-668
Fennel	



Crop	Variety
Cluster bean	RGC-1038
Coriander	-
Gangtok	
Maize	RCM-1-1
Ginger	Gorubuthane
Turmeric	RCT-10
Soybean	RCS-1-10
Pigeon Pea	UPAS-120
Buckwheat	Local Teethay
Rajmash	SKR-57
French bean	-
Narendrapur	
Paddy	Satabdi/Pusa Basmati 1
Broccoli	Princess
Capsicum	California wonder
Mustard	B9
French Beans	Falguni
Green gram	Samrat
Sesame	Tilotomma
Sardar Krushinagar	
Groundnut	TG 37
K. Green gram	GM 4
Wheat	GW 451
Cumin	GC 4
Fennel	GF 12
S.Green gram	GM 4
Vegetable cowpea	Swati
Thiruvananthapuram	
Cassava	Sree Vijaya
Groundnut	Co-7
Taro	Sree Kiran
Black gram	Co-6
Green gram	Co-8
Vegetable cowpea	Anaswara
Udaipur	
Sweet corn	Sugar 75
Blackgram	PU 31
Maize	Pratap QPM Hybrid-1
Fodder Maize	Pratap Makka 6





Crop	Variety
Cowpea	Doli
Clusterbean	Gayatri-71
Wheat (Durum)	HI 8713
Wheat (Aestivum)	Raj 4120
Gram	GNG 1581
Fenugreek	RMT-305
Soyabean	RKS-24



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ANNEXURES

Contact Address

ICAR-IIFSR, Modipuram

Name and address	Phone no.	Email
Dr. A.S. Panwar, Director ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut-250 110	(Mob.) 09412078001	director.iifsr@icar.gov.in
Dr. N. Ravisankar, Principal Scientist (Agronomy) & Programme Facilitator (Coordination Unit), National Principal Investigator, AI-NPOF, ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut-250 110	(Mob.) 08755195404	npinpof.iifsr@gmail.com; npinpof.iifsr@icar.gov.in
Dr M. Shamim, Scientist (Agricultural Meteorology) & Associate (NPOF), Coordination Unit, ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut-250 110, U.P.	(Mob.) 08171812619	shamimagrimet@gmail. com
Dr. Raghuveer Singh, Scientist (Agronomy) & Associate (NPOF), Coordination Unit, ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut-250 110, U.P. Email: shamimagrimet@gmail.com	(Mob.) 9458613219	rsbicar@gmail.com
Dr Vipin Kumar, Chief Technical Officer Coordination Unit, ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut-250 110, U.P.	(Mob.) 09457267100	vipin.kumar2@icar.gov.in, vipinpdfsr@gmail.com

Principal Investigators at different Centres

Sl. No.	State	Location	Name & Designation	University / Institute	Phone no.	Email
1	Chhattisgarh	Raipur	Dr. M.C Bhambri, Chief Agronomist & Principal Investigator (AI-NPOF)	Indira Gandhi Kri- shi Vishwavidya- laya, Krishak Nagar, Raipur	9406470437	mcbhambri@yahoo.co.in raipur.npof@gmail.com
2	Gujarat	Sardarkru- shinagar	Dr. L.J. Desai, Chief Agronomist & Prin- cipal Investigator (AI-NPOF)	Dantiwada Agri- cultural University, Sardar Krushinagar, Dist. Banaskantha	9429310273	sknagar.main@gmail. com sknagar.npof@gmail.com
3	Himachal Pradesh	Bajaura (Kukku)	Dr. D.K. Parmer, Principal Scientist and Principal Inves- tigator (AI-NPOF)	CSKHPKV, Hill Ag- ricultural Research and Extension Cen- tre Bajaura, (Kullu)	9418641963	dkpharec@yahoo.co.in, bajaura.npof@gmail.com



