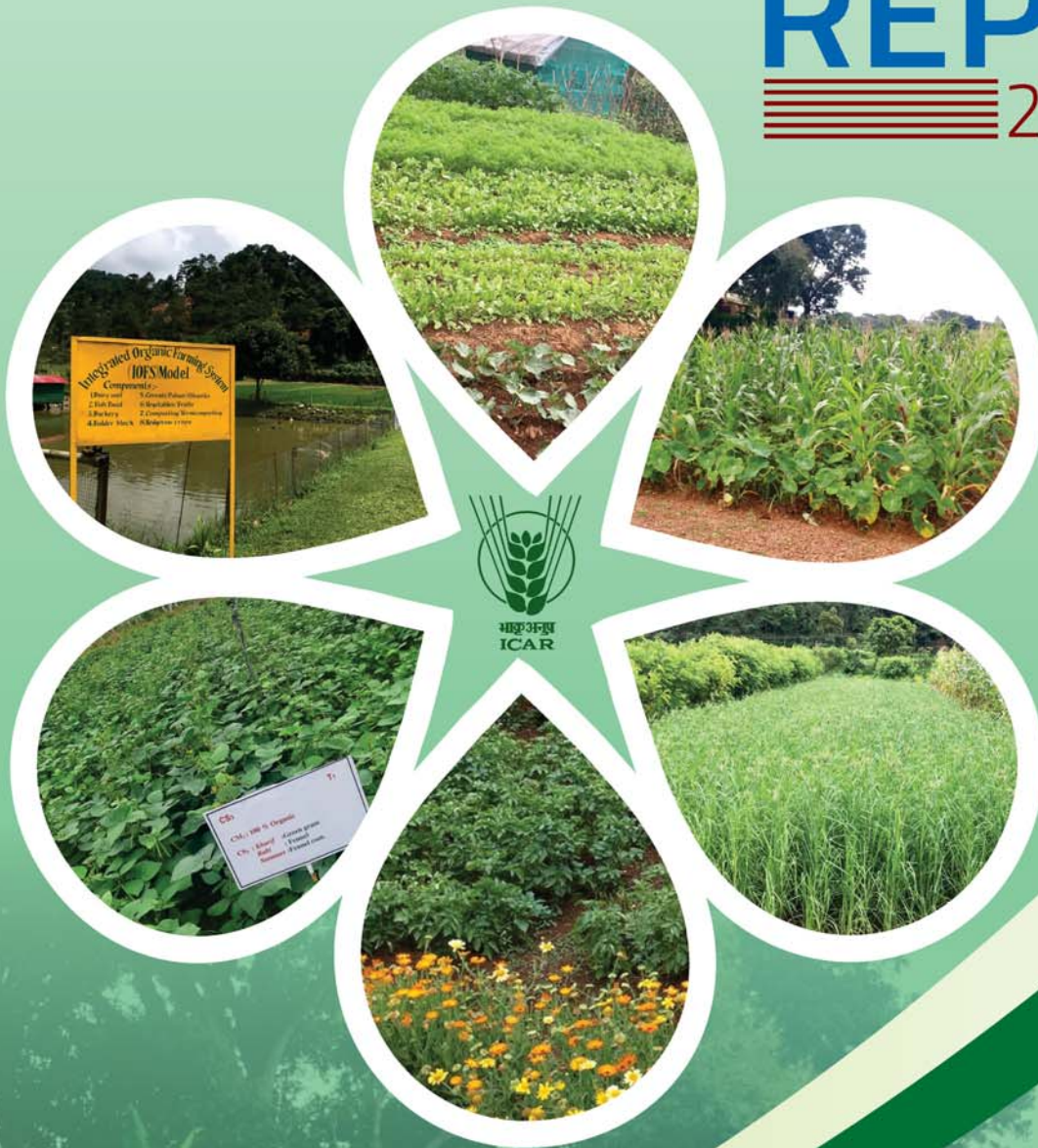


ANNUAL REPORT

2020-2021



जैविक खेती पर अखिल भारतीय नेटवर्क कार्यक्रम
All India Network Programme on Organic Farming

ICAR-Indian Institute of Farming Systems Research
Modipuram, Meerut – 250 110, India



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 no's.) on-station sub (11 no's.) on-station voluntary (6 no's) and on-farm research (32 no's) 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 2020-21



ALL INDIA NETWORK PROGRAMME ON ORGANIC FARMING
ICAR-Indian Institute of Farming Systems Research
Modipuram, Meerut – 250 110, India



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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 2020-21 is based on experimental data generated during *kharif*, *rabi* and summer seasons of 2019-20. The other details are relevant up to 31 March 2021.
 - 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).

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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 2019-20. I take this opportunity to record my sincere thanks to **Dr Himanshu Pathak**, Secretary, Department of Agricultural Research and Education and Director General, Indian Council of Agricultural Research, New Delhi for the support being extended to the scheme. I also extend my gratitude to **Dr. S.K. Chaudhari**, Deputy Director General (Natural Resource Management) for his constant guidance and mentoring the scheme to develop resource specific packages. Inputs and support received from **Dr S. Bhaskar**, Assistant Director General (Agronomy, Agroforestry and Climate Change) for improving the 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.

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, Dr Poonam Yadav, Research Associate, Dr Rahul, Research Associate and all others who have helped to shape the report by compiling 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 package of practices, varietal identification and initial findings of natural farming will pave way for alternate production strategies across different ecosystems.

A blue ink signature of A.S. Panwar is written in a cursive style.

(A.S. Panwar)
Director

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ABSTRACT

The salient research findings made during 2019-20 under All India Network Programme on Organic farming is given below

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

Bajaura: Performance of french bean & lady finger (*kharif*), tomato & summer squash (summer) were found to be better under integrated production systems (towards organic) however, cauliflower in *rabi* and french bean in summer performed better under inorganic with state recommended package. Under integrated production system, yield was increase over inorganic and organic management to the tune of 29.7 & 7.4, 60.0 & 11.7, 48.4 & 32.1, and 48 11.6% in french bean, tomato, summer squash and lady finger respectively. In case of pea, it was increase 68.4% under organic with 100% nutrient supplied through organic sources over inorganic. In terms of system equivalent yield (cauliflower equivalent), black gram-cauliflower-summer squash resulted in higher cauliflower equivalent yield (25080 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 (20945 kg/ha)

Bhopal Higher mean yield of soybean (1548 kg/ha) was recorded under integrated with application of 75% organic nutrients +25% inorganic nutrients followed by 100% organic management practice followed (1498 kg/ha). The yield of soybean was found to be higher with integrated followed by organic by 18.3 and 14.5% compared to inorganic package respectively. *Rabi* crops such as, wheat, mustard, chickpea and linseed also followed the same trends and recorded maximum yield under integrated management with (75% organic nutrients supplied through organic source + 25% inorganic nutrients) of 3990, 1680, 1627 and 1916 kg/ha respectively and increased by 28.6, 22.4, 23, and 19.2% for *durum* wheat, mustard, chickpea and linseed respectively over inorganic. In terms of system equivalent yield (soybean equivalent), towards organic, integrated management with 75% organic+ 25% inorganic nutrients through organic and inorganic sources registered higher equivalent yield (3770 kg/ha) followed by organic production package (3594 kg/ha) and difference between both the production system was 4.9% whereas 21% SEY was found to be higher compared to inorganic production package. Among the cropping systems, soybean-linseed recorded higher soybean equivalent yield (3865 kg/ha) followed by soybean-chickpea (3343 kg/ha).

Calicut: Among the different management packages, organic package consisting of 100% nutrient supply through organic manure recorded higher yield of turmeric (13900 kg/ha) and black pepper (2.10 (fresh yield g/plant) followed by integrated (50:50% each nutrient supply through organic manure and inorganic). There is 8% difference was found in yield of turmeric among production system.

Coimbatore: Among the management practices, crops brinjal, and barnyard millet recorded maximum yield under inorganic management practice with state recommendation of 24556 and 1886 kg/ha respectively. There is marginal reduction in yield of brinjal and barnyard millet (2.46 and 3.57% respectively) with organic compared to inorganic. Chilli, tomato, pearl millet, finger millet (13052, 13914, 1799 and 2790 kg/ha respectively) registered higher yield towards organic under integrated management practice either with 50:50% each organic +inorganic nutrient or 75% nutrients through organic manures +25% through inorganic source. The yield was increased significantly by 39, 87.4, 27.7 and 28.8% over inorganic while 38.8, 52.1, 12.8 And 19.8 was increased over organic respectively.

Dharwad: Among different combinations of intercropping system, significantly higher pigeon pea seed equivalent yield was recorded under inorganic management package with state recommendation package (1348kg/ha) in pigeon pea+ green gram inter cropping system and closely followed by 100% organic treatment (1331 kg/ha) and was on par with 75% organic + innovative practice (1301kg/ha) and 75% organic +25% inorganic treatment (1214 kg/ha).



Jabalpur: Mean grain yield of basmati rice in *kharif* and yield of other crops during *rabi* and summer as influenced by different nutrient management was recorded higher with inorganic production system. Significant reduction in yield of basmati rice with organic was recorded to the tune of 89.6% compared to inorganic. The reduction in the yield of wheat, chickpea, and vegetable pea was also found by 39.6, 43.6 and 5.3% as compared to inorganic production package. Berseem seed & fodder (33 & 11.6%), maize fodder (12.8%) and sorghum fodder (31.4%) with 100% organic management package was recorded lower yield against inorganic production package. Total mean productivity of cropping system in terms of basmati rice equivalent was recorded higher with 100% inorganic nutrient management (10561 kg/ha) followed by organic (8661 kg/ha) among the production packages. Among crop-sequences, basmati rice- berseem seed and fodder led to record maximum basmati rice equivalent yields (9429 kg/ha) followed by Basmati rice – vegetable pea–sorghum (fodder) of 9260 kg/ha.

Karjat: Higher mean yield of rice (3120 kg/ha) was recorded with application of 50% each organic and inorganic nutrient under integrated package and being on par with organic and inorganic. Chickpea, field bean and onion also resulted good yield with integrated package and found to be higher by 24, 4.5 and 21.1% over inorganic respectively. Brinjal resulted in higher yield with inorganic package (47341 kg/ha) followed by organic and integrated. Reduction in yield of brinjal with organic found to be 10.7% compared to inorganic. System productivity in term of rice equivalent yield, rice- brinjal system produced maximum rice equivalent yield (47765 kg/ha) compared to other cropping systems. Among the management package, organic management with 100% nutrient supply through organic sources recorded 23.5 and 20.1% higher over inorganic and integrated package.

Ludhiana: Mean yield of basmati rice (4070 kg/ha) was recorded under inorganic with state recommendation closely followed by integrated nutrient management with application of 50% each organic and inorganic nutrient (40750 kg/ha) whereas soybean was recorded higher yield of 1120 kg/ha under organic package with application of 100% organic manure and 75% N equivalent by organic manure + innovative practice. Chickpea also recorded maximum yield (1350 kg/ha) with 75% organic + Innovative organic practices under organic practice. Wheat (5750 kg/ha) performed better under inorganic practice followed by integrated. In term of system productivity among the management practices, wheat equivalent yield resulted in higher either under organic with 75% organic + innovative practice of 10100 kg/ha. Among the cropping systems, it was higher in basmati rice-wheat-green manure of 10350 kg/ha.

Modipuram: Among the different crop management practices, highest yield of basmati rice (4272 kg/ha) recorded under organic production package which was 15.8% higher over inorganic. Coarse rice, barley, potato and mustard recorded maximum yield under integrated with 50% each nutrient supplied through organic and inorganic source of 4775, 3583, 23682 and 2067 kg/ha respectively. Yield difference from integrated to inorganic and organic found to be by 15.7, 13.1, 5.3 & 2% and 28.6, 24.2, 32.2 & 7.8% for Coarse rice, barley, potato and mustard. Systems productivity among the various systems, maize-potato-okra-sesbania recorded higher rice equivalent yield of 12388 kg/ha because of higher yield of potato and good premium price followed by basmati rice-wheat-green manure of 11107 kg/ha. Among the various production package, systems productivity was highest with organic either in 100% or 75% organic +innovative practice.

Pantnagar: Among the crops evaluated, yield of basmati rice (mean yield 5439) during *kharif* was recorded higher marginally 2% only with integrated over inorganic while 7% over organic. During *rabi*, wheat recorded higher yield also under integrated package (4270 kg/ha) and the yield difference between integrated and inorganic found to be significantly by 15.8%. 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. Maximum chickpea & vegetable pea equivalent yield (3588, 8088 kg/ha) and potato tuber yield (9641kg/ha) were recorded highest in integrated (50% each nutrient organic and inorganic). Tuber yield of potato increase by 9.3% over inorganic and 37.2% over organic package. System productivity in terms of basmati rice equivalent yield recorded higher in integrated package (10149 kg/ha) having 50% nutrients through organic manures and 50% nutrients through inorganic sources. SEY was increased by 5.6% over inorganic. Among all the cropping systems, higher system productivity was recorded with basmati rice-vegetable pea +coriander-sesbania system (14324 kg/ha) followed by basmati rice-potato (80258 kg/ha).

Raipur: Organic production system with 75% organic + innovative practice (foliar spray of vermin-wash (10%) followed by cow urine (10%) resulted in higher soybean and maize sweet corn yield (2071 and 16885 kg/ha respectively) which was on par with state recommendation package (2053 kg/ha). Other crops such as chilli and onion (6695 and 16857 kg/ha respectively) resulted higher yield under inorganic practices (state recommendation) while, garden pea yield recorded higher with integrated 50% organic and 50% inorganic nutrient through organic and inorganic sources of 8404 kg/ha. Yield reduction in chilli and onion with organic was found to be 36.3 and 14.5% respectively in compared to inorganic. The productivity of cropping system in term of soybean equivalent yield recorded higher under organic management

with 75% organic manure + innovative practices (7786kg/ha) and it was increased by 14.1% over inorganic. Soybean-maize (sweet corn) cropping system registered higher soybean equivalent yield (7877 kg/ha) followed by soybean-onion (7540 kg/ha).

Ranchi: Among the production package, organic management practice either with 100% organic manure or 75% organic manure +innovative practice “Azolla”) resulted in higher mean yield of rice (3548 and 3731 kg/ha respectively). Under organic production system the yield was increased by 20 and 26% respectively than inorganic. The yield of onion and potato was increased with organic to the tune of 10.6 and 116.5% respectively over inorganic package. Wheat recorded highest yield (2888 kg/ha) under inorganic package and found to be decrease by 12.2% with organic package (100% organic manure). Okra resulted in higher yield (9363 kg/ha) in integrated package with 75% nutrients through organic source+25% inorganic fertilizer and found to be higher by 7.6% over organic and 9.5% over inorganic. In case of systems equivalent yield, production package 100% organic found to be higher (11085 kg/ha) among the management practice. Among the cropping systems, rice-potato recorded highest system equivalent yield (11884 kg/ha) followed by rice-onion (11106 kg/ha).

Umiam: Among the management packages, 100% organic package recorded maximum broccoli yield 13620 kg/ha but been on par with integrated of 13360 kg/ha and inorganic 13085 kg/ha. Difference between organic and inorganic was only 4.1%. Other vegetable crops viz. carrot and tomato recorded maximum yield under organic package with 16150 and 15600 kg/ha respectively, whereas potato and frenchbean recorded highest under integrated of 19050 and 6520 kg/ha respectively. Vegetable crops, carrot potato, frenchbean and tomato recorded their yield by 14.9, 15.1, 20.8 and 19.4% higher with either by following the organic management practice or with integrated over inorganic package.

Ajmer: 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, cluster bean, fennel and coriander were higher by 17.1, 22.4, 20.2 and 37.1% respectively over inorganic whereas, it was higher by 12.2, 17.0, 17.3 and 22.2% respectively over organic production package.

Almora: Among crop management systems, application of 100% N requirement of crop through farmyard manure produced highest energy equivalent grain yield of 52019 and 58155 MJ/ha for finger millet + black soybean-wheat + toria and grain amaranth-wheat + lentil, respectively. The highest yielding treatment recorded 126 and 112% higher energy equivalent grain yield of finger millet + black soybean-wheat + toria and grain amaranth-wheat + lentil, respectively compared to 100% inorganic package, respectively.

Gangtok: Significant higher maize yield (3133 kg/ha) was recorded under 100% N equivalent through organics in maize + ginger – french bean cropping system with mean yield of 3125 kg/ha. Organic package resulted in 15.8% higher yield of maize as compared to inorganic. Likewise, ginger, soybean, turmeric and black gram gave 89.9, 108.4, 91.8 and 113% higher yield with organic over inorganic respectively. During *rabi* French bean, buckwheat, rajmash and toria recorded higher yield to the tune of 72.1, 74.4, 220.4 and 151.2% with organic over inorganic.

Narendrapur: Basmati rice and paddy (coarse grain) recorded higher yield under integrated (50% organic+50% inorganic) but was on par with organic nutrient package consisting of 75% organic+25% innovative practices. Yield of basmati rice and coarse rice was increased with integrated and organic by 4.8 and 7.7% respectively over inorganic. Other crops in the systems such as broccoli, mustard, french bean and vegetable pea resulted in higher yield also with organic package. The yield was increased by 9.6, 1.1, 8 and 8.5% with organic compared to inorganic.

Sardarkrushinagar: The general performance of groundnut and green gram during *kharif*, wheat, coriander, and fennel during *rabi* and vegetable cowpea during summer was found to be better under inorganic with state recommendation. Organic practices in groundnut, wheat, green gram, coriander, fennel and vegetable cowpea recorded yield drop to the tune of 18.9, 14.4, 20.8, 28.1, 24.2 and 6.2% respectively over inorganic practice. System equivalent yield (ground nut equivalent) of 4046 kg/ha was recorded highest under organic with application of 100% organic input among the production package which is 31.2% higher than inorganic. Among the cropping systems, ground nut-wheat-green gram resulted in higher ground nut equivalent yield of 4885 kg/ha which gave 29.6 and 186.5% higher than green gram- cumin- vegetable cowpea and green gram-fennel- fallow system respectively.

Thiruvananthapuram: Organic production package consisting of 75% organic + innovative practice found to be better for cassava and taro. Tuber yield of cassava and taro was higher by 5.4% & 69% than inorganic and 5.7 and 8.2% over organic package respectively.



Likewise, vegetable cowpea and groundnut recorded maximum under organic with 75% organic + innovative practices whereas black gram recorded maximum yield (43 kg/ha) under organic practice. Green gram was higher in integrated package (430 kg/ha) which was 9.2 and 12.3% higher over inorganic and organic respectively.

Udaipur: Yield of all crops in cropping systems recorded higher with either by inorganic practices or state recommendation. Maize and sweet corn (2429 & 2643 kg/ha) with inter crop of black gram (229 kg/ha), sole black gram (457 kg/ha) and soybean (629 kg/ha) during *kharif* and wheat *durum* and *aestivum* (3925 & 3900 kg/ha), chickpea and fenugreek (930 & 1790 kg/ha) recorded maximum yield either in inorganic or in state recommendation practice. Reduction in yield of maize and sweet corn (11.8 & 24.3%), black gram sole (20.3%) soybean (26.2%), during *kharif* season and wheat *durum* and *aestivum* (5.4 & 4.0%), chickpea (9.3%) and fenugreek (3.3%) during *rabi* were observed with organic compared to inorganic. Total productivity among the management practices in term of maize equivalent yield, inorganic production system consisting state recommendation/farmers practice being the highest followed by organic. Out of four cropping systems, maize + black gram (2:2)–wheat (*durum*)–*sesbania* (GM) cropping system gave maximum maize equivalent yield of 9156 kg/ha.

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

Bajaura: Among the okra varieties, best performing variety i.e., Perkins long green recorded significantly fruit yield (7830 kg/ha), net returns (Rs. 1,07,413/ha) and B:C ratio (1.21) followed by Pusa makhmali which recorded fruit yield (7550 kg/ha). French bean variety Hybrid Faluni recorded significantly higher yield of 3930 kg/ha followed by Contender which being the next best performing variety which recorded yield of 3510 kg/ha. Among cauliflower varieties, curd yield (9260 kg/ha), net returns (Rs. 70,351) and B:C ratio (0.70) were obtained maximum in hybrid US-178. PSBK-1 being next best performing variety in term of yield (8300 kg/ha) and net return of Rs. 54,837/ha. Among the pea varieties, maximum yield of 7440 kg/ha was in Azad P-1 along with highest net returns (Rs 76,912) and B:C ratio (1.23) followed by Ten plus which recorded 6550 kg/ha pod yield. Among the tomato varieties, hybrid Red Gold recorded highest yield (10480 kg/ha), net returns (Rs. 1,56,820) and B:C ratio (1.49) followed by RK-123 which recorded yield of 9000 kg/ha with Rs of 1,19,867 as net return.

Bhopal: Soybean variety RVS-2002-4 resulted in higher seed yield (1516 kg/ha) but statistically on par with RVS-2002-6. Among the maize varieties grown under similar nutrient source and doses, Proagro 4412 was outperformed in yield (2867 kg/ha) followed by Kanchan (2837 kg/ha). Among the wheat varieties, GW-366 resulted in higher grain and biomass yield (4380 and 9017 kg/ha). GW 322 recorded second in yield but on par with Malwashakti, HI 8498 and HI 8663 which recorded of 3962, 3953, 3933 and 3913 kg/ha respectively. the chickpea varieties, JG-130 recorded significantly higher seed yield (1813 kg/ha) followed by JG-63 (1717 kg/ha).

Calicut: Among the 12 varieties of turmeric, maximum yield was recorded by Suguna (48000 kg/ha) followed by Pragati (44500 kg/ha), these were statistically on par. In term of quality of turmeric, Pragati and Pratibha recorded maximum oil content (5.80%) which was on par and the least oil content was noticed in Sudarsana (4.2%). Prabha recorded maximum oleoresin 14.90% whereas Pragati recorded highest curcumin content of 6.28% among the turmeric varieties. Variation in curcumin content found to be 69.3% between highest curcumin content varieties of Pragati to lowest with Kanthi.

Coimbatore: Among rice varieties evaluated under organic condition, variety CO(R) 48 recorded highest grain yield (4898 kg/ha) while CO (R) 51 had lowest grain yield (2578 kg/ha) while rice variety Improved White Ponni fetched the highest net return of Rs.58,286/ha followed by Mappillai samba (Rs.56,245/ha).

Dharwad: Among the chickpea varieties, MABC 37 recorded maximum seed yield of 3066 kg/ha which is at par to A1 (2731 kg/ha), whereas MABC 27 produced lowest yield of 2221 kg/ha under organic condition. Among wheat varieties, UAS 446 (DW) recorded maximum grain yield (3141 kg/ha) which was significantly higher to other varieties whereas Bijaga Yellow (DW) recorded minimum grain yield (1788 kg/ha).

Jabalpur: Among the rice varieties, IR 64 was the leading variety for grain yield of 4062 kg/ha, followed by PS-3, P-4 and Sahyadri which recorded yield of 3782, 3711 and 3606 kg/ha respectively. Among the wheat varieties, variety JW-17 gave maximum yield (3659 kg/ha) which was statistically on par to other except HD 4672 and HI 1418.

Karjat: Rice (Table 7.3.7.1): Among the rice varieties grouped in four categories, rice variety Sahyadri-4 (early maturing), Sahyadri-3 (mid-late maturing), Sahyadri-5 (late maturing) and karjat-3 which is popular among farmers recorded significantly higher grain yield (4563, 4649,

4691 and 4209 kg/ha respectively). Significantly higher pods yield (2374 kg/ha) of groundnut recorded in Konkan Gaurav followed by TG-26 and TAG 24.

Ludhiana: Basmati genotype RYT 3425 recorded the highest grain yield (3950 kg/ha), which was statistically at par with RYT 3677 (awn less), Pusa Basmati 1509, RYT 3649, Pusa Basmati 1121 and Punjab Basmati 4. Grain yield of wheat (3460 kg/ha) among different varieties significantly higher with Unnat PBW 550 it was statistically at par with BWL 3504 (3330 kg/ha).

Modipuram: Eleven promising varieties of maize and mustard in maize-mustard system were evaluated. Among the tested varieties of maize, highest cob yield (8883 kg/ha) was recorded under HQPM 1 variety followed by Pioneer hybrid 1866 (8470 kg/ha) and Sujata (Hybrid) (7868 kg/ha) varieties. Cost of cultivation was similar among different varieties and net return was found under HQPM 1 followed by Pioneer hybrid 1866 and Sujata (Hybrid). the varieties of mustard, highest seed yield (2360 kg/ha) was recorded under NRCHB 506 followed by DRMRIJ 31 (2313 kg/ha) and Pusa Bold (2273 kg/ha). Cost of cultivation was similar with Pusa Bold followed by Pusa Tarak and RGN 229.

Pant Nagar: Higher grain yield of basmati rice was observed with Pant Sugandha Dhan-27 (4095 kg/ha) which was at par with Pant Basmati.-2. (4059 kg/ha), Pant Sugandha Dhan-21 (3904 kg/ha) and Pusa Sugandha Dhan-5 (3976 kg/ha). Among the wheat varieties, highest grain yield was noticed in UP-2565 (2904 kg/ha) which was at par with HD-2967 (2853 kg/ha) along with net returns (Rs. 35029/ha) & B:C ratio (1.01) followed by HD-2967 (Rs. 33811/ha and 0.97, respectively).

Raipur: Among tall traditional short grain aromatic rice varieties, Karigilas produced the highest yield (5449 kg/ha) which was significantly higher over rest of the traditional varieties. Among the other traditional short grain aromatic rice varieties Vishnubhog, Sel-1, Gopalbhog, shyamjeera and Badshahbhog gave similar yields to the tune of 3757 kg ha⁻¹ to 4327 kg ha⁻¹. Highest grain yield of scented rice was recorded in C.G. Sugandhit Bhog (5857 kg ha⁻¹) followed by Sugandhmati (5573 kg ha⁻¹) which were significantly superior over rest of the varieties. On the basis of seven years stability analysis, variety Karigilas, Badsahbhog, Gopalbbhog, Vishnubbhog and Tarunbhog, Sel-1 in traditional short grain aromatic rice and C.G. Sugandhit bhog and Indira sugandhit dhan in improved scented rice performed equally well under organic farming.

Among chickpea varieties, seed yield (2034 kg/ha), net return and B:C ratio (Rs 96371/ha & 4.49) recorded significantly higher in BGD-128 followed by RG 2009-01 which recorded yield of (1863kg/ha) and found to be statistically at par to each other.

Ranchi: Grain yield was highest in late duration variety M.T.U.-1010 (4494 kg/ha). Lalat and Birsamati was the successor of MTU-1010 in case of yield and found on par to each other. Among the wheat varieties, variety K-0307 resulted in significantly higher yield of 3313 kg/ha which was statistically at par with Raj 4229 (3176 kg/ha), DBW 39 (2997 kg/ha), GW 366 (2950 kg/ha) and BG-3 (2828 kg/ha).

Umiam: The highest system productivity (6.33 t/ha/year) was recorded by the cropping system T-8 (maize cultivar RCM 1-61 followed by French bean cultivar Naga local) followed by T-4 (maize variety RCM 75 followed by French bean variety RCM FB 18). The better performances of the cropping sequence T-8 and T-4 for higher system productivity is due to higher grain and seed yield of maize cultivars (cv. RCM 1-61 & RCM 75) and French bean cultivars (cv. Naga local & RCM FB 18) French bean varieties. The maximum maize equivalent yield (MEY) was also observed for maize cultivar RCM 1-61 - Naga local (French bean) followed by maize cultivar RCM 75 - French bean cultivar RCM FB 18 system. Higher yield along with good market price for French bean was one of the major causes for getting high MEY in the sequence. So, these varieties of maize (viz. RCM 1-61, RCM 75) and French bean (Naga local, RCM FB 18) fit perfectly within the cropping system and should be promoted for high system productivity.

Ajmer: Green gram variety Mum-2 performed significantly better in term of seed yield It recorded 799 kg/ha seed yield which was statistically on par with RMG-975 (788 kg/ha). Among the cluster bean varieties, variety RGC-1038 performed better which produced highest seed yield (1595 kg/ha). Variety RGC-1055 being at par which recorded seed yield of 1517 kg/ha yield. Coriander variety Azad Dhan-1 outperformed superior over rest of varieties. It recorded maximum seed yield (1707 kg/ha). Variety ACR-1 being the next best performing variety which recorded 1693 kg/ha seed yield. Among fennel varieties, GF-12 performed superior with all yield attributes and yield. It recorded highest seed yield per hectare (2800 kg) but statistically on par with Af-1, RF-101 and RF-281 for yield.



Gangtok: Significantly higher grain yield of maize (2140 kg ha⁻¹) was observed under Vivek Sankul-35 as compared to other cultivars but remained statistically at par with Seti makkai and Vivek Sankul-31. Highest net returns (4.24 × 10³ ha⁻¹) was registered under Vivek sankul-35 which was statistically at par with Seti makkai, Vivek sankul-31 and significantly higher than other remaining cultivars. Maximum LUE (38.4%) was found under RCM 75 which was statistically at par with RCM 1-1 and significantly higher than remaining cultivars. Maximum Grain yield of buckwheat (2670 kg ha⁻¹) was recorded under IC 109433 which was statistically at par with local Meethay, IC109729, IC49671.

Sardarkrushinagar: Significantly higher pod yield of groundnut (2346 kg/ha) were recorded in GJG 17 which was at par with all other varieties except (GG 7 (B)) and (GG 5 (B1)) varieties. Economic performance of GJG 17 (S) recorded the best performance as compare to other variety under organic condition with net return (127503 ¹ /ha) and B:C ratio (2.58), at the same time as GG 5 (B1) variety of groundnut performed lowest in yield and economics parameter under organic package of practices. Among the different wheat varieties, maximum wheat yield was recorded in variety GW-451 (3287 kg/ha) which was on par with GW 496 and GW 273. Gross return (96,898¹ /ha), net return (30,517 ¹ /ha) and B:C ratio (0.46) was also obtained in GW 451 and being the best performing varieties as compared to other among the wheat variety. Green gram variety GM 4 recorded highest seed yield (698 kg/ha) and higher stover yield (926 kg/ha) along with gross return (63,812¹ /ha), net return (35,235 ¹ /ha) and B:C ratio (1.23).

Thiruvananthapuram: Tuber yield was recorded significantly higher in CR24-4 of 36970 kg/ha among the cassava varieties. Sree Vijaya was the next best performer variety in term of yield. Variety, Sree Reksha generated higher profit (Rs. 6,87,275 ha⁻¹) and B:C ratio (3.90) followed by Sree Vijaya (Rs. 4,36,345 ha⁻¹ profit and 2.84 B:C ratio).