Sl. No.	State	Location	Name & Designation	University / Institute	Phone no.	Email
4	Jharkhand	Ranchi	Dr. Mohammad Nayar Ali, Assist Prof. & Principal Investigator (AI-NPOF)	Birsa Agricultural University, Kanke, Ranchi	9801241156	ranchi.npof@gmail.com nali@bauranchi.org
5	Karnataka	Dharwad	Dr. U. K. Shanwad, Principal Scientist and Principal Investigator (AI-NPOF)	Institute of Organic Farming University of Agricultural Sciences, Krishinagar, Dharwad	8362214314 / 2955809 (O)	dharwad.npof@gmail.com shanwad@gmail.com, iofdwd@uasd.in
6	Kerala	Calicut	Dr. C.K. Thankamani, Principal Scientist and Principal Investigator (AI-NPOF)	ICAR-Indian Institute of Spices Research, Kozhikode (Calicut)	9495083552	calicut.npof@gmail.com thankamani@spices.res.in
7		Thiruvananthapuram	Dr. (Mrs) G. Suja, Principal Scientist and Principal Investigator (AI-NPOF)	ICAR-Central Tuber Crops Research Institute, Thiruvananthapuram	9847248697	thiruvananthapuram.npof@gmail.com sujagin@yahoo.com
8	Madhya Pradesh	Bhopal	Dr. A.B. Singh, Principal Scientist and Principal Investigator (AI-NPOF)	ICAR-Indian Institute of Soil Science, Nabibagh, Berasia Road, Bhopal	9425013470	bhopal.npof@gmail.com a.singh@icar.gov.in, abs980649@gmail.com.
9		Jabalpur	Dr. P.B. Sharma, Chief Agronomist & Principal Investigator (AI-NPOF)	Jawaharlal Nehru Krishi Vishwa Vidyalaya, Krishi Nagar Colony, Adhartal, Jabalpur	9893211994	jabalpur.npof@gmail.com Jabalpur.main@gmail.com
10	Maharashtra	Karjat	Dr. S.B. Bhagat, Chief Agronomist & Principal Investigator (AI-NPOF)	Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Regional Agricultural Research Station, Karjat, Dist. Raigad	8879247408,	sbbhagat1791@gmail.com karjat.npof@gmail.com
11	Meghalaya	Umiam	Dr. Jayanta Layak, Senior Scientist & Principal Investigator (AI-NPOF)	ICAR-RC-NEH Region. Umroi Road, Umiam, Meghalaya	9101011194	umiam.npof@gmail.com jayanta.icar@gmail.com
12	Punjab	Ludhiana	Dr. C.S. Aulakh, Director, School of Organic Farming & Principal Investigator (AI-NPOF)	School of Organic Farming, Punjab Agricultural University, Ludhiana	9888350044	ludhiana.npof@gmail.com csaulakh@rediffmail.com aulakhcs@pau.edu
13	Rajasthan	Ajmer	Dr. Gopal Lal, Director & Principal Investigator (AI-NPOF)	ICAR-National Research Centre on Seed Spices, Tabiji Farm, Beawar Road, Ajmer	9414609649	ajmer.npof@gmail.com glal67@yahoo.co.in,

Sl. No.	State	Location	Name & Designation	University / Institute	Phone no.	Email
14		Udaipur	Dr. S.K. Sharma, Director of Research & Principal Investigator (AI-NPOF)	Maharana Pratap University of Agriculture & Technology, Udaipur	9414430757, 7568830757	udaipur.npof@gmail.com shanti_organic@rediffmail.com
15	Sikkim	Gangtok	Dr. R.K. Avasthe, Joint Director & Principal Investigator (AI-NPOF)	ICAR-RC-NEH, Sikkim Centre, Tadong, Gangtok	9434184200	gangtok.npof@gmail.com jdsikkim.icar@gmail.com
16	Tamil Nadu	Coimbatore	Dr S. Manickam, Prof & Head & Principal Investigator (AI-NPOF)	Sustainable Organic Agriculture, Tamil Nadu Agricultural University, Coimbatore	9443499234	organic@tnau.ac.in
17	Uttarakhand	Almora	Dr. Pankaj Kumar Mishra, Principal Scientist & Principal Investigator (AI-NPOF)	ICAR- Vivekananda Parvatiya Krishi Anusandhan Sanshan Mall Road, Almora	9412589393	Pankaj.Mishra@icar.gov.in misrapk1970@gmail.com
18		Pant Nagar	Dr. D.K. Singh, Prof. & Principal Investigator (AI-NPOF)	Govind Ballabh Pant University of Technology and Agriculture, Pantnagar	9411320066	dhananjayrahul@rediffmail.com
19	Uttar Pradesh	Modipuram	Dr. RP Mishra, Principal Scientist & Principal Investigator (AI-NPOF)	ICAR- Indian Institute of Farming Systems Research, Modipuram, Meerut	9412578625	modipuram.npof@gmail.com rp_min@yahoo.co.in
20	West Bengal	Narendra-pur	Dr. Gautam Chatterjee, Asst. Prof. & Principal Investigator (AI-NPOF)	SA&RD, RKMVU, PO Belur Math, District: Howrah	9972301930	gutamchatterjee84@gmail.com





ACRONYMS

ALE	: Aquous leaf extract	Mn	: Manganese
ASE	: Aquous seed extract	MOP	: Murate of potash
BBF	: Broad bed and furrow	N	: Nitrogen
B: C	: Benefit: Cost	NC	: Neem coated
BD	: Biodynamic	NEOC	: Non edible oil cakes
CC	: Cost of cultivation	NPV	: Nuclear Polyhedrosis virus
CDM	: Cowdung manure	NR	: Net returns
Cu	: Copper	NRPRI	: Net return per rupee invested
DSR	: Direct seeded rice	OC	: Organic carbon
DTPA	: Diethylene triamine penta acetic acid	P	: Phosphorus
EC	: Enriched compost	PG	: Panchagavya
ECe	: Electrical conductivity	pH	: Negative logarithm of hydrogen ion concentration
Fe	: Iron	PPM	: Parts per million
FB	: Flat bed	RBD	: Randomized block design
FYM	: Farm yard manure	RP	: Rock phosphate
GLM	: Green leaf manure	RSB	: Raised and sunken bed
GM	: Green manure	SRI	: System of rice intensification
GR	: Gross returns	SSP	: Single super phosphate
IOFS	: Integrated organic farming system	TSP	: Tribal sub plan
ITK	: Indigenous technical knowledge	VC	: Vermicompost
K	: Potassium	Zn	: Zinc
KC	: Karanj cake		





ICAR-Indian Institute of Farming Systems Research
Modipuram, Meerut - 250110 (U.P.)