Udaipur: Among the different maize grain varieties, Pratap Hybrid Maize-3 recorded significantly higher maize yield (6000 kg/ha), among sweet corn varieties, sugar-75 gave significantly higher maize yield (5360 kg/ha). In case of baby corn varieties, PM-3 recorded higher yield (1522kg/ha). Among popcorn varieties, VL-Amber observed significantly higher maize yield (3200 kg/ha). Among local varieties, Navjot gave significantly higher maize yield (4300 kg/ha). Among wheat varieties, HI-8713 recorded significantly higher grain yield (5840 kg/ha), net return (Rs. 1,73,736 /ha) and NRPRI (3.7) as compared to other varieties. Among *Triticum aestivum* varieties, variety MP-3288 recorded significantly higher grain yield (4585 kg/ha), net return (Rs. 1,26,313 /ha) and NRPRI (2.69) as compared to other wheat varieties. In case of *Triticum durum* varieties, variety HI-8713 gave significantly higher grain yield (5840 kg/ha) net return (Rs. 1,73,736 /ha) and NRPRI (3.7) as compared to other durum varieties and it was at par with HI-8663 (5359 kg/ha and Rs. 1,54,115 /ha, respectively). In local wheat varieties, variety C-306 recorded significantly higher grain yield (4175 kg/ha), net return (Rs. 1,08,519/ha) and NRPRI (2.31) as compared to Lok-1(3730 kg/ha Rs. 96,045/ha, respectively).

3. Development of Integrated Organic Farming System models

Calicut: The plot with spices, fodder and vegetables combination was established at Chelavoor farm. The crops pepper, turmeric, fodder grasses (Congo signal grass, CO-3, CO-4), Tapioca, Banana, Cowpea, Coconut, were planted and established. 3 cows and their calves were maintaining at IISR farm. Turmeric 560 kg, Banana 150 kg, Tapioca 375 kg and vegetable cowpea 20 kg, coconut 3300 nos, were harvested. Fodder grass fed to the cows that are maintained at IISR farm. A profit of Rs 1.66 lakhs was received from one acre. Employment generated Man days/year is 415. The highest contribution towards the net return by livestock of the model which is 86%.

Coimbatore: In green manure - bhendi - maize cropping system, the net return of Rs. 18515 was realized. In green manure - cotton - sorghum cropping system, the net return of Rs.10319 was obtained. Through dairy component, an income of Rs. 15375/- was fetched. The income realized from recycling of crop residues and other livestock waste was Rs. 6205/ annum, income generated from green fodder (CO (CN) 5) grown in the one-hectare model of IOFS was Rs.12,200/ annum. The green leaf manure yield of 9.5t/ha was observed from *Gliricidia* and *desmanthus* as border crop. An income generated from kitchen garden was Rs. 1,954/ annum. A total net return of Rs. 62,172/- per year was achieved under the IOFS model. The highest contribution towards the total net return was contributed by crop component of the model followed by dairy and horticulture component.

Sardarkrushinagar: IOFS model is comprised of different components viz., crops (0.24 ha), green fodder crops (0.15 ha), dairy + vermicompost (0.01 ha) and boundary plantation. Net profit ¹ 30,569 was received by crop component from 0.24 ha area and net profit ¹ 27,937 was received by green fodder unit (0.15 ha). Construction of animal shade and purchases of animals is completed during the year.

Ardusa, napier grass and lemon grass have been planted around the border and bunds. Total net profit from all the components of IOFS Model was¹ 59,723 from 0.40 ha area.

Thiruvananthapuram: Net returns of Rs. 54,862 could be obtained from cassava based cropping system (with animal components for 4 months started during April 2020) from an area of 75 percent. The marketable equivalent yield (MEY) from the system was 9108 kg and the IOFS could generate 107 man-days. The % share of area and income of the various components of IOFS is given in model.

Udaipur: An integrated organic farming system model for 0.45 ha consisting of field crops in 0.25 ha (sweet corn + black gram 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 & brinjal in *kharif*, cabbage & cauliflower in *rabi* and okra in *zaid*), fruit crop in 0.04 ha (guava) and compost unit in 0.01 ha were evaluated during 2019-20. The total maize equivalent yield of 5149 kg/ha and a net return of Rs. 58769 /ha was obtained from the farming system model during 2019-20.

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 about to Rs. 1,85,821/ha and 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 followed by dairy and fishery component. The fish production was 115 kg.

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

Ludhiana: Grain yield of basmati rice found to be higher with integrated crop management (50:50) of 3440 kg/ha. Grain yield under integrated crop management (50:50) and NPOF package was increased by 24.6 and 16.3% respectively over complete natural farming concoctions. Performance of wheat as influenced by various concoction of natural farming found to be better with INM + pesticide free which recorded grain yield of (4270 kg/ha) but statistically at par with integrated crop management (4190 kg/ha) and significantly higher than complete natural farming input management practices by 104 and 99.5% respectively whereas NPOF package also found to be higher by 37.8%. In basmati rice, highest gross returns of Rs 1,08,340/ha was obtained with NPOF Package practice followed by ZBNF (Gurukul and Improved) which gave Rs. 93150/ha however, highest net returns (Rs 78050 per ha) were observed in NPOF package followed by control plot due to comparable yield, low cost of cultivation and premium price of organic produce. In case of wheat, highest gross return (Rs 82,200 and 80,660/ha respectively) was obtained in INM+pesticide free closely followed by ICM 50:50 and highest net return (Rs 54,830/ha) was obtained in ICM 50:50 followed by INM +pesticide free which was due to higher grain yields and low cost of cultivation under these treatments.

Modipuram: Highest productivity of basmati rice was recorded under integrated crop management (50% organic + 50% inorganic) followed by organic farming package. Yield gap between ICM and organic farming package was reduced during third year in comparison to first and second year of experimentation. Moreover, yield gap between ICM and ZBNF treatments was further increased as compared to first and second year of experimentation. On the mean yield basis, grain yield of basmati rice was reduced by 14.6%, 64.8%, 66.8%, 49.8% and 70.5% under organic farming package, Gurukul package (Product supplied by Gurukul), Locally prepared Gurukul products, Location specific improved products and control as compared to integrated crop management (50% organic + 50% inorganic), respectively. Cost of cultivation was recorded highest under organic farming package. However, net return was received maximum under ICM followed by organic farming package.

Grain yield of wheat was recorded highest under ICM 50:50 (4150 kg/ha) followed by NPOF (3010 Kg/ha). On an average, grain yield of wheat was reduced by 27.5%, 72.5%, 72.8%, 67.3% and 73.4% under organic farming package, Gurukul package (Product supplied by Gurukul), Locally prepared Gurukul products and Location specific improved products as compared to ICM, respectively. Yield gap between ICM and organic farming package was reduced from 53.5% during first year to 44.2% during second year and 27.5% during third year of experimentation. Cost of cultivation was highest under organic farming package. However, net return was highest under ICM followed by organic farming package. Higher cost of cultivation was recorded in NPOF package followed by Integrated crop management (50% organic + 50% inorganic). Integrated crop management (50% organic + 50% inorganic) treatment gave highest gross return net return and benefit cost ration followed by NPOF.



Pant Nagar: Among the management practice of natural farming, significantly higher grain yield (4020 kg/ha) of rice was recorded with integrated crop management followed by NPOF package (3775 Kg/ha). Highest per cent increase in grain yield was recorded under ICM system (221%) as compared to the control, 6.4% as compared to NPOF package. Economics of different management practice of natural farming revealed that highest net return of Rs. 80258 /ha and B:C ratio (2.31) was observed with NPOF package followed by ICM. Among different zero budget management practices in wheat, maximum grain yield of 4709 kg/ha, were recorded in integrated crop management. Economic analysis of different treatments showed that net return (Rs. 42951/ha and B:C ratio (1.34) was recorded with integrated system with and lowest net return being with control (Rs. 25684/ha) while minimum B: C ratio was recorded under NPOF Package (0.96).

Kurukshetra: Among various concoctions of natural farming practices, maximum grain yield (3850 kg/ha), Cost of cultivation (Rs 8,2484/ha), gross return (Rs 1,12,491/ha), net return (Rs 30,007/ha) and B: C ratio 0.36 was recorded under integrated crop management (50% organic+ 50% inorganic). AINP-OF package outperformed after integrated crop management. Integrated crop management package resulted in 42.6% higher yield than Gurukul package whereas AINPOF was higher to the tune of 17.2% by Gurukul package.

INTRODUCTION

1

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. Sikkim State of India has been brought under complete organic certification and production from 2016. Third party certified and in conversion cultivated area under organic farming reached to 2.66 million ha by March 2021 while around 0.73 m ha is brought under participatory Guarantee System (PGS) of certification. Currently around 2.4 % of net cultivated area is either under certified or in conversion process of organic farming. Conducive policy, technological advancements, demonstrations, and farmer led innovations have contributed for increase in area. In the past 6 years, the area under organic farming is growing at the annual growth rate of 22 %. Development of scientific technologies for organic farming, developmental schemes, introduction of user-friendly and cost effective PGS system of certification and development of online and offline jaivik kheti markets, large area certification systems resulted in phenomenal increase and involvement of communities under organic farming.



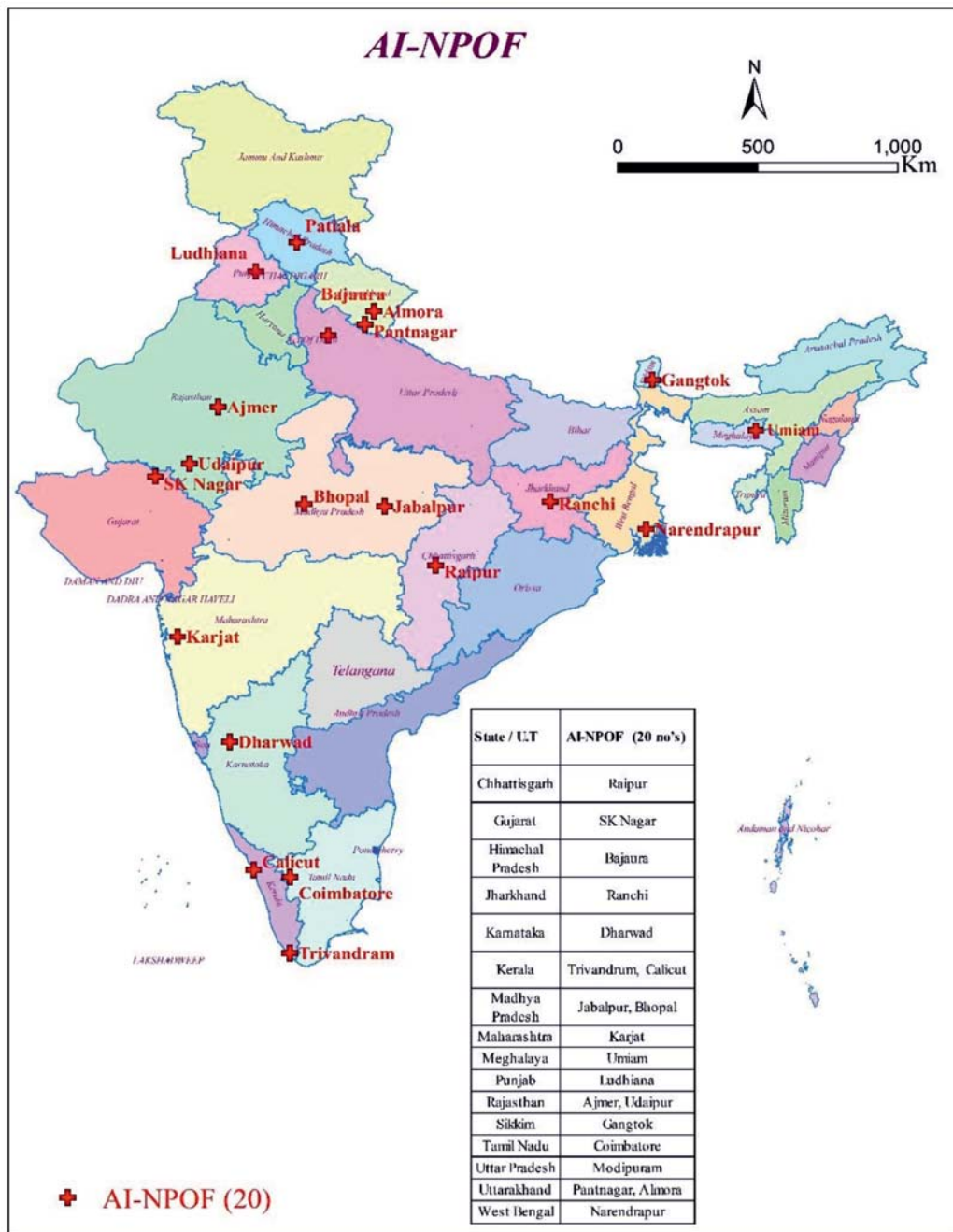
Growth of cultivated area under organic certification in India

India is producing wide range of crops under organic management with oilseeds, sugar crops, fiber crops, cereals and millets and pulses occupy the large chunk of the basket. India produces around 3.50 mt (2020-21) of certified organic products with export volume and value of 0.88 mt and Rs 7,078 crores (1041 million USD) respectively. Therefore, launch of All India Network Programme on Organic Farming by ICAR helped significantly for promotion of organic farming practices in India. Several Central Sector and Centrally Sponsored specific schemes such as ICAR-All India Network Programme on Organic Farming, Parambharaghat Krishi Vikas Yojana (PKVY), Mission Organic Value Chain Development for North-Eastern Region (MOVCD-NER) and Modern Organic Agriculture Development Initiative for Ladakh are in operation to promote the eco-friendly and sustainable farming practices among farming communities. Besides, these State specific schemes are also being formulated for promotion of organic farming.

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 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, and development of integrated organic farming systems are presented in the report besides other aspects such as publications, human resource development etc. Findings of the experiment conducted during the year will help to identify the potential areas and crops for promotion of organic farming in the country.



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, dolichos bean, coriander and cauliflower), cotton and fodder crops (sorghum, maize, cow pea and berseem) in location-specific cropping systems. During 2019-20, 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. Development of Integrated Organic Farming System models
5. Evaluation of Farm waste recycling techniques for organic farming
6. Documentation & validation of organic ITKs
7. Evaluation of organic management practices for insect pest in various crops
8. Evaluation of organic management practice for diseases in crops
9. Development of scientific organic package for large cardamom
10. Biochemical characterization & molecular identification of microbial population of different organic manures
11. Evaluation of weed management practices under organic production system
12. Evaluation of zero budget farming involving Beejamri, Jeevamrit and Ghanjeevamrit in basmati rice –wheat cropping system
13. 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.

LOCATION



Multi-location experiments were conducted during 2019-20 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	State centre	Address of SAU/ICAR institute
Centres functioning from 2004-05			
1.	Bajaura	Himachal Pradesh	CSK HPKV Hill Agri. Res. & Extn. Centre, Bajaura, Kullu-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, Marikunnu 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 & 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



Sl. No.	Location of	State centre	Address of SAU/ICAR institute
Centres functioning from 2004-05			
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 -737102
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 Pratap University of Agriculture & Technology, Udaipur- 313 001

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.

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	1018.5	24.6	9.6	88.6	31.8°N	77°E
2.	Bhopal	Vertisols, Clay Montmorillonite/ smectite type	906.2	32.67	20.91	58.8	---	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'
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'
Centres functioning from 2015-16								
14.	Ajmer	Sandy loam	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.	Thiruvananthapur am	-	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 (2019-20)

Centre	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)	S (ppm)	Fe (ppm)	Zn (ppm)	pH	EC (ds/m)
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	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	-	-	-	-	-	-	-	-	-
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	141	13.5	180.0	8.20	8.40	0.68	7.22	0.15
Thiruvananthapuram	-	-	-	-	-	-	-	-	-
Udaipur	0.56	155.76	2.87	250.13	-	-	-	8.1	0.50

BUDGET



A total budget of Rs. 150.45 lakhs were released to 21 centers during 2019-20. The centre wise allocations of funds are given below.

Sl. No.	Name of University / Institutes	Grant-in-Aid, Other than NEH & TSP					Total Other than NEH & TSP	TSP Component Sub-head	SCSP Component Sub-head			Grant-in-Aid, under NEH Component Sub-head				Grand Total
		Domestic TA	Research Expenses	Operational charges	Minor Works	Livestock			Research Expenses	Operational charges	Total SCS	Domestic T.A.	Research Expenses	Operational charges	Total NEH	
1	IGKV, Raipur	0.10	1.05	0.75	0.00	0.00	1.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.90	
2	SDAU, S.K. Nagar	0.10	0.75	1.75	2.00	1.60	6.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.20	
3	HAREC, Bajaura	0.50	1.00	3.00	0.00	0.00	4.50	0.00	2.00	2.09	4.09	0.00	0.00	0.00	8.59	
4	BAU, Ranchi	0.25	0.85	2.00	0.00	0.00	3.10	0.00	1.00	1.29	2.29	0.00	0.00	0.00	5.39	
5	ICAR-IISR, Calicut	0.90	1.50	2.50	0.00	0.00	4.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.90	
6	ICAR-CTCRI, Trivandram	0.62	2.37	3.91	2.00	1.60	10.50	0.00	4.49	0.00	4.49	0.00	0.00	0.00	14.99	
7	UAS, Dharwad	0.40	1.00	2.00	0.00	0.00	3.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.40	
8	JNKW, Jabalpur	0.25	1.00	1.80	0.00	0.00	3.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.05	
9	ICAR-IISS, Bhopal	0.75	2.00	4.50	0.00	0.00	7.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.25	
10	KKV, Dapoli	0.30	0.50	1.40	0.00	0.00	2.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.20	
11	ICAR Res. Comp., Umiam	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	3.18	6.86	6.86	
12	PAU, Ludhiana	0.80	1.00	3.00	2.00	0.80	7.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.60	



Sl. No.	Name of University / Institutes	Grant-in-Aid, Other than NEH & TSP					Total Other than NEH & TSP	TSP Component Sub-head	SCSP Component Sub-head			Grant-in-Aid, under NEH Component Sub-head				Grand Total
		Sub-heads							Sub-head			Sub-head				
		Domestic TA	Research Expenses	Operational charges	Minor Works	Livestock		Research Expenses	Research Expenses	Operational charges	Total SCSP	Domestic T.A.	Research Expenses	Operational charges	Total NEH	
13	MPUA&T, Udaipur	0.85	1.84	4.30	0.00	1.60	8.59	0.00	2.50	1.79	4.29	0.00	0.00	0.00	0.00	12.88
14	ICAR-NRC Seed Spices, Ajmer	0.50	1.50	5.00	0.00	0.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00
15	ICAR-RC-NEH, Gangtok	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10	2.58	3.18	6.86	6.86
16	TNAU, Coimbatore	1.15	1.00	3.55	0.00	0.00	5.70	0.00	2.50	2.79	5.29	0.00	0.00	0.00	0.00	10.99
17	ICAR-IIFSR, Modipuram	1.25	1.00	4.48	0.00	0.00	6.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.73
18	National PI, ICAR-IIFSR, Modipuram	3.51	0.81	5.56	0.00	0.00	9.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.88
19	GBPUA&T, Panthagar	0.80	1.60	3.00	2.00	1.60	9.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.00
20	ICAR-VPKAS, Almora	0.35	1.60	3.00	2.00	0.80	7.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.75
21	RMVU, Narendrapur	0.50	3.03	3.50	0.00	0.00	7.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.03
	Total	13.88	25.40	59.00	10.00	8.00	116.28	0.00	12.49	7.96	20.45	5.76	6.36	13.72	150.45	



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 2014-15. 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.

Bajaura

Geo-referenced characterization survey of natural farming farmers involving uncertified 30 households in 17 different villages located in three blocks namely Kullu, Manali and Banjar in district Kullu of Himachal Pradesh was carried out.

The survey revealed that villages had a total of 26.74-hectare area, out of which area under zero budget Natural Farming (ZBNF) was 7.44 ha and rest of the remaining area (19.3 ha) was under conventional farming. Out of total surveyed farmers, 70% of farmers were marginal and 30% farmers were small in land holding size. Status of farm machinery in surveyed village showed that 23% of farmers had power weeder, while hundred per cent of farmers had hand power sprayer/duster. Among the surveyed famers of the village, Livestock inventory revealed that 100% of the farmers maintain cows whereas, approximately 43% farmers also rear sheep/goats. In the surveyed village, the gross area under vegetables, cereals, pulses and fruit, crops was 6.68, 2.64, 1.52 and 3.24 ha respectively with average production of 7659, 5500, 1043 and 3217 kg/hectare, respectively.

Total area and production of surveyed village during *kharif* season

Crops	Area (ha)	Per hectare production (q)	Own Consumption (q)	Market Surplus
Cauliflower	0.32	78.13	1.00	24.00
Apple	1.88	32.42	12.60	48.35
Pomegranate	0.72	46.11	2.40	30.80
Pear	0.16	21.88	1.00	2.50
Plum	0.48	14.58	1.60	5.40
Black gram	0.28	7.18	2.01	0
Rajmash	1.56	11.41	17.80	0
Soybean	0.08	16.25	1.30	0
Maize	2.40	68.42	164.20	0



The maize crop had maximum area (2.40 ha) in *kharif* season followed by apple (1.88 ha). A large proportion of the vegetable and fruit produce is sold in the market, however black gram, rajmash, soybean and maize is consumed by the farmers.

Total area and production of surveyed village during *rabi* season

Crops	Area (ha)	Per hectare production (q)	Own Consumption (q)	Market Surplus (q)
Pea	2.44	72.03	8.30	167.45
Cauliflower	0.24	67.50	0.50	15.70
wheat	0.80	17.50	14.00	0.00
Garlic	0.16	120.00	1.50	17.70

During *rabi* season, the pea crop had maximum area (2.44 ha) followed by wheat which has an area of 0.80 ha. The vegetables and spices are marketed but wheat is kept for their own consumption.

Total area and production of sample village during *summer* season

Crops	Area (ha)	Per hectare production (q)	Own Consumption (q)	Market Surplus (q)
French bean	0.72	42.15	2.25	28.10
Tomato	2.28	90.30	9.05	196.84
Squash	0.08	83.75	0.20	6.50
Capsicum	0.08	93.75	0.50	7.00
Cucumber	0.40	95.25	2.30	35.80

Farmers grow only vegetables like frenchbean, tomato, squash, capsicum and cucumber during summer season. The tomato had maximum area (2.28ha.) followed by frenchbean with 0.72ha. Only a small quantity of their produce is kept for self-consumption and rest is sold in the market.

The farmers of surveyed village were financially assisted by ATMA Project, Department of Agriculture, Kullu, Himachal Pradesh.

Yield gap between farmers practice and AINP-OF trial

Crops	Experimental Production	Farmers Production	Percent Increase / Decrease
Black gram	7.60	7.18	5.53
Maize	74.40	68.42	8.04
Cauliflower (<i>kharif</i>)	84.80	78.13	7.87
Pea	77.80	72.00	7.46
French bean	48.80	42.15	13.63
Tomato	114.80	90.30	21.34

The computation of gap in yield in on station AINPOF experiments and farmers field showed that all the crops had higher yield under on station experiment than farmers yield. The tomato crop showed maximum yield increases (21.34%) followed by frenchbean with an increase to the tune of 13.63%.

Bhopal

Geo-referenced organic cluster survey was carried out at Barkhedanathu and MungliaChhap Tehsil- Huzur, District- Bhopal. Among the respondents in the villages, the highest total land holding was 22 acre while minimum was 1 acre. Out of which the maximum area under organic farming was 4 acre and minimum was 1 acre.



Cent percent of the farmers under organic farming using FYM and vermi-compost as organic resources. Every respondent spares 1 to 26 tonnes of crop residue for organic recycling annually. Most of farmers raised the soybean and maize crop during *kharif* season while chickpea crop was grown during rabi season and some of farmers raised wheat crop as per water availability. Neem oil, buttermilk and *kaddha* (decoction) were used as organic pesticide for the control of insect pest and diseases in crops. *Kaddha* was prepared by using leaves of different plants such as neem, oak, custard and karanj unlike SPNF specific input. Only 10-20 % of organic produces retained produced for household consumption and the rest sold out in either *krishimandi* or local market. The reasons behind adoption of organic farming were minimum purchase of external market inputs, healthy produce and improvement in soil health. However, slow responses to organic inputs, non-availability of premium price, and market unavailability for organic produce were opined as the major constraints of adoption of organic farming in the region. Poor access to the certification agencies for adoption to organic farming.

Coimbatore

Geo-referenced characterization survey was carried in organic clusters in villages of Mettukkal and Kodakur under Kothagiri block in Nilgiris District of Tamil Nadu. Total 25 organic farmer and 8 Natural Farming farmers/farms were surveyed.

Average holding size of organic farmer/farm was 0.30 ha whereas under natural farming/farms 0.40 ha was the average holding size. In surveyed villages, farmers maintaining cattles, goats and poultry as livestock. Brinjal, cabbage and chilly were the major crops under organic farming whereas cabbage and chilli grown under natural farming. Farmers using farm yard manure and vermi-compost as source of nutrients while adopted practices by the farmers under NF were mulching, whapasa, beejamrit, jeevamrit, ghanjeevamrit, and intercropping etc. Cool climatic condition prevailing in that area favours the growers to cultivate vegetables such brinjal, cabbage and chili. Eighty per cent of the organic farmers were using FYM as basal application for nutrient management followed by three fourth (75%) of the organic farmers spray Panchagavya @ 3 % as both nutrients source and for pest management. About half of the organic farmers (65%) were using neem seed kernel extract as pest repellent followed by Jeevamrith (60 %). The natural farmers were using organic inputs such as mulching, whapasa, beejamrit, jeevamrit, Ghanjeevamrit, and intercropping etc. Eighty per cent of the farmers were selling their products though, local merchant followed by local market (30 %) and few through online (10 %). Reasons for adoption of organic farming as evinced through interaction with farmers were use of locally available farm waste, less labour intensiveness, easy to manage, satisfaction in producing eco-safe food and service motto to save environment expressed by majority (80 %) of the organic farmers. Yield gap between on station (AINP-OF) experiments and farmers field showed that all the crops had higher yield under on station experiment than farmers yield. Brijal, cabbage and chili recorded 13, 15 and 12 percent yield gap on station to farmers field under organic farming condition. Likewise, yield gap under natural farming found 12.5 and 12% in cabbage and chili respectively.

Dharwad

Geo-tagged characterization of organic and natural farming farmers of twenty five each were characterized in Dharwad district of Karnataka.

Two villages namely Hallyal and Sulla of Hubli taluk are considered for survey but number of farmers really practicing organic farming is 20 and that too in their 20% of cultivated area. Though the farmers are interested in organic farming due to benefits like soil health and quality food they are not able to convert their entire land under organic farming because of the reasons mentioned above. The number of natural farming farmers is very less. They are basically organic farmers, under shortage of organic manures; they are adopting Beejamrit, Jeevamrit and Ghanajeevamrit for nutrient source. Except Neemaster for control of insect pests and sour butter milk for disease control they are not using any other natural farming plant protection measures. Average holding size of surveyed village for organic farmer/farm and natural farming was 0.8 ha. Green gram, groundnut, chili, black gram, rabi sorghum, safflower are the major crops grown under organic/natural farming. Yield gap between on-station and farmers field for green gram, groundnut and rabi sorghum were 21, 12.6 and 20 % respectively which was higher with on station than farmers field.

**Mean yield and yield gap of major crops at Dharwad**

Name of the crop	Organic Farming			Natural Farming		
	Yield on-station experiment (kg/ha)	Average yield at farmers field (kg/ha)	Yield gap (%) at farmers field	Yield on-station experiment (kg/ha)	Average yield at farmers field (kg/ha)	Yield gap (%) at farmers field
Green gram	745	740	On par	605	500	21
Groundnut	2150	2125	1.2	985	875	12.6
Rabi Sorghum	1250	1000	25.0	900	750	20
Chilli	550	500	10.0	-	-	-
Safflower	850	750	13.3	-	-	-

Karjat

Geo-referenced characterization of organic cluster namely Khandpay, Male and Pathraj was carried out under Karjat block of Raigad district of Maharashtra.

Total 30 uncertified farmers were characterized out of which, 10 farmers were marginal, 12 were small and 2 were large category in which 11.58 ha of land was found under organic farming out of 35.20 ha total land having red and medium black soil. Cropping systems rice-vegetable, field bean (Wal) under rain fed situation was followed consisting of rice, vegetable, pulses as major crops. Farmers possessing farm animals - 62, buffalo- 0 Nos., cow-35 Nos., bullock-27 nos. and poultry birds-40 nos. Crop residue availability within the farm for recycling FYM -94.35% and straw-100%. Plant protection measures for controlling the weeds through hand weeding in seasonal crops and animal grazing in rain fed fruit crops. Major organic inputs is FYM. Farmers using cow urine for Insect & pest management. Majority farmers controlled weeds through hand weeding in seasonal crops and animal grazing in rainfed fruit crops. Reasons for adoption of organic farming are customer demand + traditional farming. 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. Mean yield of major crops at farmers field recorded for rice, okra and pulse were (2900, 1050 and 900 kg/ha) and gaps between on station and farmers field found to be 17.1, 12.5 and 40% respectively.

Ludhiana

The geo-tagged characterization was conducted in Moga district of Punjab. A total of 20 organic growers were characterized. The surveyed area lies in 30°60.412' - 31°86.484' N latitude, 74°96.787' - 75°36.508' E longitude and at altitude of 163-187 m above mean sea level. Collected the information about total land holding of the farmers, area under organic management and natural farming, crops being grown under organic farming and natural farming, organic manures, concoctions of natural farming and bio pesticides being used, productivity level of the crops as compared to conventional crops, price premium on organic produce, perception of organic growers about organic farming and constraints in its adoption.

Salient Findings**Classification of farmers**

Among characterized farmers, 100 per cent were doing organic farming and no farmer was practicing complete natural farming. 20 per cent farmers were using concoctions of natural farming along with organic farming.

The proportion of area under organic farming out of total land holding of surveyed growers was 26.60 per cent. Out of total organic growers, 35 per cent were medium farmers followed by semi-medium (20 %), large (20 %), small (15%) and marginal (10%) farmers.

Adoption trend of organic farming

Fifteen per cent farmers adopted organic farming during 2009 followed by 10 per cent during 2005, 2006, 2010, 2013 and 2014. Five per cent farmers adopted organic farming during 2003, 2011, 2012, 2016 and 2017 (Fig 1).

Crops grown under organic farming

Wheat (95%), basmati rice (75%), Vegetables (40% each during *rabi* and *kharif*) were the prominent crops being grown by farmers under organic farming. The *kharif* and *rabi* fodders were being grown by 30 and 45 percent of farmers, respectively. Thirty per cent farmers had grown sugarcane. Gobhi sarson and turmeric was being grown by 20 and 15 per cent of farmers, respectively. Other crops being grown were paddy (10%) and maize (5%) in *kharif* (Fig. 2 & 3). Although, the pulses are an integral component of organic farming and significantly improve soil health but still these were being grown by very few farmers.

Use of organic manures

Farmyard manure (FYM) was the major source of nutrition, being used by 80 and 75 percent of the organic growers in *kharif* and *rabi* season, respectively. Green manuring was the second major source of nutrition used by 70 per cent of farmers in *kharif* season. Vermicompost was used by 15 per cent of farmers during both seasons. The Jeevamrit was used by 20 per cent of farmers during both seasons (Fig. 4 & 5). The vermiwash was used by 5 per cent of farmers during *kharif* season.

In *rabi* season, FYM was the predominant source of nutrition being used by 75 per cent farmers, however, FYM and green manure were predominant source of nutrition in *kharif* season being used by 80 and 70 per cent farmers.

Weed management

The hand weeding was the predominant method of weed control employed by 90 and 95 per cent of farmers in *kharif* and *rabi* crops, respectively (Fig. 6 and 7). Mulching to suppress weeds was used by 30 and 10 per cent farmers in *kharif* and *rabi* crops, respectively. Twenty per cent of farmers used mechanical methods to control weeds during *rabi* season. Cutting as a method of weed management was used by 5 per cent farmers in both seasons.

Disease and insect-pest management

The sour butter milk was used by 60 and 70 per cent of farmers in *kharif* and *rabi* crops, respectively. Neem based pesticides were used by 70 and 50 per cent of farmers during *kharif* and *rabi* seasons, respectively. Farmers also use natural farming concoctions agniastra and brahmastra to control diseases and insect-pests. Sixty per cent farmers used these products during *both* seasons. Trichocards were used by 30 per cent farmers during *kharif* season, mostly in Basmati rice crop (Fig 8 & 9).

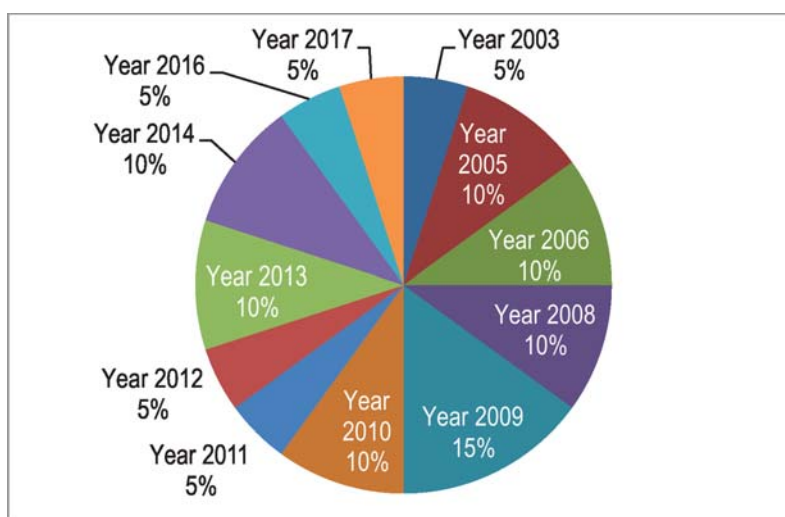


Fig.1. Adoption trend of organic growers (year wise)

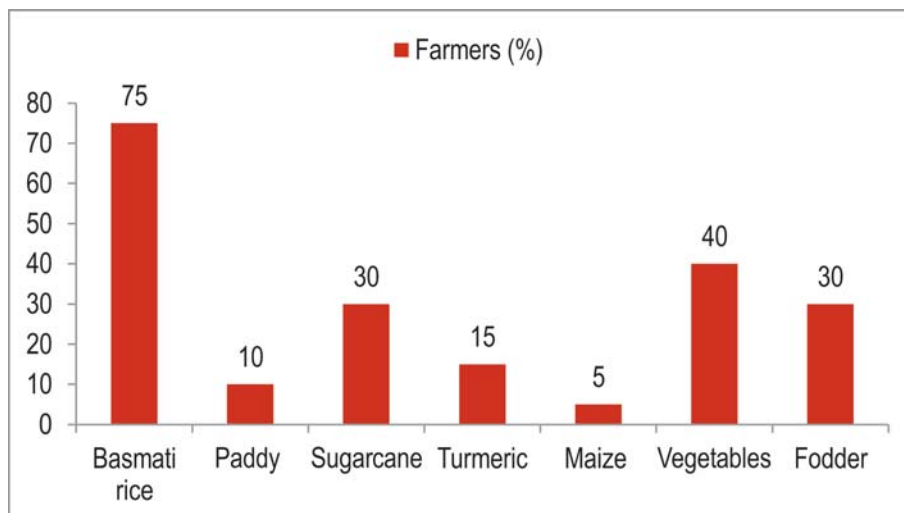


Fig.2. Crops grown under organic farming in *kharif* season

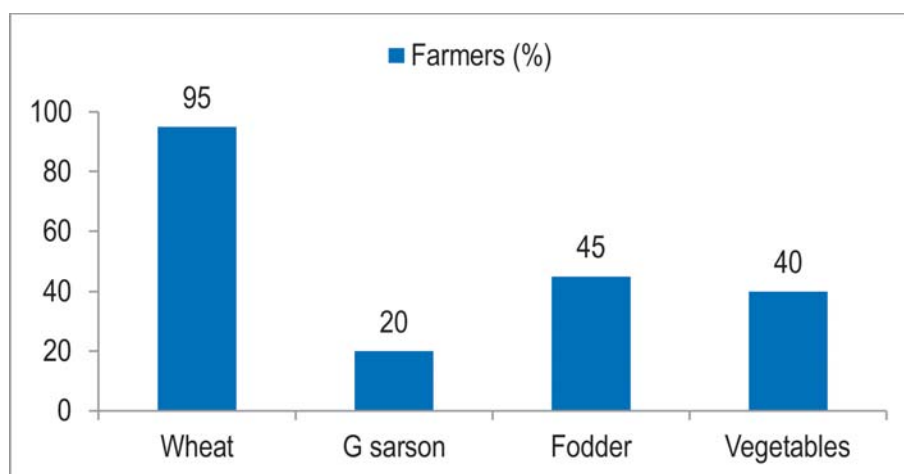


Fig.3. Crops grown under organic farming in *rabi* season

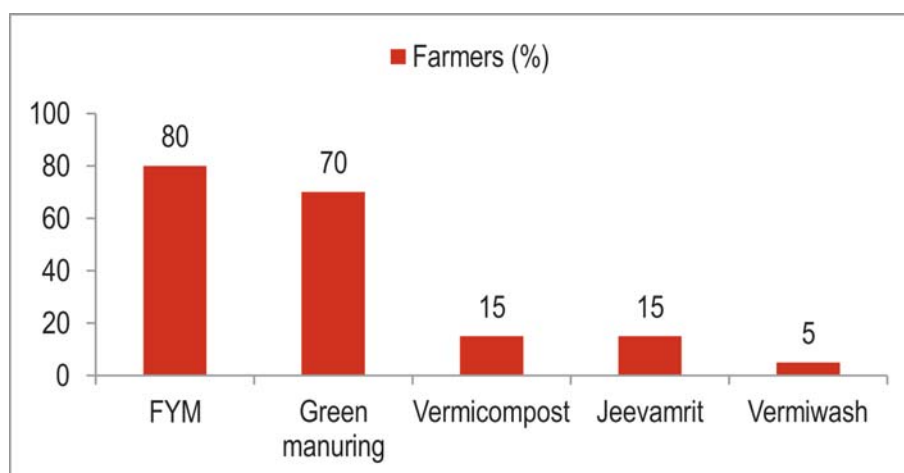
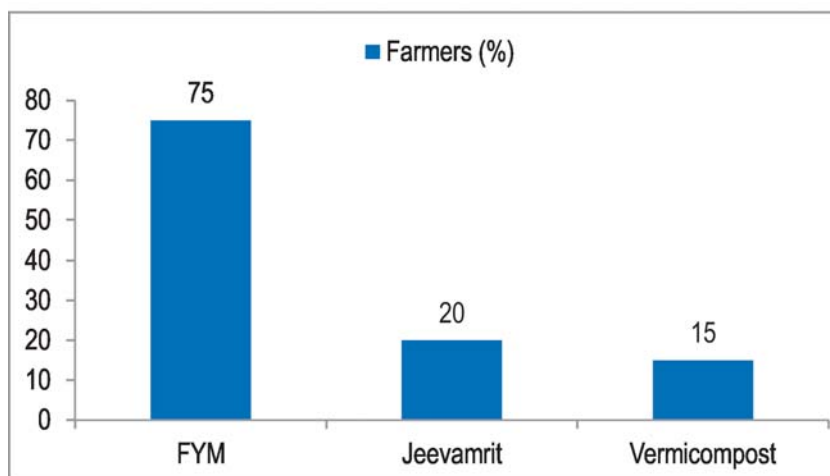
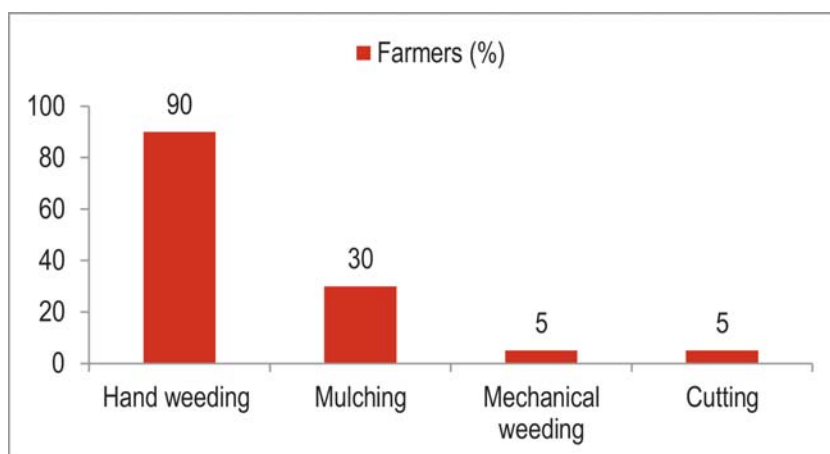
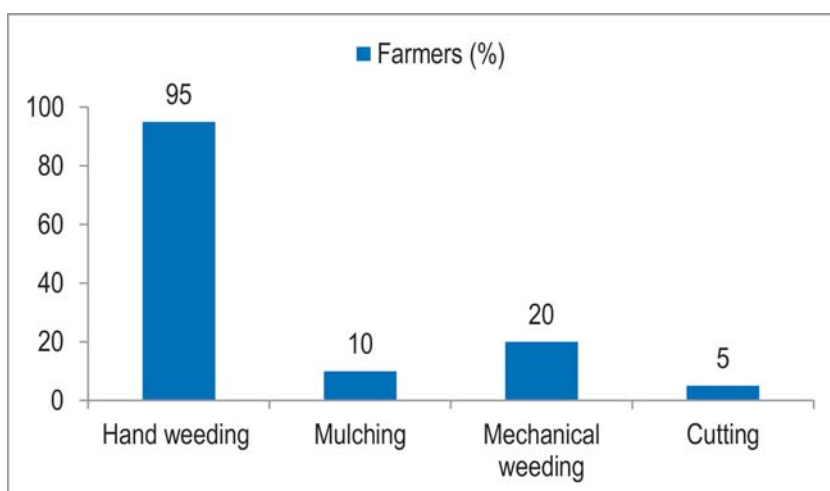


Fig.4. Organic inputs used by farmers in *kharif* season

Fig.5. Organic inputs used by farmers in *rabi* seasonFig.6. Weed management in *kharif* seasonFig.7. Weed management in *rabi* season

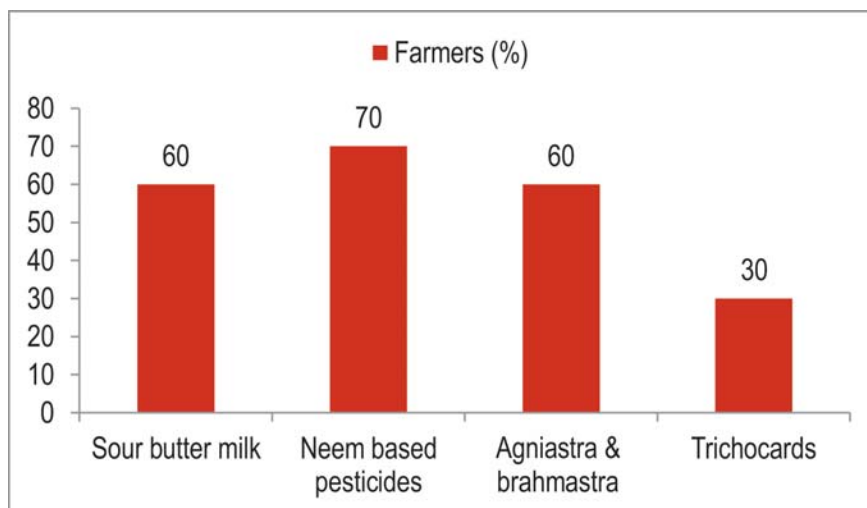


Fig.8. Disease and insect-pest management in *kharif* season

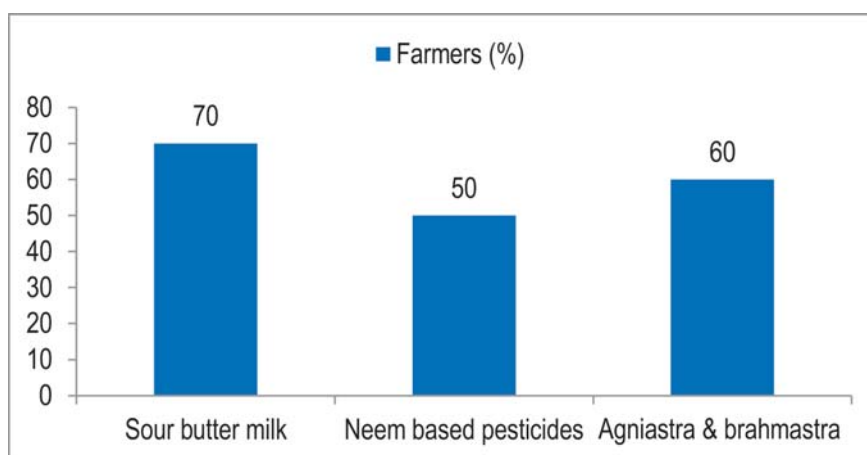


Fig.9. Disease and insect-pest management in *rabi* season

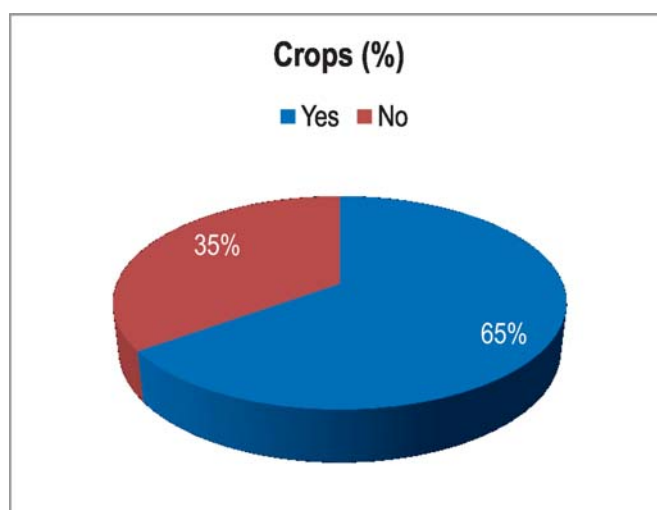


Fig. 10. Price premium available on organic crops

Productivity of crops

The economic yields of almost all the crops were lower under organic cultivation as compared to conventional cultivation of these crops. The reason behind this might be use of lower dose of FYM or other composts and less N content in these composts. The FYM used by farmers generally is not fully decomposed due to many factors, so it does not produce desired yields. Poor control of insect-pests and diseases also contributes to lower grain yields under organic production.

Marketing and price premium

The organic farmers got price premium on 65 per cent of crops which include wheat, sarson oil, and turmeric powder, products from sugarcane, pulses, maize flour and millets. However, farmers get no premium on 35 per cent of crops which include basmati rice, rice, maize grains and some vegetables (Fig. 10). The organic growers sell their produce in local market and big cities. Some of organic growers had sale point of their produce at their farms itself.

Reasons to adopt organic farming

The main reason for adopting organic farming as told by farmers was human health benefits due to healthy food production in organic farming. Fifty five per cent farmers were of this view. The healthy environment was the reason to adopt organic farming by 15 per cent of farmers. Other reasons for opting organic farming included passion (15%), business (10%) and peace of mind (5%).

Reasons to adopt organic farming

Reasons	Response (%) of farmers
Health benefits/healthy food	55
Healthy Environment	15
Passion	15
Business	10
Peace of mind	5

Constraints in adoption

The major constraint faced by farmers in adoption of organic farming was labour intensive operations and lack of marketing facilities (30% each). Other constraints were difficulty in weed control (15%) and reduced yield (14%) (Table 5.2). Non-availability of subsidized inputs, lack of premium on organic products, difficulty in pest and disease management, limited availability of organic manures and lack of technical knowledge for organic farming etc. were also the constraints in adoption of organic farming in Punjab.

Constraints in adoption of organic farming

Constraints	Response (%) of farmers
Labour intensive operations	30
Lack of marketing facility	30
Weed problem	15
Reduced yield	14
No subsidy on organic inputs	06
Lack of premium on organic products	05

Summary of Survey

Among geo-characterized farmers, most of the farmers were progressive organic farmers having strong individual marketing network. As compared to farmers in other districts surveyed during previous years, the farmers of Moga district were technically sound. The farmers faced fewer constraints in adoption of organic farming. None of the farmer was practicing complete natural farming. However, one or more concoctions of natural farming were being integrated with the organic farming practices. Wheat (95%), basmati rice (75%) and Vegetables (40% during both seasons) were the prominent crops grown by farmers under organic farming. Farmyard manure and green manure were the major source of nutrition to crops followed by vermicompost, jeevamrit and vermiwash. The hand weeding was the predominant method of weed control. The pest and disease management was done with sour butter milk, neem based biopesticides and agniastra & brahmastra. Human health concerns and healthy environment were the major reasons to adopt organic farming. Labour intensive operations, lack of marketing facilities, difficulty in weed control and reduced yield were the serious constraints in its adoption.

Modipuram

Geo-referenced characterization of organic farmers was carried out in Meerut, Muzaffarnagar and Saharanpur district of Uttar Pradesh.

Total 16 farmers were characterized in which 2.78 ha mean holding size was there out of which 85.2% land maintained under Organic Farming having loam to sandy loam soil in nature. Out of 16 organic farmers, one farmer practicing Natural Farming. One farmer is having dairy farm with 76 no. of cattles, without him the avg. no. of cattle/buffalo is 8.07. Sugarcane, wheat, basmati rice, mustard, forage crops (sorghum, berseem, oat, hybrid napier etc.), black gram, potato etc. are the major crops grown in surveyed area. Farmers are using FYM, Vermicompost, Green Manure, Ghanjeevamrit, Biogas slurry, Waste decomposer, Jeevamrit, Cow urine as a source of nutrient management Input. Plant protection measures for controlling the



Glimpse of Geo-reference characterization survey of organic farmers at Modipuram

weeds through hand weeding mechanical weeding and mulching. For plant protection management, they are using *Trichoderma* spp., *Pseudomonas fluorescens*, Fermented buttermilk, Dashparni extract, Neem oil, Neemashttra, Agniashtra, Brahmashttra, Fruit fly trap, Tricho cards Cow urine etc. Average yield for major crops and their gaps between farmers field is given below.

Yield gap under different crops at the farm of organic growers

Name of the crop	Yield as per on-station experiment (kg/ha)	Mean yield at farmers field (kg/ha)	Yield gap (%)
Sugarcane	72870	60000	-17.66
Basmati rice	4398	3200	-27.24
Wheat	3214	2750	-14.44
Mustard	1963	1400	-28.68

Pantnagar

Geo-referenced characterization of organic farmers was carried out in under Kotabag block in Nainital district of Uttarakhand. Total 40 nos. of organic farmers surveyed. No SPNF farmers were there in surveyed areas. Among the 40 farmers surveyed, the average land holding size of the organic farmers found to be 0.8 ha. All most all the organic farmers are having 4-5 animals (cows, buffalos and goat). Farmers are preparing compost at their own farm and composts are not being purchasing by the farmers. However the quality of composts is not much good as compared to scientific composts. All the farmers are using cow urine fortified with neem leaves/neem oil/garlic paste for plant protection purposes. In general, farmers practicing weeding manually. In surveyed area, most of the farmers are growing traditional organic basmati rice (Organic Dehraduni Basmati) followed by wheat and other crops. Rabi crops mostly for their own consumptions. Productivity of the traditional basmati rice is 26.8% less than the station experiment however that of wheat is 16.2% less.

Raipur

Geo-referenced characterization of 30 organic farmers was carried out and the salient features of the survey are as follows. Mean holding size of surveyed organic farmers of Durgukondal block of Uttar kanker district is 1.42 ha. The livestock maintained by the farmers are cow, buffalo, bullock, goat, poultry and pig with average livestock population of 5.0 dairy animals, 4.0 goat, 16.0 poultry and 3 pig per farmer was observed. The main crops of organic farmers were rice (mainly short grain aromatic rice), Kodo millet (finger millet) and kutki (Little millet). Other crops like horse gram, black gram and sesame was grown by some farmers in smaller area for self-consumption. Among the 30 farmers only 2-3 farmers grow wheat mustard and vegetables having assured irrigation facility. FYM is main source of organic manure prepared from the livestock maintained and on an average 4-5 t/ha FYM is used in the field. For plant protection neem oil, seed treatment with trichoderma was used and some farmers also use cow urine spray for disease control. For weed management hand weeding has been adopted by majority of farmers only few farmers have used mechanical weeder for weed management in rice. The average cost involved in weed management was Rs 4695 ha⁻¹. The yield gap of 54.13% was observed in aromatic rice over experimental yield, whereas in kodo millet the yield gap was 51% and in kutki (Little millet) the yield gap was 50.5%. All the organic farmers have PGS certification.

Ranchi

Geo-referenced characterization of organic farmers was carried out at Totambhi and Bhudha Khokhra villages in Block Mandar district Ranchi (Jharkhand).

Total 50 nos. of organic farmers surveyed. No SPNF farmers were there in surveyed areas. Among the 50 farmers surveyed, the average land holding size is 0.4 ha out of which average area maintained under Organic Farming was 80%. All most all the organic farmers are having 2-4 animals. FYM, vermi compost was used for nutrient management input. In transplanted rice farmers are using stem of *Vitex negundo* (Sendwar) and *Semicarpus anacardium* (Bhelwa) plants to protect the crop from



insect-pest and diseases. In general, farmers practicing weeding manually. In surveyed area, farmers are growing transplanted rice, maize, finger millet, wheat, mustard, potato, onion, chill, brinjal, frenchbean and tomato. Yield gap between on-station and farmer's field found to be in range from 20 to 30%.

Umiam

Geo-referenced characterization of organic farmers, The ICAR Research Complex for NEH Region under the NPOF project has adopted three (3) villages in the RiBhoi District of Meghalaya viz., Mynsain, Pynthor and Umden Umbathiang and their GPS coordinates are 25°44'21,61"N - 92°1'1,73"E, 25°45'18,31"N - 92°1'48,14"E and 25°44'58,99"N - 92°2'10,67"E, respectively.

The major soil type found in the three villages is the red loamy soil along with few locations composing of the alluvial and laterite soils. The soil prevailing in the lowland and upland regions of the villages were sampled at depths of 0-15 cm and 15-30 cm and the average nitrogen (N), phosphorus (P), soil organic content (SOC) and pH content were analyzed by standard procedures. 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.

The farmers of the villages are mostly dependent upon rainfall for raising their crops except for those who have constructed micro rain harvesting structures (**Jalkund**) which have greatly promoted the productivity of crops (especially vegetables) grown in the winter season.

The number of farmers who are actively participating in the activities that are under the purview of the NPOF in Mynsain, Pynthor and Umden sums to about 303 individuals collectively.

Livelihood

The main occupation of the villagers is agriculture. Paddy, maize, ginger, French bean and some vegetables are main crops cultivated by the villagers. Ginger is the cash crop and is the most profitable as ginger is non-perishable crop, and it has become a major source of income for the farmers. Paddy is mostly cultivated for self-consumption. There are other crops and vegetables that the villagers grow like sweet potatoes, potatoes, pumpkin, yam, corn, tomato, beans, chillies, cabbage, cauliflower, radish, broccoli, carrot etc.

Almost all farmers from the village maintain an average of 3-4 numbers of farm animals (goats, cows, pigs or poultry) for acquiring additional benefits and income for themselves and inputs for their farming practices.

The climatic and edaphic condition of the 3 villages is more likely the same (receiving around 2400 mm annual rainfall in the months of April to November with a mild climate) with diminutive variations and therefore the food crops grown in the 3 villages at various cropping seasons are of the same type.

Major Crops grown during the *Kharif* season at the aforementioned villages are rice, maize, French bean, ginger, colocasia, sweet potato, turmeric, some vegetables etc.

During the *Rabi* season, the farmers usually cultivate French bean, mustard, radish, cole crops, tomato, potato, peas, etc., whilst the post *Rabi* season is highlighted by the cultivation of various cucurbits. But overall, the cropping intensity is very low (less than 130%).

Crop enhancement inputs are purely organic based that are accessible and available within the village. Growth enhancement inputs such as manure comes in the form of farmyard manure which is either cow dung or pig manure, poultry manure, vermicompost and other composted materials. For most farmers, manure is collected from their livestock shed while for some is purchased.



Weed and pest management

Weed management adopted by the farmers is basically a mechanical/manual approach which involves physical disturbance/uprooting of the weeds, through activities including hoeing with spades, pulling weeds, tilling the soil before or after weeds emerge, and mowing.

Pest management is purely practiced by the villagers by manual and traditional means. As most of the farmers grow their local pest resistant varieties, incidence of large scale attack is very less. However, with the introduction of high yielding cultivars, report of some pest attack is noticed. After scientific intervention by ICAR, organic pest management options are being promoted.

Economy

Crops produced are either utilized for household consumption or marketed if there is a surplus. Production profit analysis of crops cultivated and marketed from the three villages all year round reveals that production profit is maximum in the *kharif* season than when compared to production profit generated from the other 2 agro season.

Production profit is highest in the *kharif* season since the major crops cultivated in this season such as rice, maize, ginger and turmeric are cultivated in larger land area as compared to other food crops belonging to other cropping seasons. Due to lack of irrigation facilities and absence of winter rain, cultivation of crops in this season is very limited.

Ajmer

Total 40 farmers from Jaipur district of Rajasthan were characterized.

- Soil type in surveyed village found to be sandy loam in nature and 100% farmers are having average holding size of 1.6 ha organic farmer/farm.
- Farmers (100%) are using only FYM and vermi-compost as nutrient source for crop production.
- Major crops of *kharif* are moong, bajra, sorghum whereas in *rabi* barley, wheat, gram occupies the major area under organic farming.
- All the farmers are following hand weeding for controlling weeds and most of them are using *Aak datura* leaf extract, neem oil and homemade bio-pesticide for pests and disease management.
- Organic growers are selling their produce in local market and not getting any premium price for their produce this the major constrain but adopting organic farming is due harmful effect of chemicals on human health and soil fertility.
- Average yield in wheat is 3200 kg/ha, barley 2800 kg/ha, moong 600 kg/ha, bajra (grain) 1800 kg/ha, and sorghum (grain) 600 kg/ha.

Gangtok

Timpyem Village of East Sikkim District of Sikkim state and their GPS coordinates is 27°33'94"N-88°60'29"E, Altitude 1150-1500 m at mean sea level.

The main occupation of the villagers is agriculture. Paddy, maize, ginger, French bean and some vegetables are main crops cultivated by the villagers. Ginger is the most profitable cash crop and has become a major source of income for the farmers. Paddy is mostly cultivated for self-consumption. There are other crops and vegetables that the villagers grow like tomato, beans, chillies, cabbage, cauliflower, radish, broccoli, etc. Almost all farmers from the village maintain an average of 3-4 numbers of farm animals (goats, cows, pigs and poultry) for acquiring additional benefits and income for themselves and inputs for their farming practices.

Major crops are grown during the *pre-Kharif* season at the aforementioned villages are rice, maize, French bean, ginger, turmeric, some vegetables etc. During the *Rabi* season, the farmers usually cultivate French bean, mustard, radish, cole



crops, tomato, peas, etc., Crop enhancement inputs such as manure comes in the form of farmyard manure which is either cow dung or pig manure, poultry manure, vermicompost and other composted materials.

Most of the farmers collect manure from their livestock shed. Weed management adopted by the farmers is basically a mechanical/manual hand weeding. Pest management is purely practiced by the villagers manually or by ITKs.

As most of the farmers grow their local pest resistant varieties, incidence of large scale infestation is very less. However, with the introduction of high yielding cultivars, report of some pest attack is noticed. After scientific intervention by ICAR-NOFRI, organic pest management options are being promoted. Crops produce are utilized for household consumption or marketed if there is a surplus.

Production profit is highest in the *pre-kharif* and *kharif* season as compared to production profit generated from the other agro seasons causing major crops cultivated in this season such as rice, maize, ginger and turmeric are cultivated in larger land area as compared to other food crops belonging to other cropping seasons.

Case study on cluster based farming on Timpyem village

Farmers Name	Total land holding (ha)	No. of farm animals	Organic/vermicompost unit (capacity in t/year)	Crop residue availability within the farm for recycling (t/year)
Karma Dorjee Lepcha	0.30	3	1.20	0.70
Cheychu Lepcha	0.20	2	1.10	0.50
Layda Lepcha	0.20	2	1.20	0.50
Hari maya Lepcha	0.30	7	2.40	0.70
Palden Lepcha	0.40	2	2.50	0.90
Lakthi Lepcha	0.20	2	1.20	0.50
Namgay Lepcha	0.30	4	2.40	0.70
Rinzing Gyatso Lepcha	0.05	4	1.10	0.30
Kiki Lepcha	0.30	3	1.20	0.70
Lakden Lepcha	0.60	2	2.50	1.40
Rinchen Lepcha	0.20	12	2.80	0.50
Tempo Lepcha	1.00	5	3.00	2.00
Dawa Pintso Lepcha	0.50	5	3.40	1.00

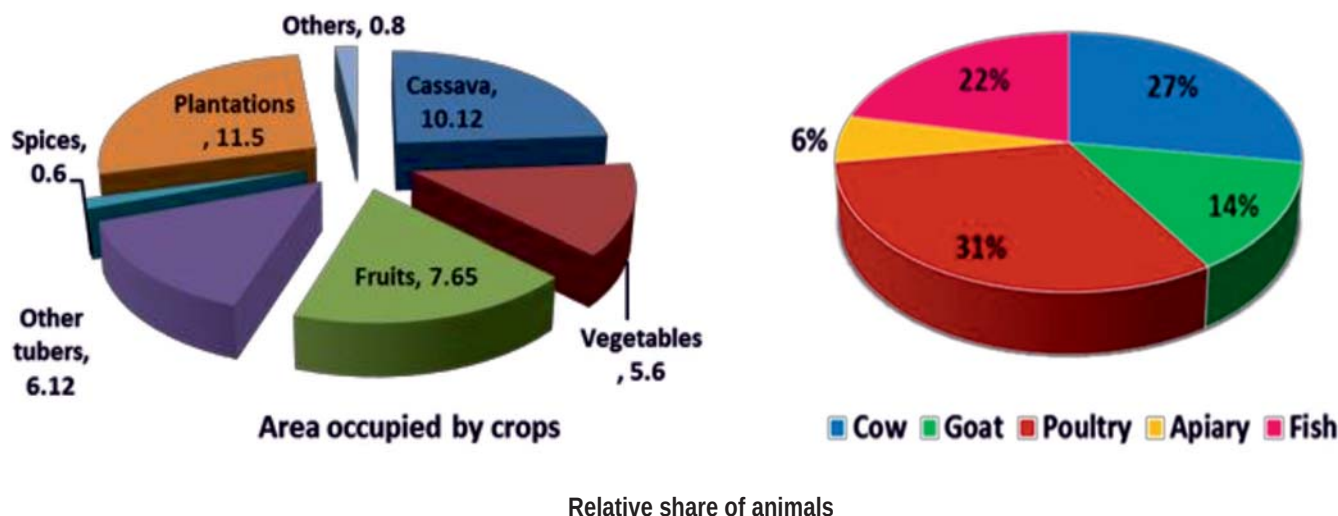
Sardarkrushinagar

Geo-referenced characterization of organic farmer/farms cluster was done in Mehsana district of Gujarat. Total 30 households selected from eleven villages of two block of Mehsana. In the surveyed villages, 37.4% land being cultivated under organic farming. Average land holding size of farms is 1.54 ha out of which average land holding size under organic farming was 0.58 ha. Castor was the major crop. Average number of animals per household was 2. Farmers using farm yard manure as main sources of nutrient for raising the field crop. Among the surveyed farmers, 9 farmers having vermicompost unit and production from vermicompost unit was 2833 kg/year. Hand weeding and inter culturing was mode of weed management. Farmers possessing tractor and its implement as farm machineries. Major reason for adoption of organic farming is healthy and safe food. Yield gap in castor crop from on-station to farmers field was observed 37.4% and major constraint for yield gap was lack of labour availability and difficult to control insect pest damage.

Thiruvananthapuram

Geo-referenced survey of uncertified 30 farmers practicing organic farming in Thiruvananthapuram, Kollam and Pathanamthitta district of Kerala was conducted. The survey was carried out in Kazhakkootam and Kilimanoor blocks, Thiruvananthapuram, Ochira, Chavara and Chittumala blocks, Kollam and Koipuram, Elanthoor and Mallappally blocks, Pathanamthitta.

- Eighty three per cent of the farmers belonged to the small and marginal group with a land holding size <2 ha. 63% of farmers had a land holding size < 1 ha, 30% 1-2 ha and 7% >2 ha. Average land holding size was 1.12 ha. The soil type was laterite (100%).
- Most of the farming situation surveyed was rainfed (80%), some are irrigated.
- 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 86.67% of the farmers.
- Major Crops: Fruit crops (banana, mango, jack fruit, guava, rambutan); 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, pepper) and Plantation crops (coconut, rubber).
- About 46.67% of the surveyed farmers owned cow, 23.33% had goat, 53.33% had poultry (hen and duck), 36.66% had fish and 10% had apiary as an integral part of organic farming. Relative share of animals in the surveyed area is given in Fig. 33.



- Organic recycling units: Animal wastes were converted to excellent manures using biogas (in 6.67% cases) and vermi compost units (10% farms) (with an average capacity to produce nearly 200 kg compost/annum).
- Organic sources: Nutrient sources for organic farming constituted cow dung slurry/FYM (100%), neem cake (56.67%), poultry manure (50%), vermicompost (40%), goat manure (30%), green leaf manuring (23.33%), kitchen waste compost (20%), groundnut cake (13.33%), bio-formulations like *Jeevamrutham* (26.67%), *Hridayamrith* (20%), *Panchagavya* (16.67%) and biogas slurry (6.7%). Apart from these, ash (66.67%) and bone meal (50%) were also used. Majority of farmers conducted soil testing before raising the crop.
- Insect pest management: Through application of *Kanthari* emulsion (50%), neem oil-garlic emulsion (36.67%), fish amino acid (36.67%), neem oil (30%), egg amino acid (23.33%), neem soap (30%), *Pseudomonas* (60%), *Beauveria* (53.33%), *Trichoderma* (53.33%), and pheromone trap (50%). Also practicing cultural methods, intercropping, trap crops on field bunds and some indigenous practices.
- Constraints faced: 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 and other animal attack.

Yield gap of cassava, taro and elephant yam in Kerala

Name of the crop	Yield as per on-station experiment (kg/ha)	Mean yield at farmers field (kg/ha)	Yield gap (%)
Cassava	24926	27777	No yield gap (higher by +11.44%)
Taro	8288	10300	No yield gap (higher by +24.28%)
Elephant foot yam	39556	28085	-29%



Glimpses of the survey

Udaipur

Total 45 farmers from different villages, practicing organic farming in 02 villages i.e. Kanooj and Sukhwada of Bhadesar block of Chhitorgarh district were surveyed. The highlights of the Geo-referenced on-farm characterisation of organic growers of Rajasthan are as follows:

- Average land holding size is 1.79 ha.
- Average land holding size under organic farming is 0.85 ha.
- Average number of animals per household is 7.

- Average vermicompost production is 1.5 tonne per year.
- Crop residues available for recycling are 4.56 ton/household.
- Majority of farmers grow maize in *kharif* and wheat in *Rabi*.
- Average yield of maize is 21.4 q/ha and average yield of wheat is 29.4 q/ha.
- Fruit and vegetables were grown organically for home consumption.
- On average, 7.69 ton/ha organic manure in *Kharif* and 3.41 tone/ha during *Rabi* were used.
- Use of neem leaves, Dashparni, NSKE and Go mutrawere used for plant protection in crops, fruit and vegetables.
- For weed management during *Kharif* & *Rabi* season, hand weeding, weed hoe and weeder is used.
- On average 23 man-days during *kharif* and 18 man-days during *rabi* were used in weeding.
- No assured market and lack of premium price for organic product, labour intensive and costly weed management, low yield of crops, lack of technical knowledge, poor mechanization and lack of availability of large quantity of organic inputs from small land holding are major constraints faced by organic farmers.
- Farmers produce the crops and vegetables without use of fertilizers and pesticides are associated with NGOs and SHGs.
- Farmers get training from NGOs/SHGs & also sale the produce to these organisations as well as nearby market at Udaipur



Farmers showing maize crops



Azolla production

Geo-referenced on-farm characterization Survey of organic growers in Rajasthan at Kanooj, Bhadesar, Chittorgarh villages



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	1. Supply of 100% nutrients through organic sources and complete organic management
		2. 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)	3. 100% inorganic nutrients and management
		4. Either state recommendation or farmers package (Choice to centres)
	Integrated management	5. 50% organic + 50% inorganic source of nutrients and management
		6. 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, Coimbatore and SK Nagar) 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
	<i>Sesbanniarostrata</i>	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



Centre	Nutrient Sources	NPK contents on dry weight basis (%)		
		N	P	K
	Vermi-compost	0.76	0.88	0.65
	Green leaf manure	2.02	0.16	1.10
	Rajphos	-	18.5	-
	Urea	46	-	-
	MOP	-	-	58
Coimbatore	Vermi-compost	-	-	-
	Neem cake	-	-	-
	<i>Sesbania</i> rostrata	-	-	-
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
	<i>Glyricidia</i> (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
	<i>Glyricidia</i> 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
	<i>Sesbania</i>	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	
	MOP			60.0

Centre	Nutrient Sources	NPK contents on dry weight basis (%)		
		N	P	K
Umiam	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
SardarKrushinagar	-	-	-	-
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

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 in vegetable-based cropping systems for comparative efficiency of organic, inorganic and integrated management, the performance of french bean & lady finger (*kharif*), tomato & summer squash (summer) were found to be better under integrated production systems (towards organic) however, cauliflower in *rabi* and summer french bean performed better under inorganic with state recommended package. The yield of pea (7780 kg/ha) was maximum under organic production system with innovative practice (application of 75% organic + 25% organic supplemented through 10% vermi-wash). Under integrated production system, yield was increase over inorganic and organic management to the tune of 29.7 & 7.4, 60.0 & 11.7, 48.4 & 32.1, and 48 & 11.6% in french bean, tomato, summer squash and lady finger respectively. In case of pea, it was increase 68.4% under organic with 100% nutrient supplied through organic sources over inorganic. In terms of system equivalent yield (cauliflower equivalent), black gram-cauliflower-summer squash resulted in higher cauliflower equivalent yield (25080 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 (20945 kg/ha) followed by application of 75% nutrients only through organic manures+ 25% nutrient supply through inorganic sources (20430kg/ha). Cauliflower equivalent yield was increased to the tune of 56.6 and 45.9% respectively with and organic compared to inorganic nutrient management.



Best performing production system (black gram-cauliflower-summer squash) at Bajaura

Bhopal: Higher mean yield of soybean (1548 kg/ha) was recorded under integrated with application of 75% organic nutrients +25% inorganic nutrients followed by 100% organic management practice followed (1498 kg/ha). The yield of soybean was found to be higher with integrated followed by organic by 18.3 and 14.5% compared to inorganic package respectively. *Rabi* crops such as, wheat, mustard, chickpea and linseed also followed the same trends and recorded maximum yield under integrated management with (75% organic nutrients supplied through organic source + 25% inorganic nutrients) of 3990, 1680, 1627 and 1916 kg/ha respectively and increased by 28.6, 22.4, 23, and 19.2% for *durum* wheat, mustard, chickpea and linseed respectively over inorganic. In terms of system equivalent yield (soybean equivalent), towards organic, integrated management with 75% organic+ 25% inorganic nutrients through organic and inorganic sources registered higher equivalent yield (3770 kg/ha) followed by organic production package (3594 kg/ha) and difference between both the production system was 4.9% whereas 21% SEY was found to be higher compared to inorganic production package. Among the cropping systems, soybean-linseed recorded higher soybean equivalent yield (3865 kg/ha) followed by soybean-chickpea (3343 kg/ha).



Performance of soybean crop under organic package



Performance of mustard crop under organic package



Performance of linseed crop under integrated package



Performance of chickpea crop under integrated package

Calicut: Among the different management packages, organic package consisting of 100% nutrient supply through organic manure recorded higher yield of turmeric (13900 kg/ha) and black pepper (2.10 (fresh yield g/plant) followed by integrated (50:50% each nutrient supply through organic manure and inorganic). There is 8% difference was found in yield of turmeric among production system.

Coimbatore: Among the management practices, crops brinjal, and barnyard millet recorded maximum yield under inorganic management practice with state recommendation of 24556 and 1886 kg/ha respectively. There is marginal reduction in yield of brinjal and barnyard millet (2.46 and 3.57% respectively) with organic compared to inorganic. Chilli, tomato, pearl millet, finger millet (13052, 13914, 1799 and 2790 kg/ha respectively) registered higher yield towards organic under integrated management practice either with 50:50% each organic + inorganic nutrient or 75% nutrients through organic manures + 25% through inorganic source. The yield was increased significantly by 39, 87.4, 27.7 and 28.8% over inorganic while 38.8, 52.1, 12.8 and 19.8 was increased over organic respectively.

Dharwad: Crops such as green gram, soybean and groundnut was taken as intercrop with pigeon pea and cotton. Main and intercrop yield was converted into equivalent yield in term of pigeon pea equivalent. Among different combinations of intercropping system, significantly higher pigeon pea seed equivalent yield was recorded under inorganic management package with state recommendation package (1348 kg/ha) in pigeon pea + green gram inter cropping system and closely followed by 100% organic treatment (1331 kg/ha) and was on par with 75% organic + innovative practice (1301 kg/ha) and 75% organic + 25% inorganic treatment (1214 kg/ha).

Jabalpur: Basmati rice based cropping systems with wheat (*durum*), chickpea, maize (fodder), berseem (seed and fodder), vegetable pea and sorghum (fodder) was evaluated. Mean grain yield of basmati rice in *kharif* and yield of other crops during *rabi* and summer as influenced by different nutrient management was recorded higher with inorganic production system. Significant reduction in yield of basmati rice with organic was recorded to the tune of 89.6% compared to inorganic. The reduction in the yield of wheat, chickpea, and vegetable pea was also found by 39.6, 43.6 and 5.3% as compared to inorganic production package. Berseem seed & fodder (33 & 11.6%), maize fodder (12.8%) and sorghum fodder (31.4%) with 100% organic management package was recorded lower yield against inorganic production package. Total mean productivity of cropping system in terms of basmati rice equivalent was recorded higher with 100% inorganic nutrient management (10561 kg/ha) followed by organic (8661 kg/ha) among the production packages. Among crop-sequences, basmati rice- berseem seed and fodder led to record maximum basmati rice equivalent yields (9429 kg/ha) followed by Basmati rice – vegetable pea-sorghum (fodder) of 9260 kg/ha.

Karjat: The rice-based cropping systems including vegetable crops were evaluated. Higher mean yield of rice (3120 kg/ha) was recorded with application of 50% each organic and inorganic nutrient under integrated package and being on par with organic and inorganic. Chickpea, field bean and onion also resulted good yield with integrated package and found to be higher by 24, 4.5 and 21.1% over inorganic respectively. Brinjal resulted in higher yield with inorganic package (47341 kg/ha) followed by organic and integrated. Reduction in yield of brinjal with organic found to be 10.7% compared to inorganic. System productivity in term of rice equivalent yield, rice- brinjal system produced maximum rice equivalent yield (47765 kg/ha) compared to other cropping systems. Among the management package, organic management with 100% nutrient supply through organic sources recorded 23.5 and 20.1% higher over inorganic and integrated package.

Ludhiana: Mean yield of basmati rice (4070 kg/ha) was recorded under inorganic with state recommendation closely followed by integrated nutrient management with application of 50% each organic and inorganic nutrient (40750 kg/ha) whereas soybean was recorded higher yield of 1120 kg/ha under organic package with application of 100% organic manure and 75% N equivalent by organic manure + innovative practice. Chickpea also recorded maximum yield (1350 kg/ha) with 75% organic + Innovative organic practices under organic practice. Wheat (5750 kg/ha) performed better under inorganic practice followed by integrated. In term of system productivity among the management practices, wheat equivalent yield resulted in higher either under organic with 75% organic + innovative practice of 10100 kg/ha. Among the cropping systems, it was higher in basmati rice-wheat-green manure of 10350 kg/ha.

Modipuram: Among the different crop management practices, highest yield of basmati rice (4272 kg/ha) recorded under organic production package which was 15.8% higher over inorganic. Coarse rice, barley, potato and mustard recorded maximum yield under integrated with 50% each nutrient supplied through organic and inorganic source of 4775, 3583, 23682 and 2067 kg/ha respectively. Yield difference from integrated to inorganic and organic found to be by 15.7, 13.1, 5.3 & 2% and 28.6, 24.2, 32.2 & 7.8% for Coarse rice, barley, potato and mustard. Systems productivity among the various systems, maize-potato-okra-sesbania recorded higher rice equivalent yield of 12388 kg/ha because of higher yield of potato and good premium price followed by basmati rice-wheat-green manure of 11107 kg/ha. Among the various production package, systems productivity was highest with organic either in 100% or 75% organic +innovative practice.

Pantnagar: Among the crops evaluated under basmati rice-based cropping systems, the performance of basmati rice, wheat, and potato were found to be better under integrated production systems (towards organic) along with equivalent yield of chickpea + coriander and vegetable pea+ coriander. Yield of basmati rice (mean yield 5439) during *kharif* was recorded higher marginally 2% only with integrated over inorganic while 7% over organic. During *rabi*, wheat recorded higher yield also under integrated package (4270 kg/ha) and the yield difference between integrated and inorganic found to be significantly by 15.8%. 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. Maximum chickpea & vegetable pea equivalent yield (3588, 8088 kg/ha) and potato tuber yield (9641kg/ha) were recorded highest in integrated (50% each nutrient organic and inorganic). Tuber yield of potato increase by 9.3% over inorganic and 37.2% over organic package. System productivity in terms of basmati rice equivalent yield recorded higher in integrated package (10149 kg/ha) having 50% nutrients through organic manures and 50% nutrients through inorganic sources. SEY was increased by 5.6% over inorganic. Among all the cropping systems, higher system productivity was recorded with basmati rice-vegetable pea +coriander-sesbania system (14324 kg/ha) followed by basmati rice-potato (80258 kg/ha).



Performance of basmati rice and vegetable pea at Pantnagar

Raipur: Soybean based cropping systems were evaluated with maize, pea, chilli, and onion under different package of practice. Organic production system with 75% organic + innovative practice (foliar spray of vermin-wash (10%) followed by cow urine (10%) resulted in higher soybean and maize sweet corn yield (2071 and 16885 kg/ha respectively) which was on par with state recommendation package (2053 kg/ha). Other crops such as chilli and onion (6695 and 16857 kg/ha respectively) resulted higher yield under inorganic practices (state recommendation) while, garden pea yield recorded higher with integrated 50% organic and 50% inorganic nutrient through organic and inorganic sources of 8404 kg/ha. Yield reduction in chilli and onion with organic was found to be 36.3 and 14.5% respectively in compared to inorganic. The productivity of cropping system in term of soybean equivalent yield recorded higher under organic management with 75% organic manure + innovative practices (7786kg/ha) and it was increased by 14.1% over inorganic. Soybean-maize (sweet corn) cropping system registered higher soybean equivalent yield (7877 kg/ha) followed by soybean-onion (7540 kg/ha).

Ranchi: Rice based cropping systems were evaluated wherein different crops such as wheat, onion, potato and okra were grown with basmati rice variety Birsamati. Organic management practice either with 100% organic manure or 75% organic manure +innovative practice "Azolla") resulted in higher mean yield of rice (3548 and 3731 kg/ha respectively). Under organic

production system the yield was increased by 20 and 26% respectively than inorganic. Other crops like onion and potato during *rabi* recorded higher yield with organic package. The yield of onion and potato was increased with organic to the tune of 10.6 and 116.5% respectively over inorganic package. Wheat recorded highest yield (2888 kg/ha) under inorganic package and found to be decrease by 12.2% with organic package (100% organic manure). Okra resulted in higher yield (9363 kg/ha) in integrated package with 75% nutrients through organic source+25% inorganic fertilizer and found to be higher by 7.6% over



Rice under 100% organic



Rice-75% organic + innovative practices



Wheat crop under inorganic condition



Wheat under integrated (50% organic+50% inorganic)



Onion under organic



Onion under integrated



Potato under organic condition at Ranchi

organic and 9.5% over inorganic. In case of systems equivalent yield, production package 100% organic found to be higher (11085 kg/ha) among the management practice. Among the cropping systems, rice-potato recorded highest system equivalent yield (11884 kg/ha) followed by rice-onion (11106 kg/ha).

Umiam: Four vegetable-based cropping system namely broccoli-carrot, broccoli -potato, broccoli -french bean, broccoli -tomato were grown on raised beds and four rice varieties Megha Aromatic 2, Shahsarang-1, Ngoba, Lampnah taken on sunken beds 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 undertaken to carry out the experiment. Among the management packages, 100% organic package recorded maximum broccoli yield 13620 kg/ha but been on par with integrated of 13360 kg/ha and inorganic 13085 kg/ha. Difference between organic and inorganic was only 4.1%. Among the cropping systems mean yield of broccoli was recorded higher in was recorded with broccoli-French bean cropping system (14820 kg/ha) followed by broccoli -potato (13550 kg/ha). Other vegetable crops viz. carrot and tomato recorded maximum yield under organic package with 16150 and 15600 kg/ha respectively, whereas potato and frenchbean recorded highest under integrated of 19050 and 6520 kg/ha respectively. Vegetable crops, carrot potato, frenchbean and tomato recorded their yield by 14.9, 15.1, 20.8 and 19.4% higher with either by following the organic management practice or with integrated over inorganic package.



Different crops grown on raised and sunken beds at Umiam, Meghalaya

Ajmer: Seed spices coriander and fennel in *rabi* was evaluated with green gram and cluster bean (*khariif*) 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, cluster bean, fennel and coriander were higher by 17.1, 22.4, 20.2 and 37.1% respectively over inorganic whereas, it was higher by 12.2, 17.0, 17.3 and 22.2% respectively over organic production package.



Performance of green gram, cluster bean, coriander and fennel crops towards organic (75% organic +25% inorganic) at Ajmer



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/ Treatments	Organic						Inorganic						Integrated					
	100% organic			75% organic + innovtive 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																		
Frenchbean-cauliflower-frenchbean	4880	7020	4860	4530	6730	4630	4040	4330	4090	5110	9800	5680	5240	9100	5510	5100	9440	5020
Fallow-cauliflower -tomato	-	8780	11480	-	7470	10110	-	5420	8000	-	1060	11690	-	1110	12830	-	9330	11760
Black gram-cauliflower - summer squash	764	7890	8490	752	6980	8070	560	4400	7560	800	6090	8560	791	6300	10200	772	6870	11220
Lady finger-pea	6130	7780		5950	6800		4620	3890		6490	6180		6560	7290		6840	6940	
mean	3925	7868	8277	3744	6995	7603	3073	4510	6550	4133	5783	8643	4197	5950	9513	4237	8145	9333
Bhopal																		
Soybean-durum wheat	1520	3757		1407	3310		1307	3103		1320	3093		1480	3687		1617	3990	
Soybean-mustard	1490	1550		1417	1430		1303	1373		1357	1377		1430	1587		1503	1680	
Soybean- chickpea	1493	1534		1383	1413		1340	1323		1353	1342		1457	1493		1557	1627	
Soybean- linseed	1490	1839		1400	1753		1283	1607		1300	1626		1450	1782		1517	1916	
Mean (Soybean)	1498			1402			1308			1333			1454			1548		
Calicut																		
Turmeric	32800			29300			26000						30200			28600		
Black pepper (Fresh yield g/pl)	2.10						1.40						1.80					
Coimbatore																		
Brinjal - pear millet - green manure	23967	1595		23622	1662		23533	1478		24556	1622		23289	1725		23056	1799	
Chillies - barnyard millet - green manure	9504	1427		10237	1821		9393	1341		10978	1886		13052	1480		12296	1529	
Tomato - finger millet - green manure	8673	2329		10332	2658		7041	2166		7639	2482		13027	2496		13914	2790	
Dharwad (Pigeon pea equivalent yield)																		
Pigeonpea + greengram	1331			1301			1118			1348			1138			1214		

Locations/ Treatments	Organic						Inorganic						Integrated					
	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
Pigeonpea + soybean	1040			925			899			1088			909			919		
Pigeonpea + groundnut	1924			1847			1723			2009			1765			1805		
Cotton + greengram	1048			921			866			1194			1027			940		
Cotton + soybean	1078			990			947			1159			1019			1017		
Jabalpur																		
Basmati rice-wheat (durum) -green manure	2811	4056		2711	3012		5221	5663		5422	2651		3012	4016		3615	3868	
Basmati rice-chickpea - maize fodder	3213	1004	32692	2611	863	30089	5422	1446	36896	5020	1265	32491	4016	1305	33093	4217	1165	32892
Basmati rice-berseem (Seed and fodder)	2611	121+6040		2410	118+55800		5823	161+67400		4819	157+61800		3414	144+63400		4619	140+62000	
Basmati rice-vegetable pea- sorghum (fodder)	3012	5341	36306	2811	4904	32491	5623	5623	47712	4418	3213	36105	3715	5419	46707	3213	5050	45507
Mean (Basmati rice)	2912			2636			5522			4920			3539			3916		
Karjat																		
Rice-brinjal	3352	42290		2690	38225		3330	47341		2802	33216		3368	43421		3107	41886	
Rice-chickpea	2613	1325		2291	1135		2698	1155		2513	997		2682	1432		2431	1409	
Rice-field bean	2995	924		2610	773		3019	886		2768	731		3094	926		2658	830	
Rice-onion (White)	3147	14407		2754	9352		3158	12707		2868	9202		3334	15388		3013	11097	
Mean (Rice)	3027			2586			3051			2738			3120			2802		
Ludhiana																		
Basmati rice-chickpea-GM	3820	1310		3970	1350		4070	740		4120	800		3950	1180		4160	1210	
Basmati rice-wheat-GM	3690	4020		3860	3960		3910	4840		4020	4900		4000	4620		3940	4700	
Moong (kharif)-wheat -summer moong	820	5350		790	5180		660	5690		640	5750		780	5700		850	5610	
Soybean -wheat	1080	4480		1120	4430		790	5280		760	5060		1070	4970		1040	4830	



Locations/ Treatments	Organic						Inorganic						Integrated					
	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
Modipuram																		
Basmati rice– wheat (durum) - sesbania green manure	4272	4099		3715	3800		3689	4550		3912	4902		4055	4833		3846	4250	
Rice– barley (malt) – green gram	3713	2883	527	3488	2500	478	4125	3167	435	4550	3417	456	4775	3583	498	3788	3333	495
Maize (pop corn) – potato– okra - sesbania green manure	-	17918	3667		14458	3333		22496	3167		22973	3083		23682	2833		18851	3000
Maize (sweet corn) – mustard - Sesbania green manure	-	1917			1762			2028			1855			2067			1938	
Pantnagar																		
Basmati rice-wheat	4742	3307		4490	2967		5039	3685		5409	3412		5424	4270		5483	3976	
Basmati rice -chickpea (4rows+2rows coriander)	5283	3011+892		4416	3039+900		5609	3651+865		5520	3440+815		5765	3588+850		4935	3517+833	
Basmati rice -vegetable pea (4 rows vegetable pea +2 rows coriander)	5039	8246 (6286+905)		4364	7699 (5857+850)		5076	7212 (5000+817)		5417	6979 (4786+810)		5217	8088 (5786+850)		5291	8062 (5714+867)	
Basmati rice -potato	5246	7026		5017	6872		5580	8821		4868	8359		5350	9641		5091	8923	
Mean (Basmati rice)	5078			4572			5326			5304			5439			5200		
Raipur																		
Soybean-maize (Sweet corn)	1954	15312		2168	16885		1842	15346		2005	16345		1990	12107		1963	13246	
Soybean-garden pea	1986	5998		2204	7792		1963	4785		2178	5526		2074	8404		2174	7843	
Soybean-chilli	1990	4265		1978	5557		1993	6089		1971	6695		2041	3627		1963	5408	
Soybean-onion	1951	14407		1934	15371		2023	14179		2059	16857		1897	13975		1842	13422	
Mean (Soybean)	1970			2071			1955			2053			2001			1986		
Ranchi																		
Rice -wheat	3521	2536		3679	2481		3047	2888		2683	2278		3350	2764		3512	2658	

Locations/ Treatments	Organic						Inorganic						Integrated					
	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
Rice-onion	3608	15587		3832	14103		2964	14087		2588	11061		3108	15108		3398	15492	
Rice-potato	3513	21178		3598	17549		2909	9781		2909	8579		3264	16484		3349	20246	
Rice-okra	3548	8702		3816	7393		2918	8549		2918	5138		3262	8831		3051	9363	
Mean (Rice)	3548			3731			2960			2775			3246			3328		
Uniam																		
Vegetable-vegetable systems on raised bed																		
Broccoli -carrot	12450	16150		11070	14920		12500	14050					11650	15340				
Broccoli - potato	13480	18400		12500	16930		13900	15770					14300	19050				
Broccoli -french bean	15800	6130		14740	5830		13790	5460					14960	6520				
Broccoli -tomato	12750	14450		12910	15600		12150	13550					12530	14150				
Mean (Broccoli)	13620			12805			13085						13360					
Centres started from 2015-16																		
Ajmer																		
Green gram – fennel	591	1850		592	1871		566	1806		653	2096		593	1919		663	2171	
Green gram - coriander	591	620		592	640		566	553		653	701		593	602		663	758	
Cluster bean - fennel	1203	1850		1182	1871		1149	1806		1331	2096		1198	1919		1407	2171	
Cluster bean – coriander	1203	620		1182	640		1149	553		1331	701		1198	602		1407	758	
Gangtok																		
Maize + ginger (1:1) – french bean	3130+	6040		2990+	5480					2690+	3510		2900+	5200				
	7230			6800						3890			6240					
Maize + soybean (1:1) – buckwheat	3290+	1360		3120+	1300					2760+	780		2960+	1190				
	1730			1600						830			1440					
Maize + turmeric (1:1) – rajmash	3050+	1410		2970+	1140					2680+	440		2810+	850				
	13330			11780						6950			10530					
Maize + black gram (Pahenlo Dal)–toria	3070+	1080		2960+	850					2700+	430		2900+	660				
	980			960						460			790					
Narendrapur																		
Basmati rice –broccoli – sesbania green manure	2467	1643		2516	1610		2440	1499		2401	1561		2578	1599		2419	1520	



Locations/ Treatments	Organic						Inorganic						Integrated					
	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
Paddy– mustard– green gram	5654	1609	-	5678	1604	-	5220	1593	-	5262	1598	-	5712	1595	-	5698	1603	-
Paddy – frenchbean – green gram	5554	6588	-	5578	6600	-	5243	6100	-	5268	6145	-	5742	6445	-	5648	6047	-
Paddy –vegetable pea – sesame	5820	2667	-	5878	3000	-	5443	2250	-	5468	2417	-	5842	2583	-	5748	2333	-
Sardarkrushinagar																		
Groundnut- Wheat- Green gram	2083	3472	722	1667	3250	564	1986	3444	667	2569	4056	800	2361	3694	767	1611	2917	500
Greengram- Coriander - Vegetable cowpea	653	1208	4328	625	925	3561	644	1019	4061	825	1681	4614	753	1453	4317	558	944	3858
Greengram-Fennel	678	869		531	697		619	800		736	1147		694	978		606	778	
Thiruvananthapuram																		
Cassava-veg. cowpea	21200	469		22400	773		21250	177		21370	283		20450	376		16870	254	
Cassava-groundnut	21200	2805		22400	3180		21250	2428		21370	2281		20450	2415		16870	2232	
Taro-greengram	7270	350		7810	250		4622	360		4020	329		4590	180		4120	393	
Taro-blackgram	7270	473		7810	370		4622	237		4020	403		4590	368		4120	343	
Udaipur																		
Maize + blackgram (2:2)–wheat (<i>durum</i>) –sesbania (GM)	2143	3830		2214	3700		2429	3925		2357	4050		2286	3460		2179	3600	
	+157			+171			+214			+207			+193			+179		
Blackgram–wheat (<i>Triticum aestivum</i>)	364	3820		379	3650		457	3900		443	3980		393	3450		386	3500	
Sweet corn + blackgram (2:2)– chickpea	2000	880		2071+	820		2643+	930		2571+	970		2429+	730		2286+	770	
	+164			179			229			207			186			200		
Soybean – fenugreek	464	1770		486	1650		629	1790		607	1830		507	1440		529	1510	

Table 7.2.2: Influence of organic, inorganic and integrated packages on straw yield (kg ha⁻¹) of crops in cropping systems at various 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		
	Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer
Bajaura																		
Frenchbean-cauliflower-frenchbean	1460	5620	1530	1450	5580	1510	1330	2260	1300	1520	6000	1580	1550	6250	1580	1500	6040	1550
Fallow-cauliflower-tomato		5540	2670		5590	2410		2500	1930		6940	2600		7090	2710		6600	2580
Black gram-cauliflower-summer squash	1530	5250		1550	5600		1400	2000		1620	4360		1680	5910		1650	5650	
Lady finger-pea	2140	1900		2100	1810		1740	1440		2200	1850		2250	1800		2180	1730	
Bhopal																		
Soybean-durum wheat	4813	8710		4347	7777		4240	7557		4297	7327		4683	8663		4997	9187	
Soybean- mustard	4773	5323		4300	5220		4207	4707		4280	4733		4680	5767		4883	6367	
Soybean- chickpea	4773	5024		4233	4660		4240	4487		4263	4527		4727	4923		4920	5543	
Soybean- linseed	4840	5923		4323	5213		4153	4670		4207	4577		4758	5533		4870	6252	
Mean	4800			4301			4210			4262			4712			4918		
Coimbatore																		
Brinjal - pear millet - green manure	4720	19380		4670	19880		4620	18460		4820	18680		4870	18230		5170	18540	
Chillies - barnyard millet - green manure		2920	20750		3070	19550		2860	18950		3160	19150		2900	19300		2950	20250
Tomato - finger millet - green manure	8673	7260	19100	10332	7320	19550	7041	6850	18700	7639	7050	18950	13027	7150	19550	13914	7650	19000
Jabalpur																		
Basmati rice–durum wheat-green manure	3414	4819		2912	4820		4418	6587		4016	3374		4819	5422		3815	2952	
Basmati rice–chickpea - maize fodder	4217	3213		3815	2751		4418	3876		3815	3956		6426	3313		3615	3253	



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–berseem (fodder and seed)	3815			3213			5020			5221			5020			4016		
Basmati rice–vegetable pea-sorghum (fodder)	4016			3414			5422			4819			5321			3114		
Basmati rice Mean	3866			3339			4820			4468			5397			3640		
Ludhiana																		
Basmati rice-chickpea-GM	6760	2460		6820	2380		6920	1450		7070	1520		6850	2250		7000	2210	
Basmati rice-wheat-GM	6320	6340		6740	6300		6740	6880		6950	7010		6800	6840		6880	6880	
Kharif moong-wheat-summer moong	1410	7230		1320	7060		920	7450		950	7520		1350	7420		1160	7500	
Soybean -wheat	3810	6620		3980	6550		2860	7230		3120	7080		4100	7150		4050	6960	
Pantnagar																		
Basmati rice-wheat	5567	3583		4865	3382		5915	4503		6611	4005		6629	4992		6702	4668	
Basmati rice-chickpea (4rows+2rows coriander)	5724			5184			6367			5980			7046			5793		
Basmati rice-vegetable pea (4 rows vegetable pea + 2 rows coriander)	5459			5124			6204			6108			5883			5966		
Basmati rice -potato	5817			5657			6550			5743			5568			5976		
Basmati rice mean	5642			5208			6259			6111			6282			6109		
Ranchi																		
Rice -wheat	5366																	
Rice -onion	5179																	
Rice -potato	5378																	
Rice -okra	5103																	

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
	5490			5778			4965			4847			5178			5283		
Mean (Rice)							New centre started from 2015-16											
Sardarkrushinagar																		
Groundnut- Wheat- Green gram	3111	4028	1317	2778	3611	1139	2944	3972	1172	3861	4333	1506	3278	4083	1417	2694	3333	917
Greengram-Coriander- Vegetable cowpea	1208	1389	2528	1114	1278	2500	1125	1347	2611	1483	1722	3111	1372	1667	3056	1089	1347	2361
Greengram-Fennel- Fennel continue	1194	1278		1056	1167		1167	1250		1417	1583		1278	1417		944	1194	
Udaipur																		
Maize+blackgram (2:2)-durum wheat- sesbania (GM)	3571+	7029		3643+	6716		4000+	7176		3929+	7323		3857+	6348		3786+	6440	
	443			471			536			521			500			493		
Blackgram – wheat	950	7047		964	6808		1286	7222		1214	7452		1000	6366		1107	6624	
Sweet corn + blackgram (2:2) – chickpea	4143+	2244		4286+	2091		4929+	2372		4786+	2474		4571+	1862		4357+	1964	
	507			521			579			564			514					
Soybean - fenugreek	1271	3752		1371	3498		1729	3795		1679	3880		1529	3053		1421	3201	

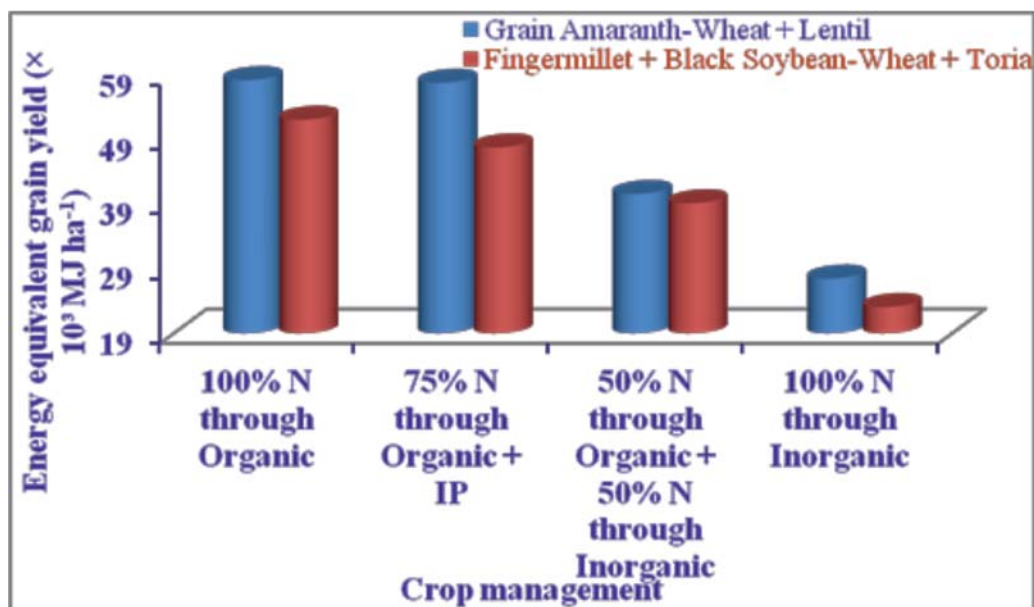


Table 7.2.3: Influence of organic, inorganic and integrated package on systems productivity (kg/ ha) at various locations

Locations/Treatments	Organic		Inorganic		Integrated (towards organic)		Mean
	100% organic	75% organic + innovative organic practices	100% inorganic	State recommen- dation	50% organic + 50% inorganic	75% organic+ 25% inorganic	
Bajuara (CEY)							
Frenchbean-cauliflower-frenchbean	19600	17440	14840	23760	23000	22510	20192
Fallow-cauliflower-tomato	17390	15050	11420	19370	20720	18150	17017
Black gram-cauliflower- summer squash	25080	23480	17170	23440	24020	25000	23032
Lady finger-pea	15950	14730	10050	14830	16040	16060	14610
Mean	19505	17675	13370	20350	20945	20430	
Bhopal (SEY)							
Soybean-durum wheat							3253
Soybean- mustard							3195
Soybean- chickpea							3343
Soybean- linseed							3865
Mean	3594	3334	3518	3770	3116	3153	
Dharwad (cot. EY)							
Pigeon pea + green gram	1331	1301	1118	1348	1138	1214	1242
Pigeon pea + soybean	1040	925	899	1088	909	919	963
Pigeon pea + groundnut	1924	1847	1723	2009	1765	1805	1846
Cotton + green gram	1048	921	866	1194	1027	940	999
Cotton + soybean	1078	990	947	1159	1019	1017	1035
Mean	1284	1197	1111	1360	1172	1179	
Jabalpur (REY)							
Basmati rice – wheat (durum) – green manure	8223	7116	9880	7707	6473	6617	7669
Basmati rice – chickpea – maize fodder	7951	6705	9665	8813	7896	7760	8132
Basmati rice-berseem (fodder and seed)	8439	7829	11554	10161	8769	9823	9429
Basmati rice – vegetable pea–sorghum (fodder)	10031	9192	11143	7924	9062	8210	9260
Mean	8661	7711	10561	8651	8050	8103	
Karjat (REY)							
Rice-brinjal	57053	51101	50613	36070	46786	44965	47765
Rice-chickpea	10268	8933	7715	6894	8780	8354	8491
Rice-field bean	11936	10153	9389	8020	9683	8614	9633
Rice-onion (White)	37886	25585	27169	20343	32329	24016	27888
Mean	29286	23943	23722	17832	24395	21487	
Ludhiana (WEY)							
Basmati rice-chickpea-GM	8700	11200	7600	7800	8900	8500	8783
Basmati rice-wheat-GM	9200	11700	10300	10500	10200	10200	10350
Cluster bean-wheat-summer moong	7700	9300	7600	7700	8100	8000	8067
Soybean -wheat	6600	8200	6800	6600	6800	7000	7000
Mean	8050	10100	8075	8150	8500	8425	
Modipuram							
Basmati rice– wheat (durum) - sesbania green manure	10467	9352	10110	10803	10935	10017	10281

Locations/Treatments	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% inorganic	State recommendation	50% organic + 50% inorganic	75% organic+ 25% inorganic	
Rice- barley (malt) – green gram	10928	9127	12533	12674	12780	10788	11472
Maize (popcorn) – potato– okra + <i>sesbania</i> green manure	8182	7445	8475	9192	9720	8511	8588
Maize (sweet corn) – mustard - <i>sesbania</i> green manure	5841	4295	4945	4523	5039	4726	4895
Mean	8855	7555	9016	9298	9619	8511	
Pantnagar							
Basmati rice-wheat	7289	6775	7876	8036	8712	8545	7872
Basmati rice -chickpea (4rows+2rows coriander)	7602	6756	8421	8169	8527	7643	7853
Basmati rice -vegetable pea (4 rows vegetable pea+2 rows coriander)	14934	13603	13730	13791	14922	14965	14324
Basmati rice -potato	8057	7765	8402	7543	8435	7946	8025
Mean	9471	8725	9607	9385	10149	9775	
Raipur							
Soybean-maize (Sweet corn)	8672	8924	7796	8354	6680	6835	7877
Soybean-garden pea	6154	6834	5335	5751	5696	5430	5867
Soybean-chilli	6819	7233	6622	6973	5866	6157	6612
Soybean-onion	7870	8151	7522	8181	6603	6915	7540
Mean	7379	7786	6819	7315	6211	6334	
Ranchi							
Rice -wheat	6188	6288	6084	5078	6256	6307	6034
Rice -onion	12207	11613	10736	8690	11443	11945	11106
Rice -potato	15197	13280	8305	7642	12358	14519	11884
Rice -okra	10749	9851	9993	7170	10570	10799	9855
Mean (Rice)	11085	10258	8780	7145	10157	10893	
Gangtok							
Maize + ginger (1:1)–french bean	1260	1160		1090	7180		2673
Maize + soybean (1:1) – buckwheat	6190	5790		5250	3200		5108
Maize + turmeric (1:1) – rajmash	1230	1040		8660	5230		4040
Maize + pigeon pea (2:1)	9180	8180		6580	4010		6988
Mean	4465	4043		5395	4905		4702
Sardar Krushinagar							
Groundnut- wheat- green gram	5729	4812	4479	5535	5107	3646	4885
Greengram- cumin- vegetable cowpea	4401	3698	3273	4314	3909	3021	3769
Greengram-fennel- fflow	2009	1599	1497	1938	1741	1446	1705
Mean	4046	3370	3083	3929	3586	2704	
Udaipur							
Maize + blackgram (2:2)–wheat (<i>durum</i>)– <i>sesbania</i> (GM)	8959	8916	9732	9810	8748	8770	9156
Blackgram – wheat (<i>Triticum aestivum</i>)	8043	7868	8723	8760	7647	7681	8120
Sweet corn + blackgram (2:2)–chickpea	7919	7947	9757	9619	8404	8338	8664
Soybean – fenugreek	6486	6180	6962	7028	5659	5815	6355
Mean	7852	7728	8794	8804	7615	7651	

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 farmyard manure produced highest energy equivalent grain yield of 52019 and 58155 MJ/ha for finger millet + black soybean-wheat + toria and grain amaranth-wheat + lentil, respectively. The highest yielding treatment recorded 126 and 112% higher energy equivalent grain yield of finger millet + black soybean-wheat + toria and grain amaranth-wheat + lentil, respectively compared to 100% inorganic package, respectively.



Energy equivalent grain yield in different crop management system at Almora

Gangtok: Among all the cropping systems, ginger, soybean, turmeric and black gram were taken as intercrop with maize in *pre kharif*. French bean, buckwheat raj mash and toria were grown in *rabi* season. Yield of maize with intercrops ginger, turmeric, soybean and black gram remarkably higher with organic package. Similarly, frenchbean, buckwheat and rajmash and toria were also recorded highest yield with organic (100% N equivalent though organics (25% FYM+25% VC+25% NK+25% MC). Significant higher maize yield (3.13 t/ha) was recorded under 100 % N equivalent through organics in maize + ginger – french bean cropping system with mean yield of 3125 kg/ha. Organic package resulted in 15.8% higher yield of maize as compared to inorganic. Likewise, ginger, soybean, turmeric and black gram gave 89.9, 108.4, 91.8 and 113% higher yield with organic over inorganic respectively. During *rabi* French bean, buckwheat, rajmash and toria recorded higher yield to the tune of 72.1, 74.4, 220.4 and 151.2% with organic over inorganic.

Narendrapur: Basmati rice and paddy (coarse grain) recorded higher yield under integrated (50% organic+50% inorganic) but was on par with organic nutrient package consisting of 75% organic+25% innovative practices. Yield of basmati rice and coarse rice was increased with integrated and organic by 4.8 and 7.7% respectively over inorganic. Other crops in the systems such as broccoli, mustard, french bean and vegetable pea resulted in higher yield also with organic package. The yield was increased by 9.6, 1.1, 8 and 8.5% with organic compared to inorganic.

Sardarkrushinagar: The general performance of groundnut and green gram during *kharif*, wheat, coriander, and fennel during *rabi* and vegetable cowpea during summer was found to be better under inorganic with state recommendation. Organic practices in groundnut, wheat, green gram, coriander, fennel and vegetable cowpea recorded yield drop to the tune of 18.9, 14.4, 20.8, 28.1, 24.2 and 6.2% respectively over inorganic practice. System equivalent yield (ground nut equivalent) of 4046 kg/ha was recorded highest under organic with application of 100% organic input among the production package which is 31.2% higher than inorganic. Among the cropping systems, ground nut-wheat-green gram resulted in higher ground nut equivalent yield of 4885 kg/ha which gave 29.6 and 186.5% higher than green gram- cumin- vegetable cowpea and green gram-fennel- fallow system respectively.



Wheat and coriander under organic with 75% organic input+25% innovative practice at SK Nagar

Thiruvananthapuram: Organic production package consisting of 75% organic + innovative practice found to be better for cassava and taro. Tuber yield of cassava and taro was higher by 5.4% & 69% than inorganic and 5.7 and 8.2% over organic package respectively. Likewise, vegetable cowpea and groundnut recorded maximum under organic with 75% organic + innovative practices whereas black gram recorded maximum yield (43 kg/ha) under organic practice. Green gram was higher in integrated package (430 kg/ha) which was 9.2 and 12.3% higher over inorganic and organic respectively.



Cassava



Taro



Cassava-vegetable cowpea



Cassava-ground nut



Taro-black gram



Taro-green gram

Udaipur: Yield of all crops in cropping systems as affected by organic, inorganic and integrated practices recorded higher with either by inorganic practices or state recommendation. Maize and sweet corn (2429 & 2643 kg/ha) with inter crop of black gram (229 kg/ha), sole black gram (457 kg/ha) and soybean (629 kg/ha) during *kharif* and wheat *durum* and *aestivum* (3925 & 3900 kg/ha), chickpea and fenugreek (930 & 1790 kg/ha) recorded maximum yield either in inorganic or in state recommendation practice. Reduction in yield of maize and sweet corn (11.8 & 24.3%), black gram sole (20.3%) soybean (26.2%), during *kharif* season and wheat *durum* and *aestivum* (5.4 & 4.0%), chickpea (9.3%) and fenugreek (3.3%) during *rabi* were observed with organic compared to inorganic. Total productivity among the management practices in term of maize equivalent yield, inorganic production system consisting state recommendation/farmers practice being the highest followed by organic. Out of four cropping systems, maize + black gram (2:2)–wheat (*durum*)–sesbania (GM) cropping system gave maximum maize equivalent yield of 9156 kg/ha.



75% organic+ 25% inorganic in maize + black gram



100% organic in sweet corn + black gram



75% organic + innovative practice in wheat (*Aestivum*)



75% organic + innovative practice in wheat (*Durum*)



100% organic practice in sole chickpea



100% organic in fenugreek



soybean under 75% organic+ 25% inorganic



black gram under 75% organic+ 25% inorganic

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 soil physical and available nutrient status (Table 7.2.4 -7.2.10)

Bajaura: pH, organic carbon, available N, P, K, Mn, Zn, Cu and Fe were estimated. The soil pH in different cropping systems as influenced by nutrient management was higher with integrated (7.20) and being on par with organic package whereas lower value of soil pH was recorded in inorganic management. Cropping systems and nutrient management package recorded soil organic carbon ranging from 0.84 as minimum under inorganic to 1.40% as maximum in organic management with 100% nutrients application through organic manures in frenchbean-cauliflower-frenchbean system. An increase in 66.6% in organic carbon was observed with organic over inorganic practice. Availability of residual N (261.2 kg/ha), phosphorus (77.7 kg/ha) and potassium (254.1 kg/ha) were higher with integrated followed by organic farming system. Among the cropping systems, french bean-cauliflower- frenchbean recorded maximum N availability in the soil whereas P and K was not differed due to the cropping systems. Available iron and zinc (16.1 and 3.69 ppm) were recorded higher 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 12.2 and 2.98 ppm. Available iron was found to be higher (18.2 ppm) at the end of black gram-cauliflower- summer squash whereas, manganese (13.1 ppm) was higher frenchbean-cauliflower-frenchbean, ladyfinger-pea recorded higher copper (3.95 ppm) among the cropping systems.

Bhopal: Physical and chemical properties of soil in term of pH, OC, available N, P, & K were estimated. Not much changes were observed among various input practice and cropping systems. Soil organic carbon was higher under organic (1.01%)



followed by 75% input through organic +innovative practice (0.96%) and integrated (75% organic input+25% inorganic) of 0.93%. An increase in organic carbon was found to be 44.3% with organic over inorganic. Available N, P and K were higher under organic management and found to be increase by N (7.4%), P (47.1%) and K (10.9%) compared to inorganic package.

Calicut: pH, OC, available N, P, & K were estimated. In ginger and black pepper, soil pH, organic carbon, nitrogen, phosphorus and potassium were higher under organic management practice. An increase in SOC, found to higher to the tune of 16.3% with organic over inorganic in ginger and black pepper respectively. The soil pH, organic carbon was significantly higher under organic management system in turmeric whereas phosphorous and potassium were higher under integrated management. Micronutrients such as iron, manganese and copper recorded higher under organic with either 100% input supply through organic (100% organic) or 75% organic +innovative practice in ginger, turmeric and black pepper.

Dharwad: Numerically similar value recorded for bulk density among various input practices and cropping system. Lower EC was recorded with organic management practice while, in case of pH it was higher (7.13) under inorganic practice. pH was lower under organic. (6.84). The organic carbon increased significantly from 6.0 g/kg with 100% inorganic to 6.42 g/kg with 100% organic and it was increased by 7.03%. Among the cropping systems, pigeon pea + groundnut recorded maximum SOC (6.47 g/kg). An increase of 4.0% was observed in available N under organic practice over inorganic while remarkable improvement in residual K (32%) was noticed. No significant variation in soil available N, P & K was observed among different cropping systems. Higher residual availability of Fe, Mn and Zn were observed under organic practice compared to inorganic and integrated whereas, Cu availability was higher under integrated practice. The cropping systems showed mixed influence on micronutrient status and did not influence Zn and Fe status. The cropping systems pigeon pea + groundnut registered higher availability of Cu and Mn compared to other systems.

Karjat: There was not any significant effect on pH and EC in soil due to input management practice as well as different cropping systems. Soil pH recorded in range between 6.57 to 6.70 while EC was in range from 0.337 to 0.343. Adoption of 100% organic package remained at par with 75% organic+ innovative organic practices and recorded higher SOC content in soil compared to inorganic which was improved to the tune of 9.3% over inorganic. Variation in soil available N, P and K was among different input packages were not influenced. Among the production packages, either organic or integrated packages registered higher residual N, P and K.

Ludhiana: Electrical conductivity, pH, soil organic carbon, soil available nitrogen, phosphorus and potassium were higher under organic management either with adoption of 100% organic input practice. Soil organic carbon found to be higher by 9.5% over integrated. Available N, P and K were also higher under organic management package and found to be higher by N (2.30), P (5.6%) and K (4.1%) than integrated package. 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.

Pant Nagar: Lower EC (0.27 dsm^{-1}) was recorded under inorganic package with State recommendation practice as compared with other packages. Basmati rice -chickpea (4rows+2rows coriander) system recorded lowest EC (0.31 dsm^{-1}). Soil pH varied from 6.20 to 7.60 across the various management options and cropping systems. At the end of cropping cycle, maximum soil organic carbon (0.73%) was recorded under 100% organic package followed by 75% organic +innovative input (0.71%). The significant improvement in soil organic carbon found to be 15.02 % with organic package over inorganic. Likewise, maximum available N, and P (161 and 23.9 kg/ha) in soil was recorded under organic management followed by integrated whereas, availability of K was higher with 75% organic +25% inorganic package. Availability of iron (30.7 ppm) and was higher under 100% organic. However, the availability of Zn and Mn were at par. Among the cropping systems, the availability of zinc was maximum Basmati rice -potato system (0.98 ppm, whereas higher availability of copper (2.97 ppm) was found under Basmati rice-wheat system.

Raipur: Soil organic carbon, available N, P and K were estimated. Soil organic carbon content varied from 0.72 to 0.77% after end of cropping cycle. Organic carbon content was similar among the nutrients input package and not remarkable difference was noticed; it was recorded slightly higher with organic and styate recommendation (0.76) . As regards to cropping system no significant variation in soil carbon was noticed among different soybean-based cropping system. The available N, P and K content of soil was affected due to nutrient management practices. Farmers practice package (100% inorganic + 5 t FYM) recorded higher N, P and K content in soil followed by 100% organic nutrient management practices.

Ranchi: Higher pH, organic carbon, available N and K were recorded with 100% organic followed by 75% organic + innovative practices however available P was maximum with inorganic nutrient management. About 90% remarkable improvement in soil organic carbon with organic package was observed however under integrated an increase of about 47.5% was noticed compared to inorganic.

Ajmer: Soil nutrient status after completion of crop Coriander was greatly influenced by different input management and the maximum value of organic carbon (0.328 %), N (165.4 kg/ha), P (24.6 kg/ha) were recorded under 100 % Organic package followed by 75 % Organic + innovative practices however maximum K value is found (341.7 kg/ha) 75 % Organic + innovative practices. Likewise, Soil nutrient status in of Green gram fennel crop system, OC, N, P and K was also influenced by different input management and the maximum value organic carbon (0.33%), N (169.7 kg/ha) and P (25.4 kg/ha) was recorded under 100 % Organic followed by 75 % Organic + innovative practices whereas maximum K value (334.2 kg/ha) is observed under integrated with 75% Organic + 25% Inorganic.

Sardarkrushinagar: In general, bulk density varies from 1.44 to 1.47 g/cc. Electrical conductivity was found higher under Green gram- Cumin- Vegetable cowpea. The pH status was improved due to the adoption of 75% organic+ 75% inorganic input. The pH content was higher in integrated practices (75% organic and 75% inorganic) all the four cropping systems whereas, organic carbon content was found higher under 100% organic practice. The electrical conductivity was within the safe limits due to the management practice and cropping systems. Available N, P and K status of the soil at the end of the various cropping systems was higher under 100% organic practice. Available Fe, Mn, Zn and Cu contents were higher under 100% organic practice. Zn and Cu content were higher under Groundnut- Wheat- Green gram system.

Thiruvananthapuram: In general, electrical conductivity varies from 0.68 to 1.08 ds/m. Electrical conductivity was found higher under Cassava-veg. cowpea. The pH and organic carbon status were improved due to the adoption of 100% organic input. The pH and organic carbon content were higher in 100% organic practice. The electrical conductivity was within the safe limits due to the management practice and cropping system.



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			Mean		
	100% organic	75% organic + innovative organic practices	100% organic + innovative organic practices	100% inorganic	State recommendation	50% inorganic + 50% organic	75% inorganic + 25% organic	100% inorganic	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic	Mean
Bhopal	-	-	-	-	-	-	-	0.30	0.29	0.28	0.30	0.30
Dharwad												
Pigeon pea + green gram	1.26	1.23	1.30	1.31	1.24	1.29	1.27	0.05	0.05	0.09	0.08	0.07
Pigeon pea + soybean	1.22	1.24	1.21	1.21	1.21	1.27	1.23	0.05	0.05	0.06	0.13	0.07
Pigeon pea + groundnut	1.29	1.26	1.28	1.28	1.29	1.31	1.29	0.08	0.08	0.07	0.10	0.08
Cotton + green gram	1.27	1.29	1.33	1.30	1.30	1.28	1.30	0.10	0.08	0.09	0.06	0.08
Cotton + soybean	1.29	1.23	1.32	1.32	1.29	1.18	1.27	0.07	0.08	0.11	0.12	0.09
Mean	1.27	1.25	1.29	1.28	1.27	1.27		0.07	0.07	0.08	0.09	0.07
Karjat	-	-	-	-	-	-	-	0.343	0.339	0.342	0.340	0.340
Ludhiana												
Basmati rice-chickpea-GM								0.28	0.25	0.21	0.23	0.23
Basmati rice-wheat-GM								0.28	0.27	0.22	0.24	0.25
Cluster bean-wheat-summer moong								0.34	0.34	0.22	0.22	0.28
Soybean-wheat								0.27	0.26	0.25	0.20	0.25
Mean								0.29	0.28	0.23	0.22	0.26
Pantnagar												
Basmati rice-wheat								0.34	0.36	0.29	0.28	0.33
Basmati rice-chickpea (4rows+2rows coriander)							0.30	0.32	0.27	0.25	0.37	0.31

Locations/Treatments	Bulk density (g/cc)						Soil EC (ds/m)					
	Organic		Inorganic		Integrated		Organic		Inorganic		Integrated	
	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												
Sardarkrushinagar												
Basmati rice -vegetable pea (4 rows vegetable pea + 2 rows coriander)							0.31	0.34	0.30	0.29	0.35	0.33
Mean												
Basmati rice -potato							0.39	0.30	0.26	0.24	0.36	0.37
Mean							0.34	0.33	0.28	0.27	0.37	0.34
Thiruvananthapuram												
Groundnut - Wheat- Green gram	1.44	1.43	1.49	1.46	1.44	1.44	0.14	0.14	0.14	0.14	0.14	0.14
Greengram- Cumin- Vegetable cowpea	1.45	1.45	1.48	1.48	1.43	1.45	0.15	0.15	0.15	0.15	0.14	0.14
Greengram-Fennel- Fennel cont.	1.44	1.45	1.47	1.48	1.47	1.47	0.14	0.14	0.13	0.13	0.14	0.15
Mean	1.44	1.44	1.48	1.47	1.45	1.45	0.14	0.14	0.14	0.14	0.14	0.14
Thiruvananthapuram												
Cassava-veg. cowpea							0.99	0.99	1.08	0.93	0.93	0.88
Cassava-groundnut							0.94	0.68	0.93	1.04	1.00	1.00
Taro-greengram							0.87	0.81	0.92	0.98	0.94	0.85
Taro-blackgram							0.84	0.85	0.88	0.91	0.89	0.88



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	Organic		Inorganic		Integrated (towards organic)		Mean
	100% organic + innovative organic practices	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														
Frenchbean-cauliflower-frenchbean	7.10	7.10	6.70	7.00	7.20	7.20	7.05	1.53	1.25	0.80	1.06	1.14	1.16	1.16
Fallow-cauliflower-tomato	7.10	7.20	6.80	7.00	7.10	7.20	7.07	1.33	1.26	0.84	1.05	1.20	1.15	1.14
Black gram-cauliflower-summer squash	7.20	7.20	6.70	6.90	7.20	7.20	7.07	1.38	1.29	0.85	1.10	1.15	1.21	1.16
Lady finger-pea	7.20	7.10	6.70	7.10	7.10	7.20	7.07	1.34	1.28	0.86	1.00	1.23	1.20	1.15
Mean	7.15	7.15	6.73	7.00	7.15	7.20	7.07	1.40	1.27	0.84	1.05	1.18	1.18	1.15
Bhopal	7.59	7.63	7.59	7.59	7.58	7.64	7.60	1.01	0.96	0.70	0.68	0.90	0.93	0.86
Calicut														
Ginger -fallow	5.79	5.39	4.68		5.07	5.37		2.91	3.04	2.18		2.98	2.52	
Turmeric-fallow	5.83	5.98	5.23		5.65	5.63		3.10	2.78	1.80		1.87	1.82	
Black pepper	5.53		4.81		5.24			3.58		3.08		3.27		
Dharwad														
Pigeon pea + green gram	6.89	7.13	7.11	7.15	6.92	6.83	7.01	6.40	6.40	5.70	6.19	6.40	5.97	6.18
Pigeon pea + soybean	6.95	6.94	7.08	7.00	7.04	6.78	6.97	6.44	6.30	6.04	6.24	6.07	6.59	6.28
Pigeon pea + groundnut	6.33	7.08	7.10	6.63	7.01	7.11	6.88	6.47	6.07	5.77	5.97	6.23	6.06	6.10
Cotton + green gram	6.93	7.00	7.12	7.11	7.17	7.04	7.06	6.37	6.29	6.17	6.13	6.20	6.01	6.20
Cotton + soybean	7.09	7.04	7.24	7.27	7.11	7.37	7.19	6.42	6.37	6.31	5.80	6.07	6.18	6.19
Mean	6.84	7.04	7.13	7.03	7.05	7.03		6.42	6.29	6.00	6.07	6.19	6.16	
Karjat	6.62	6.65	6.67	6.64	6.57	6.70	6.64	1.29	1.26	1.18	1.16	1.20	1.17	1.21
Ludhiana														
Basmati rice-chickpea-GM	7.40	7.20	7.20	7.30	7.30	7.30	7.28	0.55	0.53	0.48	0.45	0.53	0.51	0.51
Basmati rice-wheat-GM	7.70	7.40	7.40	7.10	7.30	7.40	7.38	0.67	0.67	0.49	0.47	0.56	0.59	0.58
Cluster bean-wheat-summer moong	7.20	7.20	7.50	7.40	7.40	7.20	7.32	0.62	0.62	0.44	0.42	0.58	0.59	0.55
Soybean -wheat	7.80	7.40	7.20	7.20	7.60	7.40	7.43	0.6	0.59	0.45	0.43	0.53	0.54	0.52
Mean	7.53	7.30	7.33	7.25	7.40	7.33		0.61	0.60	0.47	0.44	0.55	0.56	
Pantnagar														
Basmati rice-wheat	7.20	7.30	7.30	7.50	6.90	7.30	7.25	0.72	0.76	0.66	0.63	0.69	0.7	0.69

Locations/Treatments	pH				Organic carbon					
	Organic		Inorganic		Integrated (towards organic)		Mean		Organic	
	100% organic + innovative organic practices	75% organic + innovative organic practices	100% Inorganic	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic	Mean		100% organic	75% organic + innovative organic practices
Basmati rice -chickpea (4rows+2rows coriander)	6.90	7.00	7.60	7.30	6.70	7.00	7.08		0.69	0.68
									0.64	0.6
									0.67	0.69
Basmati rice -vegetable pea (4 rows vegetable pea + 2 rows coriander)	6.40	6.20	7.40	7.10	7.00	7.40	6.92	0.74	0.61	0.59
									0.68	0.66
Basmati rice -potato	6.60	6.30	7.20	7.20	7.20	6.30	6.80	0.76	0.62	0.63
Mean	6.78	6.70	7.38	7.28	6.95	7.00		0.73	0.63	0.61
Raipur										
Soybean-maize	-	-	-	-	-	-	-	0.77	0.72	0.76
									0.74	0.75
Soybean-pea	-	-	-	-	-	-	-	0.75	0.74	0.76
									0.75	0.75
Soybean-chilli	-	-	-	-	-	-	-	0.76	0.75	0.74
									0.74	0.75
Soybean-onion	-	-	-	-	-	-	-	0.75	0.72	0.77
									0.75	0.75
Mean	-	-	-	-	-	-	-	0.76	0.73	0.76
Ranchi	6.43	6.36	5.47	5.42	6.06	6.20	5.99	0.76	0.40	0.44
Ajmer										
Green gram – fennel								0.330	0.320	0.320
									0.290	0.300
Green gram - coriander								0.326	0.314	0.306
									0.279	0.298
Cluster bean - fennel								0.330	0.320	0.320
									0.290	0.300
Cluster bean – coriander								0.326	0.314	0.306
Mean								0.328	0.317	0.312
Sardarkrushinagar										
Groundnut- wheat- green gram	7.20	7.23	7.21	7.27	7.37	7.35	7.27	0.35	0.34	0.34
									0.24	0.24
Green gram- cumin- vegetable cowpea	7.21	7.17	7.36	7.20	7.30	7.31	7.26	0.31	0.30	0.29
									0.24	0.24
Green gram-fennel- fennel cont.	7.03	7.13	7.33	7.26	7.12	7.25	7.19	0.30	0.28	0.27
Mean	7.15	7.18	7.30	7.24	7.26	7.30		0.32	0.31	0.30
Thiruvananthapuram										
Cassava-veg. cowpea	4.78	4.95	3.80	3.86	3.99	4.37	4.29	1.02	1.17	1.02
									0.96	0.96
Cassava-groundnut	4.92	4.88	4.10	4.01	4.66	4.88	4.58	0.99	1.11	0.87
									0.90	0.90
Taro-green gram	4.85	5.15	3.92	4.28	4.41	4.64	4.54	1.26	1.17	0.93
									0.96	0.93
Taro-black gram	4.77	5.06	4.28	4.20	4.48	4.43	4.54	1.02	1.26	1.02
									1.05	1.02
Mean	4.83	5.01	4.03	4.09	4.39	4.58		1.07	1.18	0.95
									0.98	0.97



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

Locations/Treatments	Available Nitrogen (kg ha ⁻¹)						Mean
	Organic		Inorganic		Integrated (towards organic)		
	100% organic	75% organic + innovative organic practices	100% inorganic	State recommen- dation	50% organic + 50% inorganic	75% organic+ 25% inorganic	
Bajaura							
Frenchbean-cauliflower-frenchbean	261.2	259.8	236.5	255.2	258.6	259.9	255.2
Fallow-cauliflower-tomato	254.4	255.6	248.4	254.7	240.0	244.5	249.6
Black gram-cauliflower- summer squash	252.9	247.9	218.8	230.5	267.7	267.8	247.6
Lady finger-pea	270.5	265.4	237.6	243.0	278.0	272.5	261.2
Mean	259.8	257.2	235.3	245.9	261.1	261.2	
Bhopal							
Calicut							
Ginger-fallow	308.0	357.0	271.0		358.0	300.0	
Turmeric-fallow	354.0	347.0	221.0		234.0	225.0	
Black papper	373.0		320.8		341.6		
Dharwad							
Pigeon pea + green gram	237.0	230.0	223.0	222.0	222.0	199.0	222.2
Pigeon pea + soybean	252.0	258.0	234.0	233.0	210.0	210.0	232.8
Pigeon pea + groundnut	230.0	205.0	200.0	222.0	230.0	247.0	222.3
Cotton + green gram	233.0	208.0	202.0	182.0	199.0	237.0	210.2
Cotton + soybean	210.0	219.0	214.0	253.0	227.0	193.0	219.3
Mean	232.4	224.0	214.6	222.4	217.6	217.2	
Karjat							
Ludhiana							
Basmati rice-chickpea-GM	365.5	363.1	315.8	320.1	349.8	350.9	344.2
Basmati rice-wheat-GM	360.2	355.4	346.0	339.1	351.7	353.5	351.0
Cluster bean-wheat-summer moong	320.4	312.8	319.0	312.5	320.0	310.5	315.9
Soybean -wheat	361.9	358.5	317.3	318.9	358.7	352.2	344.6
Mean	352.0	347.5	324.5	322.7	345.1	341.8	
Pant Nagar							
Basmati rice-wheat	161.0	163.0	157.0	155.0	159.0	161.0	159.0
Basmati rice -chickpea (4rows+2rows coriander)	160.0	161.0	155.0	152.0	161.0	158.0	158.0
Basmati rice -vegetable pea (4 rows vegetable pea +2 rows coriander)	162.0	159.0	154.0	153.0	160.0	157.0	158.0
Basmati rice -potato	160.0	162.0	153.0	151.0	160.0	161.0	158.0
Mean	161.0	161.0	155.0	153.0	160.0	160.0	
Raipur							
Soybean-maize	251.0	249.0	246.0	251.0	253.0	250.0	250.0
Soybean-pea	260.0	247.0	258.0	257.0	250.0	258.0	255.0
Soybean-chilli	259.0	244.0	254.0	257.0	249.0	253.0	252.7
Soybean-onion	246.0	245.0	245.0	262.0	252.0	255.0	250.8
Mean	254.0	246.3	250.8	256.8	251.0	254.0	
Ranchi							
Ajmer							
Green gram – fennel	169.7	163.4	156.8	162.1	161.5	159.9	162.2
Green gram - coriander	161.2	157.4	145.8	150.2	150.8	149.3	152.5
Cluster bean - fennel	169.7	163.4	156.8	162.1	161.5	159.9	162.2
Cluster bean – coriander	161.2	157.4	145.8	150.2	150.8	149.3	152.5
Mean	165.4	160.4	151.3	156.2	156.2	154.6	
Sardarkrushinagar							
Groundnut- wheat- green gram	155.3	153.4	147.7	149.5	154.7	153.9	152.4
Green gram- cumin- vegetable cowpea	155.2	151.0	146.3	145.8	152.5	153.0	150.6
Green gram-fennel- fennel cont.	152.1	151.7	144.7	145.4	149.3	150.4	148.9
Mean	154.2	152.0	146.2	146.9	152.2	152.4	

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

Locations/Treatments	Available Phosphorus (kg ha ⁻¹)						Mean
	Organic		Inorganic		Integrated (towards organic)		
	100% organic	75% organic + innovative organic practices	100% inorganic	State recommen- dation	50% organic + 50% inorganic	75% organic+ 25% inorganic	
Bajaura							
Frenchbean-cauliflower-frenchbean	73.6	72.2	45.2	52.8	75.0	73.2	65.3
Fallow-cauliflower-tomato	73.9	72.5	45.5	53.0	78.8	75.5	66.5
Black gram-cauliflower- summer squash	73.0	72.9	44.9	50.6	79.0	75.8	66.0
Lady finger-pea	76.2	77.6	42.5	49.4	77.9	74.0	66.3
Mean	74.2	73.8	44.5	51.5	77.7	74.6	
Bhopal	103.0	98.0	70.0	54.0	85.0	102.0	
Calicut							
Ginger-fallow	101.0	108.0	40.0		70.0	86.0	
Turmeric-fallow	164.6	80.1	54.8		143.9	77.1	
Black pepper	90.4		63.2		114.6		
Dharwad							
Pigeon pea + green gram	41.5	45.0	41.3	41.7	36.8	38.5	40.8
Pigeon pea + soybean	43.2	41.1	45.2	48.6	44.2	45.5	44.6
Pigeon pea + groundnut	41.0	42.0	48.3	41.6	44.6	45.3	43.8
Cotton + green gram	41.2	42.7	43.2	38.2	37.0	39.5	40.3
Cotton + soybean	44.4	41.2	43.0	41.9	36.2	38.3	40.8
Mean	42.3	42.4	44.2	42.4	39.8	41.4	
Karjat	26.3	26.1	24.3	23.8	25.9	25.8	25.4
Ludhiana							
Basmati rice-chickpea-GM	47.0	47.9	40.1	48.5	43.2	43.2	45.0
Basmati rice-wheat-GM	50.7	50.3	46.5	45.9	45.8	45.8	47.5
Cluster bean-wheat-summer moong	50.0	48.9	45.0	47.0	49.8	49.8	48.4
Soybean -wheat	48.3	45.7	43.0	47.1	46.8	46.8	46.3
Mean	49.0	48.2	43.7	47.1	46.4	46.4	
Pant Nagar							
			5.6				
Basmati rice-wheat	23.4	22.5	17.2	18.2	21.8	22.7	21.0
Basmati rice -chickpea (4rows+2rows coriander)	24.5	21.9	16.9	17.9	22.6	23.2	21.2
Basmati rice -vegetable pea (4 rows vegetable pea +2 rows coriander)	22.7	23.7	17.6	16.8	23.2	21.5	20.9
Basmati rice -potato	25.1	24.7	16.6	17.3	20.9	22.9	21.3
Mean	23.9	23.2	17.1	17.6	22.1	22.6	
Raipur							
Soybean-maize	23.7	20.3	21.3	22.9	20.9	22.3	21.9
Soybean-pea	22.8	20.5	21.5	22.8	20.9	20.9	21.6
Soybean-chilli	22.2	19.8	22.1	23.5	21.1	22.1	21.8
Soybean-onion	22.4	19.0	19.5	23.8	21.7	21.2	21.3
Mean	22.8	19.9	21.1	23.2	21.2	21.6	
Ranchi	58.2	56.4	62.0	60.0	56.6	57.9	58.5
Ajmer							
Green gram – fennel	25.4	22.3	19.4	21.3	20.5	21.1	21.7
Green gram - coriander	23.7	21.2	17.2	19.3	18.6	19.5	19.9
Cluster bean - fennel	25.4	22.3	19.4	21.3	20.5	21.1	21.7
Cluster bean – coriander	23.7	21.2	17.2	19.3	18.6	19.5	19.9
Mean	24.6	21.8	18.3	20.3	19.5	20.3	
Sardarkrushinagar							
Groundnut- wheat- green gram	18.1	18.2	16.8	16.5	18.7	17.6	17.6
Green gram- cumin- vegetable cowpea	15.9	15.3	15.8	15.7	15.3	15.9	15.6
Green gram-fennel- fennel cont.	17.2	17.0	15.6	15.4	16.1	16.9	16.3
Mean	17.0	16.8	16.1	15.8	16.7	16.8	



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

Locations/Treatments	Available Potassium (kg ha ⁻¹)						Mean
	Organic		Inorganic		Integrated (towards organic)		
	100% organic	75% organic + innovative organic practices	100% inorganic	State recommen- dation	50% organic + 50% inorganic	75% organic+ 25% inorganic	
Bajaura							
Frenchbean-cauliflower-frenchbean	73.6	72.2	45.2	52.8	75.0	73.2	65.3
Fallow-cauliflower-tomato	73.9	72.5	45.5	53.0	78.8	75.5	66.5
Black gram-cauliflower- summer squash	73.0	72.9	44.9	50.6	79.0	75.8	66.0
Lady finger-pea	76.2	77.6	42.5	49.4	77.9	74.0	66.3
Mean	74.2	73.8	44.5	51.5	77.7	74.6	
Bhopal	103.0	98.0	70.0	54.0	85.0	102.0	
Calicut							
Ginger-fallow	101.0	108.0	40.0		70.0	86.0	
Turmeric-fallow	164.6	80.1	54.8		143.9	77.1	
Black pepper	90.4		63.2		114.6		
Dharwad							
Pigeon pea + green gram	41.5	45.0	41.3	41.7	36.8	38.5	40.8
Pigeon pea + soybean	43.2	41.1	45.2	48.6	44.2	45.5	44.6
Pigeon pea + groundnut	41.0	42.0	48.3	41.6	44.6	45.3	43.8
Cotton + green gram	41.2	42.7	43.2	38.2	37.0	39.5	40.3
Cotton + soybean	44.4	41.2	43.0	41.9	36.2	38.3	40.8
Mean	42.3	42.4	44.2	42.4	39.8	41.4	
Karjat	26.3	26.1	24.3	23.8	25.9	25.8	25.4
Ludhiana							
Basmati rice-chickpea-GM	47.0	47.9	40.1	48.5	43.2	43.2	45.0
Basmati rice-wheat-GM	50.7	50.3	46.5	45.9	45.8	45.8	47.5
Cluster bean-wheat-summer moong	50.0	48.9	45.0	47.0	49.8	49.8	48.4
Soybean -wheat	48.3	45.7	43.0	47.1	46.8	46.8	46.3
Mean	49.0	48.2	43.7	47.1	46.4	46.4	
Pant Nagar							
			5.6				
Basmati rice-wheat	23.4	22.5	17.2	18.2	21.8	22.7	21.0
Basmati rice -chickpea (4rows+2rows coriander)	24.5	21.9	16.9	17.9	22.6	23.2	21.2
Basmati rice -vegetable pea (4 rows vegetable pea +2 rows coriander)	22.7	23.7	17.6	16.8	23.2	21.5	20.9
Basmati rice -potato	25.1	24.7	16.6	17.3	20.9	22.9	21.3
Mean	23.9	23.2	17.1	17.6	22.1	22.6	
Raipur							
Soybean-maize	23.7	20.3	21.3	22.9	20.9	22.3	21.9
Soybean-pea	22.8	20.5	21.5	22.8	20.9	20.9	21.6
Soybean-chilli	22.2	19.8	22.1	23.5	21.1	22.1	21.8
Soybean-onion	22.4	19.0	19.5	23.8	21.7	21.2	21.3
Mean	22.8	19.9	21.1	23.2	21.2	21.6	
Ranchi	58.2	56.4	62.0	60.0	56.6	57.9	58.5
Ajmer							
Green gram – fennel	25.4	22.3	19.4	21.3	20.5	21.1	21.7
Green gram - coriander	23.7	21.2	17.2	19.3	18.6	19.5	19.9
Cluster bean - fennel	25.4	22.3	19.4	21.3	20.5	21.1	21.7
Cluster bean – coriander	23.7	21.2	17.2	19.3	18.6	19.5	19.9
Mean	24.6	21.8	18.3	20.3	19.5	20.3	
Sardarkrushinagar							
Groundnut- wheat- green gram	18.1	18.2	16.8	16.5	18.7	17.6	17.6
Green gram- cumin- vegetable cowpea	15.9	15.3	15.8	15.7	15.3	15.9	15.6
Green gram-fennel- fennel cont.	17.2	17.0	15.6	15.4	16.1	16.9	16.3
Mean	17.0	16.8	16.1	15.8	16.7	16.8	

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

Management practice	Soil Available Iron (ppm)				Soil Available Manganese (ppm)			
	Organic		Inorganic		Organic		Inorganic	
	100% organic	75% organic + innovative organic practices	100% inorganic	State recommendation	100% organic	75% organic + innovative organic practices	100% inorganic	State recommendation
Bajjuara								
Frenchbean-cauliflower-frenchbean	15.4	12.9	8.3	10.7	11.5	10.0	6.9	8.2
Fallow-cauliflower-tomato	15.9	13.0	9.8	11.5	12.2	10.3	6.7	9.0
Black gram-cauliflower-summer squash	18.2	14.3	9.0	11.6	11.5	8.4	6.5	8.2
Lady finger-pea	14.7	14.0	9.1	10.9	11.6	10.4	6.6	9.0
Mean	16.1	13.6	9.1	11.2	11.7	9.8	6.7	8.6
Calicut								
Ginger - fallow	46.7	47.9	42.6		19.4	18.7	20.6	25.0
Turmeric-fallow	50.0	44.1	46.2		19.5	10.3	18.4	18.7
Black pepper-fallow	48.8		51.8		7.9		12.1	8.3
Dharwad								
Pigeon pea + green gram	12.7	14.2	8.3	13.5	18.1	17.3	15.7	16.4
Pigeon pea + soybean	15.4	12.2	8.7	14.3	17.4	18.0	18.6	17.2
Pigeon pea + groundnut	14.7	13.5	9.6	13.5	18.4	18.4	17.9	16.3
Cotton + green gram	12.1	11.1	10.8	11.3	15.9	15.1	15.2	15.1
Cotton + soybean	11.6	11.1	10.8	12.5	15.0	14.7	15.2	15.6
Mean	13.3	12.4	9.6	13.0	17.0	16.7	16.5	16.1
Pant Nagar								
Basmati rice-wheat	30.7	30.7	30.6	30.6	6.2	6.2	6.2	6.2
Basmati rice -chickpea (4rows+2rows coriander)	30.7	30.7	30.6	30.6	6.2	6.2	6.2	6.2
Basmati rice -vegetable pea (4 rows vegetable pea +2 rows coriander)	30.7	30.6	30.6	30.6	6.2	6.2	6.2	6.2
Basmati rice -potato	30.6	30.6	30.6	30.6	6.2	6.2	6.2	6.2
Mean	30.7	30.7	30.6	30.6	6.2	6.2	6.2	6.2
Sardarkrushinagar								
Groundnut-wheat- green gram	3.9	3.8	3.5	3.5	6.6	6.4	5.6	5.7
Green gram-cumin-vegetable cowpea	3.9	3.9	3.3	3.3	6.1	6.1	5.3	5.4
Green gram-fennel- fennel	4.1	4.0	3.6	3.6	6.2	6.1	5.6	5.5
Mean	3.9	3.9	3.5	3.5	6.3	6.2	5.5	5.5



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 at different locations

Management practice	Soil Available Zinc (ppm)						Copper					
	Organic			Inorganic			Integrated (towards organic)			Mean		
	100% organic + innovative organic practices			75% organic + innovative organic practices			50% organic + 50% inorganic			75% organic + 25% inorganic		
	100% organic + innovative organic practices	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												
Frenchbean-cauliflower-frenchbean	3.99	2.90	1.95	2.02	3.16	2.98	2.22	1.78	1.05	1.55	2.40	2.22
Fallow-cauliflower-tomato	3.41	2.93	1.77	2.20	3.32	2.96	3.21	1.92	1.11	1.75	3.81	2.50
Black gram-cauliflower-summer squash	3.78	3.18	1.89	2.92	2.98	2.84	1.40	1.24	1.03	1.12	1.74	1.53
Lady finger-pea	3.58	2.65	1.99	2.45	3.15	2.82	3.56	2.18	1.06	1.54	3.95	2.54
Mean	3.69	2.92	1.90	2.40	3.15	2.90	2.60	1.78	1.06	1.49	2.98	2.20
Calicut												
Ginger - fallow	6.50	6.90	4.60		4.70	5.30	19.10	16.70	16.40		17.20	16.30
Turmeric-fallow	4.48	3.07	3.32		3.82	3.80	3.78	2.72	4.90		4.98	3.17
Black pepper-fallow	1.84		1.91		1.99		5.88		8.30		7.60	
Dharwad												
Pigeon pea + green gram	1.10	1.12	0.31	0.33	0.48	0.39	2.32	2.26	2.02	2.30	2.22	2.16
Pigeon pea + soybean	1.11	0.97	0.32	0.42	0.40	0.43	2.29	2.38	2.61	2.27	2.28	2.33
Pigeon pea + groundnut	0.91	1.04	0.31	0.34	0.40	0.41	2.30	2.50	2.29	2.27	2.69	2.26
Cotton + green gram	0.49	0.61	0.56	0.56	0.51	0.47	2.04	2.00	2.27	2.24	2.21	2.13
Cotton + soybean	0.75	0.66	0.50	0.97	0.61	0.42	2.02	1.90	2.30	2.47	2.32	2.09
Mean	0.87	0.88	0.40	0.52	0.48	0.42	2.19	2.21	2.30	2.31	2.34	2.19
Pant Nagar												
Basmati rice-wheat	0.96	0.95	0.97	0.96	0.98	0.95	2.99	2.96	2.95	2.96	2.97	2.98
Basmati rice -chickpea (4rows+2rows coriander)	0.95	0.98	0.95	0.96	0.95	0.97	2.97	2.95	2.93	2.94	2.96	2.96
Basmati rice -vegetable pea (4 rows vegetable pea +2 rows coriander)	0.94	0.96	0.98	0.98	0.97	0.96	2.98	2.97	2.92	2.93	2.98	2.97
Basmati rice -potato	0.95	0.99	0.95	0.96	0.97	0.98	2.98	2.98	2.92	2.92	2.99	2.97
Mean	0.95	0.97	0.96	0.97	0.97	0.97	2.98	2.97	2.93	2.94	2.98	2.97
Sardarkrushinagar												
Groundnut-wheat- green gram	0.49	0.46	0.36	0.37	0.42	0.43	0.69	0.62	0.42	0.48	0.62	0.62
Green gram-cumin- vegetable cowpea	0.48	0.47	0.34	0.36	0.47	0.47	0.58	0.56	0.39	0.43	0.56	0.54
Green gram-fennel- fennel	0.40	0.38	0.28	0.30	0.37	0.38	0.54	0.54	0.38	0.42	0.52	0.49
Mean	0.45	0.44	0.32	0.34	0.42	0.42	0.60	0.57	0.40	0.44	0.57	0.55



Influence of organic management package with reduced dose of organic manures, integrated and inorganic management packages on N, P and K and micronutrients uptake (Table 7.2.11 & 7.2.14)

Bajaura: Effect of organic, inorganic and integrated nutrient management on total uptake of major nutrients revealed that cauliflower-tomato and black gram-cauliflower-summer squash system uptake the maximum N, P and K under integrated management package and being on par to each state recommendation. 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. Among different cropping systems and management practices, the uptake of Fe, Mn and Zn found to be higher in cauliflower-tomato and black gram-cauliflower-summer squash system.

Calicut: In case of turmeric, nutrient uptake of N, P and K in turmeric rhizome was found to be higher under integrated either with 50:50 each organic and inorganic input or with 75 % organic manure +25% inorganic input followed by organic.

Karjat: Uptake of nitrogen by *kharif* and *rabi* crops were found to be higher under organic with application of organic manure (100%) followed by integrated while and phosphorus and potassium uptake in all the crops were higher under integrated consisting of 50:50 each organic and inorganic input.

Pant Nagar: During *kharif* in basmati rice, highest uptake of nutrient N was observed under integrated with 50% organic+50% inorganic practice followed by 75% organic input+25% inorganic (98.5 and 96.7 kg/ha) which was closely on par with each other. Uptake of P in basmati rice was a highest in inorganic with 100 % inorganic (31.8 kg/ha) followed by integrated practice. Uptake of K was found highest under integrated with 50% organic+50% inorganic practice followed by 100% inorganic practice.

Ranchi: Uptake of major nutrients such as nitrogen, phosphorus and potassium by rice crop was maximum with organic production package either by the 75% organic + innovative practices or fertilized with 100% organic (87.45 kg/ha). Whereas lowest was recorded under farmer's practices (64.30 kg/ha).

Ajmer: Highest uptake of macronutrients i.e., N (55.1 & 55.1 kg/ha), P (12.0 & 12.0 kg/ha) and K (44.5 & 44.5 kg/ha) were recorded in green gram - fennel and cluster been- fennel, respectively. Higher N, P and K received under integrated with 75% organic + 25% inorganic (42.3 kg/ha) compared to organic and inorganic, respectively.

S.K. Nagar: Uptake of N, P and K were maximum in inorganic practice with State recommendation during *kharif*, *rabi* and summer season. Highest N and P uptake were found under groundnut- wheat- green gram cropping system during *kharif*, *rabi* and summer seasons. Whereas, Potassium uptake was highest in inorganic practice during *kharif* and summer season. During *rabi* season K uptake was higher under organic with 100% organic practice.

Udaipur: In general, total N, P & K uptake found to be higher under inorganic input practice followed by integrated and organic input management. During *rabi*, wheat *aestivam*, uptake of N, P and K (108.19, 32.82 and 135.8 kg/ha) was found to be higher in 100% inorganic management practices. During *kharif* season N and P uptake were found highest in inorganic with 100% inorganic. Whereas, K uptake was higher under integrated management practice with 75% organic and 25% inorganic.



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
Bajaura (kg/ha)												
Frenchbean-cauliflower-frenchbean	435.0		406.0		318.0		547.0		529.0		524.0	459.8
Fallow-cauliflower-tomato	500.0		415.0		324.0		587.0		632.0		553.0	501.8
Black gram-cauliflower-summer squash	405.0		363.0		282.0		361.0		401.0		436.0	374.7
Lady finger-pea	389.0		346.0		222.0		345.0		387.0		378.0	344.5
Mean	432.3		382.5		286.5		460.0		487.3		472.8	420.2
Calicut (Turmeric kg/ha)	48.3		51.8		50.5				53.2		51.4	
Karjat (kg/ha)	50.9	80.3	41.1	60.0	48.0	65.0	41.4	35.8	48.8	71.4	43.1	58.4
Pantnagar (kg/ha)												
Basmati rice - wheat	84.1	79.3	76.1	73.7	93.2	102.7	91.1	91.6	98.4	108.9	103.9	108.2
Basmati rice-chickpea (4 rows chickpea + 2 rows coriander)	90.2		83.1		99.7		96.2		104.3		95.3	
Basmati rice-vegetablepea (4 rows vegetable pea+2 rows coriander)	89.3		81.8		88.2		94.5		92.6		95.1	
Basmati rice - potato	92.9		89.7		97.1		89.9		98.5		92.5	
Mean	89.1		82.7		94.6		92.9		98.5		96.7	
Ranchi	87.5	67.6	93.6	58.2	72.3	59.6	64.3	37.8	79.7	64.5	80.8	72.7

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	
Ajmer																			
Green gram - fennel		51.7				53.2				47.8				61.0			52.6		64.3
Green gram - coriander		15.6				15.3				13.3				18.6			14.8		20.3
Cluster bean - fennel		51.7				53.2				47.8				61.0			52.6		64.3
Cluster bean - coriander		15.6				15.3				13.3				18.6			14.8		20.3
Mean		33.6				34.3				30.5				39.8			33.7		42.3
Sardarkrushinagar																			
Groundnut- Wheat- Green gram	98.2	77.0	27.0	79.7	69.9	23.2	94.3	76.1	29.8	115.0	87.4	32.5	105.7	79.5	32.2	77.9	63.9	21.2	
Greengram-Coriander - Vegetable cowpea	24.0	40.3	46.9	23.1	31.4	39.6	26.9	39.2	47.3	30.6	60.2	48.9	29.8	53.5	49.3	23.3	36.8	41.6	
Greengram-Fennel - Fennel cont.	26.1	18.5	0.0	20.6	14.6	0.0	26.4	17.6	0.0	28.4	23.7	0.0	28.2	21.2	0.0	22.8	16.7	0.0	
Mean	49.4	45.3	24.7	41.1	38.7	20.9	49.2	44.3	25.7	58.0	57.1	27.1	54.6	51.4	27.2	41.4	39.1	20.9	
Udaipur																			
Maize +blackgram (2:2) - durum wheat - sesbania (GM)	57.3	96.3		56.9	94.4		73.9	100.5		55.4	101.0		71.8	88.3		70.3	36.5		
Blackgram - wheat	26.6	103.7		26.7	100.2		36.9	108.2		26.6	98.5		32.4	95.3		35.7	97.5		
Sweet corn+blackgram (2:2)-chickpea	74.8	53.2		75.4	49.7		102.3	56.7		77.6	56.1		96.4	44.3		96.4	47.3		
Soybean - fenugreek	49.0	103.5		51.3	96.8		68.5	105.4		60.6	104.9		61.0	84.6		58.6	89.3		
Mean	51.9	89.2		52.6	85.3		70.4	92.7		55.1	90.1		65.4	78.1		65.3	67.7		



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		
	Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer
Bajaura (%)																		
Frenchbean-cauliflower-frenchbean	61.00			57.00			38.00			76.00			73.00			72.00		
Fallow-cauliflower-tomato	76.00			63.00			47.00			88.00			98.00			83.00		
Black gram-cauliflower-summer squash	63.00			57.00			41.00			54.00			66.00			69.00		
Lady finger-pea	45.00			41.00			28.00			45.00			52.00			48.00		
Mean	61.25			54.50			38.50			65.75			72.25			68.00		
Calicut (Turmeric kg/ha)	26.60			26.60			20.60						26.10			25.60		
Karjat	10.23	15.52		8.54	12.86		9.72	15.46		5.29	9.57		10.63	15.30		8.70	13.88	
Pantnagar																		
Basmati rice - wheat	19.50	25.60		23.20	25.90		28.00	36.10		34.00	30.80		30.20	42.70		29.40	44.40	
Basmati rice-chickpea (4 rows chickpea + 2 rows coriander)	21.80			27.40			34.40			30.30			34.10			31.10		
Basmati rice-vegetable pea (4 rows vegetable pea + 2 rows coriander)	22.20			24.20			30.30			25.00			30.60			35.70		
Basmati rice - potato	25.20			27.00			34.60			23.10			29.80			28.70		
Mean (BR)	22.18			25.45			31.83			28.10			31.18			31.23		
Ranchi	16.72	33.26		18.02	27.99		13.30	26.60		11.36	16.80		15.13	30.47		15.12	34.68	

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
Ajmer																		
Green gram - fennel		11.53			11.70			10.43			13.39			10.99			13.98	
Green gram - coriander		3.47			3.87			3.22			4.30			3.62			4.78	
Cluster bean - fennel		11.53			11.70			10.43			13.39			10.99			13.98	
Cluster bean - coriander		3.47			3.87			3.22			4.30			3.62			4.78	
Mean		7.50			7.79			6.83			8.85			7.31			9.38	
Sardarkrushinagar																		
Groundnut- wheat- green gram	13.00	14.56	4.54	11.36	12.77	3.46	13.65	13.49	4.89	15.28	15.19	4.91	15.07	14.17	5.39	11.73	11.02	3.17
Greengram- Cumini- Vegetable cowpea	4.00	4.23	6.28	3.45	3.43	5.26	4.49	4.09	7.47	4.77	5.84	7.03	4.88	5.18	7.52	3.35	3.64	5.74
Greengram-Fennel-Fennel cont.	3.99	5.67	0.00	3.42	4.80	0.00	4.01	5.74	0.00	3.71	6.97	0.00	4.62	6.38	0.00	3.58	5.25	0.00
Mean	7.00	8.15	3.61	6.08	7.00	2.91	7.38	7.77	4.12	7.92	9.33	3.98	8.19	8.58	4.30	6.22	6.64	2.97
Udaipur																		
Maize + blackgram (2:2) - durum wheat - sesbania (GM)	11.10	30.57		11.06	30.95		12.92	33.06		10.49	30.56		12.64	28.35		13.19	31.08	
Blackgram - wheat	3.84	31.17		3.77	30.23		5.32	32.82		4.10	30.16		4.64	28.71		5.08	30.32	
Sweet corn + blackgram (2:2) - chickpea	12.06	10.02		11.90	9.51		16.66	10.98		11.67	9.36		16.52	8.56		16.36	9.25	
Soybean - fenugreek	5.48	16.66		5.74	15.85		7.66	17.66		6.45	16.98		6.67	13.90		6.59	15.20	
Mean	8.12	22.11		8.12	21.64		10.64	23.63		8.18	21.77		10.12	19.88		10.31	21.46	



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 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 (%)																		
Frenchbean-cauliflower-frenchbean	368.0			346.0			268.0			464.0			449.0			444.0		
Fallow-cauliflower-tomato	487.0			420.0			318.0			542.0			585.0			511.0		
Black gram-cauliflower-summer squash				367.0			287.0			360.0			400.0			435.0		
Lady finger-pea	197.0			185.0			135.0			199.0			211.0			212.0		
Mean	350.7			329.5			252.0			391.3			411.3			400.5		
Calicut (Turmeric kg/ha)	56.2			58.7			58.5						69.8			61.6		
Karjat	52.4	52.6		43.6	43.5		52.5	54.7		45.8	38.1		53.9	55.4		48.3	49.0	
Pantnagar																		
Basmati rice - wheat	73.5	62.5		62.1	61.5		86.0	80.1		88.9	73.5		89.4	88.2		90.5	86.4	
Basmati rice-chickpea (4 rows chickpea + 2 rows coriander)	77.9			67.5			85.6			85.5			95.6			79.4		
Basmati rice-vegetable pea (4 rows vegetable pea + 2 rows coriander)	75.0			69.6			85.1			85.4			83.9			83.1		
Basmati rice - potato	75.8			78.0			87.8			75.7			82.7			84.9		
Mean(BR)	75.6			69.3			86.1			83.9			87.9			84.5		
Ranchi	74.7	81.6		79.4	70.5		64.0	70.2		60.2	48.6		68.6	75.1		68.0	84.4	

Locations/ Treatments	Organic						Inorganic						Integrated (towards organic)					
	100% organic			75% organic + innovtive organic practices			100% inorganic			State recommendation			50% organic + 50% inorganic			75% organic + 25% inorganic		
	K'harif	Rabi	Summer	K'harif	Rabi	Summer	K'harif	Rabi	Summer	K'harif	Rabi	Summer	K'harif	Rabi	Summer	K'harif	Rabi	Summer
Ajmer																		
Green gram - fennel		41.7			41.9			39.6			48.9			43.1			51.8	
Green gram - coriander		12.5			13.1			10.9			14.9			11.9			16.5	
Cluster bean - fennel		41.7			41.9			39.6			48.9			43.1			51.8	
Cluster bean - coriander		12.5			13.1			10.9			14.9			11.9			16.5	
Mean		27.1			27.5			25.2			31.9			27.5			34.2	
Sardarkrushinagar																		
Groundnut- Wheat- Green gram	47.6	61.7	12.1	41.7	50.0	10.1	47.2	54.8	11.9	61.4	58.4	13.5	52.8	51.7	13.3	40.9	41.0	8.1
Greengram- Cumin- Vegetable cowpea	10.4	20.4	50.2	10.1	16.7	46.7	10.8	19.0	54.5	13.4	27.5	55.9	12.7	25.5	62.4	9.2	18.0	49.0
Greengram-Fennel- Fennel cont.	11.5	15.8	0.0	9.5	14.3	0.0	11.5	16.2	0.0	13.7	20.6	0.0	12.8	18.1	0.0	10.2	15.0	0.0
Mean	23.1	32.7	20.8	20.4	27.0	18.9	23.2	30.0	22.1	29.5	35.5	23.1	26.1	31.8	25.2	20.1	24.7	19.0
Udaipur																		
Maize + blackgram (2:2) - durum wheat - sesbania (GM)	57.0	133.4		57.0	130.8		69.9	138.8		57.6	139.2		71.1	121.6		81.7	128.3	
Blackgram - wheat	12.6	132.4		12.6	127.4		18.1	137.0		15.0	135.8		14.7	120.8		17.2	123.9	
Sweet corn + blackgram (2:2)- chickpea	66.2	48.5		65.1	45.5		81.0	51.8		64.6	46.7		77.2	40.5		79.3	43.2	
Soybean - fenugreek	25.5	55.1		27.1	51.6		35.1	56.3		30.9	56.4		30.9	45.1		29.3	47.9	
Mean	40.3	92.4		40.4	88.8		51.0	96.0		42.0	94.5		48.5	82.0		51.9	85.8	



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Soil Microbial population 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 (21.2 log cfu/g) recorded maximum in organic management practice with 100% organic followed by integrated with 75% organic and 25% inorganic. Fungi (18.9 log cfu/g) was maximum in organic with 100% organic management practice followed by integrated with 75% organic and 25% inorganic. French bean and landy finger based cropping system have been found highest population of bacteria and fungi. Actinomycetes (20.0 log cfu/g) and phosphatase activity (22.2 µg/g/hr) were in black gram-cauliflower-summer squash and ladyfinger-pea system. Microbes with organic found to be higher by 36.9, 26.4, and 33.7% for bacteria, fungi, and actinomycetes respectively compared to inorganic package.

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 (27.7 log cfu/g), fungi (19.3 log cfu/g) and actinomycetes (33.6 log cfu/g) with 75% organic +innovative practices under organic management was increased to the tune of 59.2, 22.1 and 60.8% for bacteria, fungi and actinomycetes of compared to inorganic management, respectively. Among the cropping systems, paddy-capsicum-sesbania green manure followed by basmati rice-broccoli – sesbania green manure recorded higher bacterial population of 25.6 and 24.2 log cfu/g respectively. Fungal was found to be highest in paddy–capsicum– green gram whereas maximum count of actinomycetes recorded in paddy –french bean – sesame at the end of crop cycle in the soil.

Sardarkrushinagar: It is evident from the data outlined in table that bacterial population was higher under inorganic input package either by 100% organic or state recommendation in all three cropping systems at the end of cropping cycle. Fungal count in soil was higher in integrated whereas population of actinomycetes, it was highest under organic package.

Thiruvananthapuram: Bacterial count was higher in either by 100% organic or 75% organic + 25% inorganic in Cassava-veg. cowpea and Taro-black gram. Cassava-groundnut and Taro- green gram cropping system have been found higher bacterial population in either 100% inorganic or state recommendation. The fungal counts were mostly higher under 100% inorganic practice. Followed by integrated with 75% organic and 25% inorganic in Taro- green gram cropping system. However, the actinomycete count was higher in 100% inorganic practice followed by integrated with 75% organic and 25% inorganic practice.



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/Treatments	Bacteria ($\times 10^6$ cfu/g)						Fungi ($\times 10^6$ cfu/g)					
	Organic			Inorganic			Organic			Inorganic		
	100% organic	75% organic + innovative organic practices	Integrated	100% Inorganic	State recommendation	Mean	100% organic	75% organic + innovative organic practices	Integrated	100% Inorganic	State recommendation	Mean
Bajaura												
Tomato-Cauliflower- French bean	22.0	19.5	13.8	17.6	18.2	21.4	18.8	19.6	17.6	14.2	18.2	17.6
Fallow-Cauliflower-Tomato	21.3	18.6	13.2	17.5	19.5	18.6	18.1	18.5	17.9	13.5	17.5	17.2
Black gram-Cauliflower-Summer squash	19.5	17.8	13.0	17.2	17.6	19.5	17.4	18.4	17.2	13.8	18.4	17.5
Lady finger-Pea	22.0	19.0	13.5	17.8	17.9	19.7	18.3	18.9	17.4	14.0	16.8	17.3
Mean	21.2	18.7	13.4	17.5	18.3	19.8		18.9	17.5	13.9	17.7	18.7
Narendrapur												
Basmati rice-broccoli – sesbania green manure	29.3	31.0	16.3	15.3	25.3	27.7	24.2	16.3	17.66	12.66	16.33	14.0
Paddy– mustard– green gram	19.7	21.7	13.3	14.7	17.3	20.3	17.8	15.3	18.33	14.66	18	15.1
Paddy– capsicum– green gram	28.7	31.0	20.3	18.7	26.7	28.3	25.6	20.7	22.33	19.33	20.66	18.4
Paddy –french bean – sesame	24.3	27.3	19.7	17.0	20.7	24.7	22.3	16.3	19	16.66	20.33	16.1
Mean	25.5	27.7	17.4	16.4	22.5	25.2		17.2	19.3	15.8	18.8	11.7
Sardarkrushinagar												
Groundnut- wheat- green gram	3.35 $\times 10^8$	1.15 $\times 10^9$	8.81 $\times 10^6$	1.27 $\times 10^7$	3.06 $\times 10^7$	5.22 $\times 10^7$		1.55 $\times 10^6$	2.45 $\times 10^6$	5.52 $\times 10^4$	2.41 $\times 10^6$	1.17 $\times 10^6$
Green gram- coriander- vegetable cowpea	9.74 $\times 10^5$	8.09 $\times 10^5$	9.91 $\times 10^4$	7.14 $\times 10^5$	4.03 $\times 10^4$	1.03 $\times 10^5$		6.57 $\times 10^3$	4.14 $\times 10^3$	2.32 $\times 10^2$	2.43 $\times 10^3$	1.67 $\times 10^3$
Green gram-fennel	1.86 $\times 10^7$	2.10 $\times 10^8$	2.95 $\times 10^6$	7.13 $\times 10^8$	4.86 $\times 10^6$	1.22 $\times 10^7$		5.53 $\times 10^5$	4.01 $\times 10^6$	3.51 $\times 10^4$	2.04 $\times 10^5$	6.08 $\times 10^5$
Thiruvananthapuram												
Cassava-veg. cowpea	17.7	13.3	7.0	12.0	10.3	10.7	11.8	16.0	8.0	14.7	15.7	12.1
Cassava-groundnut	7.3	8.0	9.3	25.0	12.3	13.0	12.5	5.0	14.3	15.0	17.3	12.7
Taro-black gram	10.0	29.3	46.7	23.3	17.3	30.0	26.1	86.3	12.7	187.7	19.0	73.1
Taro-green gram	28.7	46.0	20.7	14.3	27.3	17.7	25.8	8.0	6.3	13.0	13.0	10.6
Mean	15.9	24.2	20.9	18.7	16.8	17.9		28.8	10.3	57.6	16.3	35.9

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

Locations/Treatments	Soil actinomycetes (x10 ⁴ cfu/g)						Phosphate solubilizing bacteria (x10 ⁴ cfu/g)					
	Organic			Inorganic			Organic			Inorganic		
	100% organic	75% organic + innovative organic practices	100% organic + innovative organic practices	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic	100% organic	75% organic + innovative organic practices	100% organic + innovative organic practices	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic
Bajaura												
French bean (Kharif)-cauliflower - french bean (summer)	19.3	16.6	12.5	16.7	17.3	17.9	16.7	18.2	15.4	18.5	18.5	19.5
Fallow-Cauliflower-Tomato	18.7	17.4	12.3	16.2	16.9	18.2	16.6	18.2	16.2	19.0	19.4	19.5
Black gram-Cauliflower-Summer squash	20.0	18.8	12.6	17.5	17.8	18.7	17.6	18.1	16.3	18.2	19.0	19.3
Lady finger-Pea	17.7	16.9	12.8	17.3	17.6	18.6	16.8	18.6	16.4	18.3	18.8	19.6
Mean	18.9	17.4	12.6	16.9	17.4	18.4		18.3	16.1	18.5	18.9	19.5
Narendrapur												
Basmati rice-broccoli – sesbania green manure	32.3	34.3	22.3	21.3	29.7	31.3	28.6					
Paddy- mustard- green gram	29.7	31.0	16.7	15.0	28.3	30.7	25.2					
Paddy- capsicum- green gram	31.7	32.7	15.7	21.3	29.3	30.7	26.9					
Paddy –french bean – sesame	35.7	36.3	29.0	29.7	32.3	34.3	32.9					
Mean	32.3	33.6	20.9	21.8	29.9	31.7	28.4					
Sardarkrushinagar												
Groundnut- Wheat- Green gram	6.18 x 10 ⁶	3.11 x 10 ⁶	3.32 x 10 ⁴	1.21 x 10 ⁵	4.12 x 10 ⁴	3.24 x 10 ⁶						
Greengram- Coriander-Vegetable cowpea	8.20 x 10 ⁴	4.20 x 10 ⁴	1.13 x 10 ²	6.17 x 10 ²	3.22 x 10 ²	4.25 x 10 ²						
Greengram-Fennel	2.27 x 10 ⁶	6.25 x 10 ⁶	3.20 x 10 ⁴	5.08 x 10 ⁶	1.45 x 10 ⁵	7.16 x 10 ⁵						
Thiruvananthapuram												
Cassava-veg. cowpea	8.7	7.0	10.0	6.7	6.3	7.0	7.6	472.1	308.1	391.9	449.0	418.0
Cassava-groundnut	9.0	7.3	12.7	13.3	9.0	12.0	10.6	449.9	233.9	470.3	370.6	388.9
Taro-black gram	4.3	4.7	12.0	7.7	7.0	9.0	7.4	479.6	477.2	307.8	451.1	538.7
Taro-green gram	4.7	12.0	11.0	5.7	12.0	13.0	9.7	491.0	470.6	491.0	400.6	536.6
Mean	6.7	7.8	11.4	8.3	8.6	10.3		473.1	372.4	415.2	417.8	470.6



Effect of different management systems (Organic, inorganic and integrated) on quality aspects of organic produce (Table 2.7.17)

Bajaura: Quality parameters protein, TSS ($^{\circ}$ brix) and vitamin C in different vegetable crops namely frenchbean, black gram, tomato, pea and cauliflower were estimated. In general, protein content among the various input practice observed slightly numerically higher under integrated nutrient management, although in pea, protein was better in inorganic. Tomato recorded maximum TSS content with integrated consisting of 75% organic + 25% inorganic practice. Whereas, In Pea highest TSS recorded under organic practice. The highest vitamin C content of tomato fruits (35.40 mg/100g) 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 of 47.07 mg/100g.

Bhopal: Although, nutritional quality constituents in soybean and wheat did not influence significantly due to different nutrient management practices but all the quality parameters viz. protein, oil, methionine and tryptophan content percent in soybean, protein and globulin, ash and gluten percent in wheat were maximum in organic either with organic or integrated nutrient management practices.

Calicut: In turmeric, curcumin, oleoresin and oil content was higher in organic management followed by with 75% nutrient through organic manure+25% innovative practice. Oil and oleoresin content in black pepper recorded higher under inorganic while, peperine% content being maximum with integrated (50% organic+50%inorganic input practice).

Coimbatore: All the quality parameter in chilli and tomato did not differ significantly due to various input management package. Ascorbic acid (126.40 mg/100g) and TSS (5.50 Brix) in chilli was higher under organic input practice. Ascorbic acid in brinjal (14.56 mg/100g) and T. acidity (0.31 Brix) was higher under organic practice, but these were on par to other management practices.

Ranchi: Nutritional quality constituents such as protein and moisture did not significantly differ due to production practice. 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.

Ajmer: Quality parameters such as protein and essential oil % in coriander and fennel crops 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 7.2.17: 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 %	14.40	14.20	13.60	14.00	14.20	14.50
	Black gram		14.20	14.10	13.60	14.20	14.30	14.20
	Pea		20.50	20.40	20.00	20.70	20.20	20.60
	Tomato	TSS (° Brix)	5.20	5.20	4.00	5.00	5.20	5.40
	Pea		15.80	15.80	13.50	15.20	15.00	15.40
	Tomato	Vitamin C (mg/100g)	34.80	34.00	30.00	30.20	34.20	35.40
	Cauliflower		47.07	45.27	42.03	44.73	46.37	45.23
Bhopal	Soybean	Protein %	35.55	35.52	35.00	34.88	35.45	35.60
		Oil (%)	18.08	18.02	17.98	18.01	18.04	18.10
		Methionine (g/16gN)	1.71	1.69	1.68	1.69	1.70	1.73
		Tryptophan (g/16gN)	1.80	1.83	1.78	1.79	1.82	1.84
	Wheat	Protein %	11.52	11.39	11.26	11.34	11.48	11.62
		Globulin %	23.92	23.82	23.75	23.77	24.02	24.33
		Ash%	1.64	1.63	1.55	1.58	1.69	1.72
		Gluten%	17.03	16.88	16.81	16.83	16.92	17.13
Calicut	Turmeric	Oil (%)	5.11	5.21	5.17		4.96	4.97
		Oleoresin content (%)	12.21	12.83	11.94		11.94	11.94
		Curcumin (%)	5.41	4.84	4.59		4.70	4.80
	Black pepper	Oil (%)	3.00		3.27		3.12	
		Oleoresin (%)	8.23		8.75		8.59	
		Piperine (%)	5.00		5.35		5.62	
Coimbatore	Tomato	TSS (%)	3.80	4.10	3.20	3.40	3.40	3.60
		Acidity (%)	0.96	1.12	0.61	0.73	0.69	0.83
		Ascorbic acid	22.62	26.20	20.35	22.46	21.79	23.50
	Chilli	TSS (%)	5.50	5.30	4.80	4.50	4.80	5.20
		Ascorbic acid	126.40	122.60	118.70	115.40	120.20	123.80
	Brinjal	Titration Acidity (%)	0.29	0.31	0.20	0.24	0.24	0.28
		Ascorbic acid (mg/100g)	14.56	14.78	13.24	13.68	13.88	14.35
Ranchi	Rice	Protein (%)	9.26	9.40	9.30	9.09	9.20	9.10
		Moisture (%)	14.30	14.20	14.10	13.98	14.20	14.10
	Wheat	Protein (%)	11.27	11.24	11.42	11.19	11.32	11.37
		Moisture (%)	10.12	10.16	10.33	10.24	10.22	10.20
Ajmer	Coriander	Protein (%)	15.74	14.91	14.91	16.53	15.39	16.75
		Essential oil (%)	0.32	0.30	0.29	0.33	0.31	0.34
	Fennel	Protein (%)	17.49	17.46	16.49	18.19	17.14	18.50
		Essential oil (%)	1.47	1.45	1.43	1.52	1.45	1.53



Influence of organic, inorganic and integrated management packages on economics of different crops and cropping systems Table (7.2.18 and 19)

Bajaura: Gross return was significantly higher (61.7%) with organic input practice (100% organic) followed by integrated (50% organic + 50% inorganic; 54.4%) over inorganic package. Although, cost of cultivation was higher under organic and integrated, the increase in net return was 451% and 310% higher with organic and integrated over inorganic. Among the cropping system, Frenchbean-cauliflower-frenchbean gave the highest gross return, and fallow-cauliflower-tomato gave the highest net return. All the input practice registered higher B:C ratio with higher B:C ratio in organic practices (0.86, 0.79) followed by integrated practices (0.67, 0.58) under 100% organic and 50% organic + 50% inorganic respectively, and among the systems, fallow-cauliflower-tomato system recorded higher B:C ratio 0.95.

Bhopal: 100% organic input followed by integrated (75% organic + 25% inorganic) production systems recorded maximum gross returns (Rs. 1,66,824/ha and 1,39,963/ha), net returns (76% and 34%) and B:C ratio (2.06 and 1.55), respectively, as compared to inorganic management. Among the cropping systems, soybean-linseed recorded maximum net return (Rs 1,02,888/ha) and B:C ratio (1.95).

Calicut: Highest gross return for turmeric was with 100% organic practice (Rs 5,45,400/ha) followed by integrated (75% organic + 25% inorganic) practice (Rs 5,40,000/ha). Higher net return was recorded in integrated input practice (17.6%) followed by 100% organic (13.5%) system over inorganic system. Only 75% organic + 25% inorganic practice gave higher BC ratio as compared to inorganic practice.

Coimbatore: Among the production systems, maximum net return of Rs. 2,00,017 per hectare was recorded in brinjal-pearl millet-green gram system under organic with 75% organic nutrients +25% innovative practices. Benefit cost ratio was recorded higher in inorganic followed by towards organic approach i.e. integrated management consisting of 50% each organic + inorganic or by 75% organic+25% inorganic of 2.20 and 2.14 respectively. Cropping system brinjal-pearl millet-green manure found more profitable in term of net return and it is higher by 154.5 and 109.4% than chili-barnyard green manure and tomato-finger millet-green manure system. Though lower cost of cultivation of Rs.71,106 /ha was under inorganic management resulted higher B:C ratio of 2.20 among the production systems but being on par with integrated.

Dharwad: Among the production packages, though gross return of organic packages was higher by 15.6% and 7.8% in 100% organic and 75% organics + innovative organic practices, respectively as compared to inorganic package, however, cost of cultivation was highest for organics practices and net returns were decreased in organic and integrated packages both (between 3-12%). However, among the cropping system, highest net return (Rs 57,727/ha) and B:C ratio (2.69) was recorded in Pigeonpea + groundnut.

Jabalpur: Organic and integrated nutrient input practices recorded a decrease in gross return, ranging between 18 to 23%, with higher cost of cultivation in organic practices (38% in 100% organic practice) over inorganic practice. Net return was also reduced in organic and integrated practices with highest decrease by 79% in 75% organic + 25% innovative organic management system, thus inorganic practice resulted in high net return (Rs 162077/ha) and B:C ratio (2.06). Among the cropping systems, basmati rice – berseem (fodder and seed) recorded higher net return (Rs 2,00,238 /ha) and B:C ratio (2.37) under inorganic practice.

Karjat: On comparing the input practices, only 100% organic input showed consistent increase in gross return under all the cropping systems with 47% highest increase in Rice-Field bean. Though, cost of cultivation was also high under the 100% organic practices as compared to inorganic inputs. However, net return was increased under 100% organic package (by 17.4%), all other inputs showed a decline in net returns as compared to inorganics. The B:C ratio were also declined for all organic inputs whereas higher BC ratio of 3.03 and 2.65 was noted for Rice-brinjal and Rice –onion system respectively. Both the system found highest profitable among the systems.

Ludhiana Though the cost of cultivation was higher under organic input practice (26.9%) due to the higher gross return (18.9%), there was an increase in gross return (18 and 19%) and net return (11 and 13%) under organic practices as compared to inorganics. Integrated practices showed a decrease in net return by 3% as compared to inorganic practice. Among the cropping systems, significantly higher increase in net return (Rs 128131/ha) for Basmati rice-chickpea-GM system was obtained with organics (62.4 and 73.3%) and integrated (25 and 18%) practices over inorganic. There was no significant variation in B:C ratios of all the input practices however, Basmati rice-wheat-GM showed higher B:C ratio (2.57).

Modipuram: Among the management practices, all the inputs except 50% organic + 50% inorganic showed decline (5 to 16%) in gross return as compared to inorganic systems. Cost of cultivation was high for organics (24%) and integrated (22%) systems. Among the cropping systems, Maize (sweet corn)- mustard- sesbania green manure was recorded with higher cultivation cost (62%) under 100% organics and Maize (popcorn)- potato -okra + sesbania green manure with higher gross return (15%) under 50% organic + 50% inorganic inputs. Among the inputs, inorganics systems showed higher benefit-cost ratio (1.39) in comparison to organics and integrated inputs, whereas among the cropping systems, B:C ratio was higher in maize (sweet corn)- mustard- sesbania green manure (1.4) system.

Pantnagar: Organic input practice showed higher increase in gross return over the integrated practice as compared to inorganic input. Highest increase by 23.2% in gross return was noticed under 100% organic over the inorganic input practice. Cost of cultivation was between 5-6% higher for organic and 7-9% higher for integrated inputs over the inorganic practice. On comparing the net returns, there was higher net return under 100% organic (30.1%) and 75% organic + innovative organic practices (17%) over the inorganic input. Integrated input practices did not show any significant variation in net returns. Benefit cost ratio was highest for 100% organic input (3.05). On comparing the cropping systems, Basmati rice -vegetable pea (4 rows vegetable pea +2 rows coriander) showed higher gross return, (36%) under 100% organic input and a total of Rs 387828/ha for all the input practice, and higher net return of total Rs 317682/ha with B:C ratio 4.52.

Raipur: Raipur: The cost of cultivation with organic and integrated package was found to increase by 31.5 and 27% over inorganic. Although net return increased significantly 84.8 and 53.8% under organic consisting of 75% organic input application +innovative organic practice followed by 100% organic owing to higher gross return which was also increase to the tune of 69.8 and 48.1% respectively in same treatment. B:C ratio followed the same trend. Among different cropping system, the maximum net return and benefit cost ratio (Rs 3,38,745/ha and of 4.46) was obtained in soybean-maize.

Among all the input practices, an increase in gross return was found with organic inputs. There was an increase in gross return by 46% under 100% organic input, with higher increase by 69.8% under the 75% organic + innovative organic practice. Cost of cultivation was higher for organic inputs with 31% and 26% higher for 100% and 75% organic + innovative organic practice as compared to inorganic practices. No significant variation was observed under the integrated input practice. On comparing the cropping systems, Soybean-Pea showed higher increase in gross return, by 72.2% and 116% under 100% and 75% organic + innovative organic practice, respectively, over inorganic input. Among all the inputs and cropping system, higher gross return (Rs 437276/ha) and cost of cultivation (Rs 97531/ha) was noted under Soybean-maize system.

Ranchi: Adoption of organic package with 100% organic input and 75% organic manure +innovative practices produced higher gross return (52.7 and 55.7%, respectively) followed by integrated either by with 50:50% organic and inorganic (9%) or towards organic by 75% organic manure +25% inorganic (12%) as compared to inorganic input. Organic and integrated package recorded higher cost of cultivation, 36.7% and 27.6% respectively, over inorganic. Owing to higher gross return, an increase in net return by 56.4% and 79% recorded with 100% and 75% organic manure +innovative practices, respectively. Similar trend was observed for B:C ratio under 100% and 75% organic manure+ innovative practices, 1.54 and 1.93, respectively. Rice -potato system recorded higher net return (Rs 45854/ha) and B:C ratio (1.43) Among cropping systems, rice-wheat being the second-best performing system in term of net return (Rs 44 999/ha) with benefit cost ratio of 1.4.

Umiam: Among the cropping systems, maximum net returns were recorded in broccoli-tomato cropping system (Rs. 2,95,708/ha) followed by broccoli-carrot (Rs. 2,87,584/ha) and broccoli-french bean (Rs. 2,40,365/ha). Application of 100% organic management practice recorded the highest average net return (Rs. 2,73,861/ha) followed by integrated management (50%



organic + 50% inorganic) (Rs. 2,66,392/ha). Among production package, organic production package was 11.3% more net return over inorganic. gave

Ajmer: Though, there was an increase in gross return under organic inputs, only 75% organic + 25% inorganic input showed significant increase (23%) in gross return as compared to inorganics with highest in Cluster bean – coriander system (34.1%). Cost of cultivation was higher for 100% organic input (70%) compared to inorganic input. On comparing the cropping systems Green gram-fennel and Cluster bean – fennel systems share higher and same cost of cultivation (Rs 65228/ha). On comparing the input wise net returns, there was decrease in net return for organic inputs (highest for 100% organic, 27%) except 75% organic + 25% inorganic input (non-significant increase by 8.6%) with higher B:C ratio (2.95) under inorganic input. Among the cropping systems, Cluster bean – fennel gave higher net return of Rs 130418/ha including all the input practices with higher B:C ratio (3.14).

Narendrapur: Gross return recorded significantly higher by 21.6 and 23.2% respectively under organic with 100% and 75% organic+25% innovative practices. Although, cost of cultivation was higher under organic and integrated, but for the increase in net return was 17.2 and 28.3% with organic over inorganic. Integrated was also higher by about 5.2% than inorganic. Benefit cost ratio with organic (organic 75% +innovative practice 25%) was also increased by about 6%. Among the cropping system, rice-capsicum-green gram gave the highest gross return and net return and B:C ratio of 4,52,293 and 3,14,722 Rs/ha and 3.32 respectively.

Sardarkrushinagar: All the input practices recorded with decrease in gross return except 75% organic + innovative organic practice with an increase by 9.3% as compared to inorganic input. Among the cropping system groundnut- wheat- green gram recorded with higher gross return of Rs 232903/ha for all the inputs and a maximum of Rs 323949/ha under the 100% organic input. Cost of cultivation was reduced by 92% for the 50% organic + 50% inorganic input and by 57 % for 100% organic inputs. Net return was higher under the 100% organic (24.4%) as compared to inorganic input and decrease by 45% for 75% organic + 25% inorganic inputs. Among the cropping systems, higher net return (Rs 152645/ha) and cost of cultivation (Rs 80259/ha) noted for Groundnut- Wheat- Green gram system with higher B:C ratio (1.26). Inorganic nutrient input showed higher B:C ratio (1.17) as compared to organic input practices.

Thiruvananthapuram: Among the various cropping systems, cassava followed by cowpea recorded highest net return and benefit cost ratio under inorganic package whereas cassava followed by groundnut system recorded higher net return of Rs. 6,53,117/ha under organic followed by inorganic. Benefit cost ration recorded maximum un inorganic package.

Udaipur: All the four cropping systems performed better under inorganic for gross return, net return and benefit cost ratio due to the lower cost of cultivation compared to organic input practice. Organic and integrated practice recorded 10 and 30.8% lower net return respectively. Among 4 cropping systems evaluated under different management practices, maize + black gram (2:2) – durum wheat – *sesbania* (GM) recorded maximum net return (Rs1,17,337/ha) while net rupees per rupees invested of 1.75 was higher in black gram– wheat.

Table 7.2.18. 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			Integrated			Mean	Organic			Inorganic			Integrated			Mean
	100% organic	75% organic + innovative organic practices	100% organic + innovative organic practices	100% organic	75% organic + innovative organic practices	100% organic + innovative organic practices	State recommendation	50% organic + innovative organic practices	75% organic + innovative organic practices		100% organic	75% organic + innovative organic practices	100% organic	75% organic + innovative organic practices	State recommendation	50% organic + innovative organic practices	75% organic + innovative organic practices			
Bajaura																				
	Frenchbean-cauliflower-frenchbean	3,61,778	3,41,583	2,26,222	3,39,378	3,32,333	3,22,344	3,20,606	2,60,356	2,52,606	2,29,581	2,64,592	2,47,724	2,57,971	2,52,138					
	Fallow-cauliflower-tomato	2,53,222	2,19,708	2,14,222	3,39,800	3,67,600	3,28,533	2,87,181	2,06,890	1,97,640	1,70,365	2,10,365	1,89,394	1,87,339	1,93,666					
	Black gram-cauliflower-summer squash	3,61,221	3,40,515	1,97,698	2,73,839	2,77,737	2,84,582	2,89,265	2,57,185	2,49,835	2,16,713	2,68,213	2,51,128	2,59,672	2,50,458					
	Lady finger-pea	2,99,083	2,76,250	1,50,733	2,22,467	2,40,533	2,40,933	2,38,333	1,61,315	1,57,065	1,46,605	1,74,205	1,62,682	1,67,657	1,61,588					
Mean	3,18,826	2,94,514	1,97,219	2,93,871	3,04,551	2,94,098	2,21,437	2,14,287	1,90,816	2,29,344	2,12,732	2,18,160								
Bhopal																				
Soybean-durum wheat	1,61,064	1,45,040	1,08,217	1,08,520	1,25,877	1,36,786	1,30,917	59,705	57,425	55,628	56,697	57,968	59,743	57,861						
Soybean- mustard	1,54,851	1,44,812	1,09,124	1,11,250	1,23,263	1,30,113	1,28,902	52,708	51,797	50,568	50,899	51,983	52,985	51,823						
Soybean- chickpea	1,62,732	1,50,259	1,14,227	1,15,632	1,26,842	1,37,052	1,34,457	52,885	51,810	50,895	51,181	52,147	53,152	52,012						
Soybean- linseed	1,88,649	1,78,905	1,31,176	1,32,800	1,46,477	1,55,900	1,55,651	53,751	52,779	51,596	51,862	52,734	53,860	52,764						
Mean	1,66,824	1,54,754	1,15,686	1,17,051	1,30,615	1,39,963	54,762	53,453	52,172	52,660	53,708	54,935								
Calicut																				
Ginger																				
Turmeric	5,45,400	5,04,000	4,68,000		5,13,000	5,40,000		1,83,996	1,72,846	1,45,100		1,56,034	1,61,534							
Coimbatore																				
Brinjal - pear millet - green manure	3,36,208	3,33,185	2,66,554	2,79,576	2,68,810	2,94,766	2,96,517	1,47,213	1,33,168	87,272	1,15,222	1,14,780	1,31,351	1,21,501						
Chillies - barnyard millet - green manure	1,53,180	1,70,520	1,23,780	1,50,048	1,62,965	1,56,379	1,52,812	93,597	86,328	65,836	91,036	79,720	86,689	83,868						
Tomato - finger millet - green manure	1,69,504	1,98,104	1,23,103	1,35,166	1,89,503	2,10,240	1,70,937	1,12,822	99,269	60,211	85,411	78,187	87,167	87,178						
Mean	2,19,631	2,33,936	1,71,146	1,88,263	2,07,093	2,20,462		1,17,877	1,06,255	71,106	97,223	90,896	1,01,736							



Locations/Treatments	Gross returns (Rs/ha)						Cost of cultivation (Rs/ha)					
	Organic			Inorganic			Mean			Organic		
	100% organic	75% organic + innovative organic practices	Inorganic	100%	State recommendation	50% organic + 50% inorganic	75% organic + 25% inorganic	Integrated	Mean	100% organic	75% organic + innovative organic practices	100% inorganic
Dharwad												
Pigeonpea + greengram	66,550	65,030	55,890	67,410	56,900	60,710	62,082	32,714	29,915	22,587	29,330	26,280
Pigeonpea + soybean	52,018	46,236	44,956	54,418	45,470	45,946	48,174	34,714	31,915	24,587	31,330	28,280
Pigeonpea + groundnut	96,200	92,350	86,150	1,00,450	88,250	90,250	92,275	38,714	35,915	28,587	35,330	32,280
Cotton + greengram	52,380	46,070	43,300	59,710	51,340	47,000	49,967	40,250	35,237	22,400	33,965	25,816
Cotton + soybean	53,884	49,502	47,328	57,956	50,928	50,872	51,745	44,250	39,237	26,400	37,965	29,816
Mean	64,206	59,838	55,525	67,989	58,578	58,956		38,128	34,444	24,912	33,584	28,494
Jabalpur												
Basmati rice – wheat (durum) – green manure	2,46,682	2,13,465	2,96,404	2,31,196	1,94,178	1,98,523	2,30,075	2,17,336	1,93,057	1,43,992	1,39,133	1,68,565
Basmati rice – chickpea – maize fodder	2,38,523	2,01,157	2,89,961	2,64,403	2,36,884	2,32,808	2,43,956	2,21,153	2,05,104	1,54,818	1,49,695	1,80,658
Basmati rice – berseem (fodder and seed)	2,53,155	2,34,873	3,46,630	3,04,831	2,63,080	2,94,686	2,82,876	1,81,104	1,73,243	1,46,392	1,43,886	1,58,467
Basmati rice – vegetable pea – sorghum (fodder)	3,00,923	2,75,758	3,34,277	2,37,724	2,71,867	2,46,311	2,77,810	2,36,002	2,19,952	1,73,760	1,68,637	1,99,600
Mean	2,59,821	2,31,313	3,16,818	2,59,539	2,41,502	2,43,082		2,13,899	1,97,839	1,54,741	1,50,338	1,76,823
Ludhiana												
Basmati rice-chickpea-GM	2,08,930	2,16,345	1,49,079	1,53,422	1,72,995	1,68,720	1,78,249	96,050	95,925	79,600	82,900	86,295
Basmati rice-wheat-GM	2,22,335	2,26,691	2,02,773	2,06,993	2,00,951	2,05,230	2,10,829	94,175	92,972	69,950	82,258	79,524
Cluster bean-wheat-summer moong	1,54,821	1,50,543	1,36,645	1,37,850	1,34,655	1,36,138	1,41,775	85,825	84,515	66,965	66,818	76,045
Soybean -wheat	1,46,816	1,44,222	1,31,949	1,26,601	1,25,513	1,25,611	1,33,452	77,650	77,013	62,207	61,974	63,001
Mean	1,83,226	1,84,450	1,55,112	1,56,217	1,58,529	1,58,925		88,425	87,606	69,681	73,488	76,216
Modipuram												
Basmati rice- wheat - sesbania green manure	1,89,978	1,69,740	1,83,502	1,96,069	1,98,472	1,81,809	1,86,595	1,12,930	1,06,555	79,050	89,650	1,03,840
Rice- barley (maize) – green gram	1,98,340	1,65,660	2,27,468	2,30,034	2,31,959	1,95,808	2,08,212	1,24,500	1,19,000	1,09,257	1,30,357	1,18,979
												1,22,040
												1,20,689

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	
Green gram - coriander	89,481	90,722	83,676	1,00,542	88,722	1,02,891	92,672	40,938	53,438	54,637
Cluster bean - fennel	1,88,273	1,84,935	1,82,748	2,12,930	1,88,185	2,16,800	1,95,645	45,136	57,636	65,228
Cluster bean – coriander	1,10,123	1,08,015	97,878	1,19,803	1,09,185	1,31,268	1,12,712	40,938	53,438	54,637
Mean	1,37,218	1,38,284	1,30,941	1,54,147	1,38,871	1,61,104		43,037	55,537	65,661
Nareन्द्रapur										
Basmati rice-broccoli-Sesbania green manure	254785	252429	205428	210578	218572	207069	224810	98901	99101	108198
Paddy– mustard–greengram	195921	196102	161520	164428	174332	174524	177805	89900	89900	104007
Paddy– capsicum– greengram	500820	501988	419388	422263	446347	422952	452293	117495	117495	137571
Paddy – french bean – sesame	185246	201560	148780	153372	163896	156049	168151	83425	83425	89160
Mean	284193	288020	233779	237660	250787	240149		97431	97481	118568
Sardar Krushinagar										
Groundnut- Wheat- Green gram	3,23,949	2,72,125	2,53,309	3,13,019	2,88,826	2,06,192	2,76,237	99291	114810	123592
Greengram- Cumin- Vegetable cowpea	2,48,889	2,09,122	1,85,090	2,43,961	2,21,044	1,70,863	2,13,162	85282	100281	95280
Greengram-Fennel-Fennel cont.	1,13,628	90,448	84,653	1,09,611	98,431	81,764	96,423	47318	57317	65069
Mean	2,28,822	1,90,565	1,74,351	2,22,197	2,02,767	1,52,940		77297	90803	100307
Udaipur										
Maize + blackgram (2:2)–durum wheat–sesbania (Gm)	193740	192311	209003	210987	188607	189950	197433	52412	64072	80096
Blackgram – wheat (Triticum aestivum)	164434	160166	177253	178233	155021	156612	165287	47140	54685	61737
Sweet corn + blackgram (2:2)–chickpea	154995	155388	187663	185347	162403	160988	167797	70041	81745	88213
Soybean – fenugreek	124795	119352	134643	135826	109932	112503	122842	37979	45569	47394
Mean	159491	156804	177141	177598	153991	155013		51893	61518	74994



Locations/Treatments	Gross returns (Rs/ha)						Cost of cultivation (Rs/ha)					
	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
Green gram - coriander	89,481	90,722	83,676	1,00,542	88,722	1,02,891	64,525	57,335	40,938	53,438	52,896	58,691
Cluster bean - fennel	1,88,273	1,84,935	1,82,748	2,12,930	1,88,185	2,16,800	81,685	70,745	45,136	57,636	63,532	72,631
Cluster bean - coriander	1,10,123	1,08,015	97,878	1,19,803	1,09,185	1,31,268	64,525	57,335	40,938	53,438	52,896	58,691
Mean	1,37,218	1,38,284	1,30,941	1,54,147	1,38,871	1,61,104	73,105	64,040	43,037	55,537	58,214	65,661
Narendrapur												
Basmati rice-broccoli-Sesbania green manure	254785	252429	205428	210578	218572	207069	121220	110461	98901	99101	105178	114327
Paddy- mustard- greengram	195921	196102	161520	164428	174332	174524	117500	104300	89900	89900	106057	116384
Paddy- capsicum- greengram	500820	501988	419388	422263	446347	422952	163013	146587	117495	117495	130640	150194
Paddy - french bean - sesame	185246	201560	148780	153372	163896	15049	96304	90804	83425	83425	87631	93368
Mean	284193	288020	233779	237660	250787	240149	124509	113038	97431	97481	107377	118568
Sardar Krushinagar												
Groundnut- Wheat- Green gram	3,23,949	2,72,125	2,53,309	3,13,019	2,88,826	2,06,192	143186	130959	99291	114810	121128	132177
Greengram- Cumin- Vegetable cowpea	2,48,889	2,09,122	1,85,090	2,43,961	2,21,044	1,70,863	101221	95260	85282	100281	92911	96727
Greengram-Fennel- Fennel cont.	1,13,628	90,448	84,653	1,09,611	98,431	81,764	79998	69981	47318	57317	63784	72016
Mean	2,28,822	1,90,565	1,74,351	2,22,197	2,02,767	1,52,940	108135	98733	77297	90803	92608	100307
Udaipur												
Maize + blackgram (2:2)-durum wheat-sesbania (GM)	193740	192311	209003	210987	188607	189950	103045	92924	52412	64072	77736	90387
Blackgram - wheat (Triticum aestivum)	164434	160166	177253	178233	155021	156612	72693	69185	47140	54685	59926	66795
Sweet corn + blackgram (2:2)-chickpea	154995	155388	187663	185347	162403	160988	101835	96546	70041	81745	85462	93647
Soybean - fenugreek	124795	119352	134643	135826	109932	112503	53259	52306	37979	45569	46105	49145
Mean	159491	156804	177141	177598	153991	155013	82708	77740	51893	61518	67307	74994

Table 7.2.19: : 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		Integrated		Organic		Inorganic		Integrated	
	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												
Frenchbean-cauliflower-frenchbean	1,45,311	1,31,061	18,308	1,23,786	1,30,109	1,11,596	1,10,029	0.56	0.52	0.08	0.47	0.43
Fallow-cauliflower-tomato	2,44,693	1,95,110	70,968	1,82,435	2,33,706	1,87,861	1,85,796	1.18	0.99	0.42	0.87	1.00
Black gram-cauliflower-summer squash	2,12,504	1,89,844	40,763	83,420	1,09,109	1,15,354	1,25,166	0.83	0.76	0.19	0.31	0.44
Lady finger-pea	1,37,768	1,19,185	4,128	48,262	77,851	73,276	76,745	0.85	0.76	0.03	0.28	0.44
Mean	1,85,069	1,58,800	33,542	1,09,476	1,37,694	1,22,022		0.86	0.76	0.18	0.48	0.58
Bhopal												
Soybean-durum wheat	101,359	87,615	52,589	51,823	67,909	77,043	73,056	1.70	1.53	0.95	0.91	1.17
Soybean-mustard	102,143	93,015	58,556	60,351	71,280	77,128	77,079	1.94	1.80	1.16	1.19	1.37
Soybean-chickpea	109,847	98,449	63,332	64,451	74,695	83,900	82,446	2.08	1.90	1.24	1.26	1.43
Soybean-linseed	134,898	126,126	79,580	80,938	93,743	1,02,040	1,02,888	2.51	2.39	1.54	1.56	1.78
Mean	1,12,062	1,01,301	63,514	64,391	76,907	85,028		2.06	1.90	1.22	1.23	1.44
Calicut : Turmeric	3,62,901	3,32,288	3,19,792		3,39,891	3,76,011		2.00	1.93	2.15	1.96	2.30
Coimbatore												
Brinjal - pear millet - green manure	1,88,995	2,00,017	1,79,282	1,66,854	1,54,030	1,63,415	1,75,432	1.92	2.13	2.58	2.09	2.12
Chillies - barnyard millet - green manure	59,583	84,191	57,944	59,012	83,245	69,690	68,944	1.64	2.04	1.94	1.60	1.97
Tomato - finger millet - green manure	56,682	98,835	62,892	49,755	1,11,317	1,23,073	83,759	1.57	2.03	2.08	1.59	2.34
Mean	1,01,753	1,27,681	1,00,039	91,874	1,16,197	1,18,726		1.71	2.06	2.20	1.76	2.14
Dharwad												
Pigeonpea + greengram	33,836	35,115	33,303	38,080	30,620	30,250	33,534	2.03	2.17	2.47	2.30	2.17
Pigeonpea + soybean	17,304	14,321	20,369	23,088	17,190	13,486	17,626	1.50	1.45	1.83	1.74	1.61
Pigeonpea + groundnut	57,486	56,435	57,563	65,120	55,970	53,790	57,727	2.49	2.57	3.01	2.84	2.73
Cotton + greengram	52,380	46,070	43,300	59,710	51,340	47,000	49,967	1.30	1.31	1.93	1.78	1.99



Locations/Treatments	Net returns (Rs/ha)						Net return per rupee invested (NRPRI)					
	Organic			Inorganic			Organic			Inorganic		
	100% organic	75% organic + innovative organic practices	Mean	100%	50%	75%	100% organic	75% organic + innovative organic practices	Mean	100%	50%	75%
Cotton + soybean	9,634	10,265	20,928	19,991	21,112	10,020	122	126	153	179	171	125
Mean	34,128	32,441	35,093	41,198	35,246	30,909	1.71	1.75	2.04	2.21	2.04	1.68
Jabalpur												
Basmati rice – wheat (durum) – green manure	29,346	20,409	1,52,411	92,063	25,613	17,670	56,252	1.14	1.11	2.06	1.15	1.10
Basmati rice – chickpea – maize fodder	17,370	-3,946	1,35,143	1,14,708	56,226	39,231	59,789	1.08	0.98	1.87	1.31	1.20
Basmati rice – berseem (fodder and seed)	72,051	61,630	2,00,238	1,60,945	1,04,513	1,30,181	1,21,593	1.40	1.36	2.37	1.66	1.79
Basmati rice – vegetable pea – sorghum (fodder)	64,922	55,806	1,60,517	69,086	72,267	33,792	76,065	1.28	0.13	1.92	1.36	1.16
Mean	45,922	33,475	1,62,077	1,09,201	64,655	55,219	1.23	0.89	2.06	1.74	1.37	1.31
Karjat												
Rice-Brinjal	6,28,324	5,58,528	6,06,239	3,76,257	5,04,823	4,61,240	5,22,569	3.06	3.02	3.74	2.94	2.68
Rice-Chickpea	63,137	50,755	44,923	35,702	51,457	45,019	48,499	1.57	1.51	1.52	1.53	1.47
Rice-Field bean	85,531	65,528	58,285	48,311	61,030	43,935	60,437	1.74	1.62	1.58	1.59	1.43
Rice-Onion (White)	4,11,514	2,33,904	3,02,898	1,96,497	3,56,140	2,10,996	2,85,325	2.95	2.24	3.10	3.04	2.14
Mean	2,97,127	2,27,179	2,53,086	1,64,192	2,43,363	1,90,298	2.33	2.10	2.49	2.04	2.28	1.93
Ludhiana												
Basmati rice-chickpea-GM	1,12,880	1,20,420	69,479	70,522	86,700	82,108	90,352	2.18	2.26	1.87	2.00	1.95
Basmati rice-wheat-GM	1,28,160	1,33,719	1,32,823	1,24,735	1,21,427	1,27,923	1,28,131	2.36	2.44	2.90	2.53	2.65
Cluster bean-wheat-summer moong	68,996	66,028	69,680	71,032	58,610	62,268	66,102	1.80	1.78	2.04	1.77	1.84
Soybean -wheat	69,166	67,209	69,742	64,627	62,512	62,508	65,961	1.89	1.87	2.12	1.99	1.99
Mean	94,801	96,844	85,431	82,729	82,312	83,702	2.06	2.09	2.23	2.12	2.07	2.11
Modipuram												
Basmati rice- wheat - sesbania green manure	77,048	63,185	1,04,452	1,06,419	94,632	73,123	86,477	0.68	0.59	1.32	0.91	0.67
Rice- barley (malt) – green gram	73,840	46,660	1,18,211	99,677	1,12,980	73,768	87,523	0.59	0.39	1.08	0.95	0.60
Maize (popcorn)- potato –okra + sesbania green manure	38,721	29,029	60,843	63,250	72,933	47,546	52,054	0.35	0.27	0.65	0.70	0.44

Locations/Treatments	Net returns (Rs/ha)						Net return per rupee invested (NRPRI)					
	Organic		Inorganic		Integrated		Organic		Inorganic		Integrated	
	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
Maize(sweet corn)- mustard-sesbania green manure	42,381	37,104	64,116	51,646	50,615	43,986	1.00	0.91	2.50	1.70	1.24	1.05
Mean	57,998	43,995	86,906	80,248	82,790	59,606	0.66	0.54	1.39	1.06	0.95	0.69
Pantnagar												
Basmati rice-wheat	1,55,178	1,41,851	1,34,550	1,36,612	1,47,099	1,41,041	2.14	2.03	2.16	2.12	2.08	1.94
Basmati rice -chickpea (4rows+ 2rows coriander)	1,68,046	1,41,880	1,37,975	1,39,020	1,43,692	1,20,658	2.42	2.05	1.90	2.13	2.07	1.71
Basmati rice-vegetable pea (4 rows vegetable pea +2 rows coriander)	3,94,279	3,50,444	2,78,967	2,78,548	3,01,661	3,02,192	5.45	4.69	4.34	4.21	4.23	4.20
Basmati rice -potato	1,73,434	1,67,082	1,33,277	1,10,181	1,27,016	1,12,030	2.21	2.21	1.74	1.41	1.51	1.29
Mean	2,22,734	2,00,314	1,71,192	1,66,090	1,79,867	1,68,980	3.05	2.75	2.53	2.47	2.47	2.29
Raipur												
Soybean-Maize	4,56,867	5,18,902	2,94,580	3,07,843	2,19,993	2,34,285	5.17	5.88	4.63	4.51	3.28	3.26
Soybean- Garden pea	2,84,849	3,81,886	1,50,561	1,83,511	2,53,751	2,32,077	4.23	5.48	3.28	3.51	4.35	3.75
Soybean-Chilli	2,60,292	3,44,883	2,41,755	2,52,336	1,37,227	1,96,236	3.63	4.64	4.17	3.96	2.64	3.10
Soybean-Onion	3,52,542	3,82,234	1,93,559	1,94,154	2,05,954	1,62,550	4.59	5.18	3.50	3.34	3.49	2.75
Mean	3,38,638	4,06,976	2,20,114	2,34,461	2,04,231	2,06,287	4.41	5.30	3.90	3.83	3.44	3.22
Ranchi												
Rice -wheat							44,999					1.40
Rice -onion							43,273					1.35
Rice -potato							45,854					1.43
Rice -okra							41,298					1.29
Mean	57,109	65,244	36,517	30,766	37,150	36,349	1.54	1.93	1.35	1.18	1.16	1.05
Umiam												
Broccoli -carrot	3,10,794	2,76,486	2,91,248		2,71,806							
Broccoli - potato	2,28,098	2,07,030	2,01,315		2,38,536							
Broccoli -french bean	2,53,446	2,35,253	2,14,523		2,58,239							
Broccoli -tomato	3,03,105	3,04,108	2,78,633		2,96,985							
Mean	2,73,861	2,55,719	2,46,430		2,66,392							



Locations/Treatments	Net returns (Rs/ha)						Net return per rupee invested (NRPRI)					
	Organic			Inorganic			Organic			Inorganic		
	100% organic	75% organic + innovative organic practices	Integrated	100%	State recommendation	50% organic + 50% inorganic	100% organic	75% organic + innovative organic practices	Integrated	100%	State recommendation	50% organic + 50% inorganic
Ajmer												
Green gram – fennel	79,309	98,718	1,14,325	1,25,676	1,05,860	1,20,827	1,07,453	1,92	2,41	4,00	3,46	2,76
Green gram - coriander	24,956	33,387	42,738	47,104	35,826	44,200	38,035	1,05	1,24	1,67	1,49	1,32
Cluster bean - fennel	1,06,588	1,14,190	1,37,612	1,55,294	1,24,653	1,44,169	1,30,418	2,21	2,51	4,38	3,84	3,03
Cluster bean – coriander	45,598	50,680	56,940	66,365	56,289	72,577	58,075	1,13	1,33	1,73	1,63	1,37
Mean	64,113	74,244	87,904	98,610	80,657	95,443		1,58	1,87	2,95	2,61	2,12
Narendrapur												
Basmati rice-broccoli – sesbania green manure	133565	141968	106526	111476	113394	92742	116612	2,10	2,29	2,08	2,12	2,08
Paddy– mustard– green gram	78421	91802	71620	74528	68275	58140	73797	1,67	1,88	1,80	1,83	1,64
Paddy– capsicum– green gram	337808	355401	301893	304768	315707	272759	314722	3,07	3,42	3,57	3,59	3,42
Paddy –french bean – sesame	88942	110756	65355	69946	76265	62881	78991	1,92	2,22	1,78	1,84	1,87
Mean	159684	174981	136348	140179	143410	121581		2,19	2,45	2,31	2,35	2,25
Sardar Krushinagar												
Groundnut- Wheat- Green gram	1,80,763	1,41,166	1,54,018	1,98,209	1,67,698	74,015	1,52,645	1,26	1,08	1,55	1,73	1,38
Greengram- Cumin- Vegetable cowpea	1,47,668	1,13,862	99,808	1,43,680	1,28,133	74,136	1,17,881	1,46	1,20	1,17	1,43	1,38
Greengram-Fennel- Fennel cont.	33,630	20,467	37,335	52,294	34,647	9,748	31,354	0,42	0,29	0,79	0,91	0,54
Mean	1,20,687	91,832	97,054	1,31,394	1,10,159	52,633		1,05	0,86	1,17	1,36	1,10
Thiruvananthapuram												
Cassava-veg. cowpea	96,560	1,25,830	1,98,548	2,63,012	1,52,361	52,216		1,24	1,31	1,77	1,97	1,45
Cassava-groundnut	5,85,952	6,53,117	6,13,961	5,31,026	4,94,472	2,94,639		2,95	3,00	3,44	3,08	2,57
Udaipur												
Maize + blackgram (2:2) – durum Wheat – sesbania (GM)	90,695	99,387	1,56,591	1,46,915	1,10,871	99,563	1,17,337	0,88	1,07	2,99	2,29	1,43
Blackgram – wheat (<i>Triticum aestivum</i>)	91,741	90,981	1,30,113	1,23,548	95,095	89,817	1,03,549	1,26	1,32	2,76	2,26	1,59
Sweet corn + blackgram (2:2) – chickpea	53,160	58,842	1,17,622	1,03,602	76,941	67,341	79,585	0,52	0,61	1,68	1,27	0,90
Soybean – fenugreek	71,536	67,046	96,664	90,257	63,827	63,358	75,448	1,34	1,28	2,55	1,98	1,38
Mean	76,783	79,064	1,25,248	1,16,081	86,684	80,020		1,00	1,07	2,49	1,95	1,32

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

Result for each centre are presented and discussed

Bajaura (Table 7.3.1.1 – 7.3.1.5)

Lady's Finger (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 all the traits were observed except plant height and fruit length. Best performing variety i.e., Perkins long green recorded significantly higher nos. of fruit/plant (32), days taken to flowering (57 days), fruit yield (7830 kg/ha), net returns (Rs. 1,07,413/ha) and B:C ratio (1.21) followed by Pusa makhmali which recorded fruit yield (7550 kg/ha) and nos. of fruits/plant (30). Hybrids, indiranil and Chameli-015 recorded the tallest plant but registered lower yield.

Table 7.3.1.1: Yield attributes and yield of okra in under organic condition at Bajaura

Varieties/hybrids	Plant height(cm)	Days taken to Flowering	No. of fruits /plant	Fruit length(cm)	Fruit yield (kg/ha)	Net Returns (Rs./ha)	B:C ratio
Perkins Long Green	193.0	57	32	12.1	7830	107413	1.21
Pusa Makhmali	191.9	54	30	11.7	7550	100330	1.13
Palam Komal	186.8	52	29	12.0	6750	80247	0.91
P-8 (check)	187.6	55	27	12.1	6150	58997	0.62
Indranil*	193.4	53	25	11.9	5580	43580	0.45
Chameli-015*	194.5	56	26	12.0	5840	53163	0.57
CD (P= 0.05)	NS	1.6	2.3	NS	430	11163	0.13

*Hybrids

French bean (Table 7.3.1.2): Three varieties and hybrids each were evaluated for their performance under organic conditions during *Kharif*. Significant differences were observed among the varieties for yield, nos. of pod/plant and plant height. Hybrid Faluni recorded significantly higher yield of 3930 kg/ha but gave lower net return and benefit ratio. Contender being the next best performing variety which recorded plant height (48.4 cm), number of pods per plant (27.0), pod length (12.3 cm) yield (3510 kg/ha) and highest net returns (Rs. 74,634/ha) and B:C (1.21).

**Table 7.3.1.2. Yield attributes and yield of French bean (*kharif*) under organic condition at Bajaura**

Varieties/hybrids	Plant height (cm)	No. of pods /plant	Pod length (cm)	Days taken to Flowering	Yield (kg/ha)	Net Returns (Rs./ha)	B:C ratio
Vaishnavi 264*	45.2	24	12.1	30	3040	21650	0.14
Palam Mridula	40.7	22	11.9	27	2040	52881	0.19
Falguni*	47.3	25	12.5	29	3930	15847	0.41
Contender	48.4	27	12.3	30	3510	74634	1.06
Shivani*	42.9	18	12.0	28	2580	23347	0.01
Pusa Parvati	47.3	23	11.8	30	3220	59746	0.65
CD (P= 0.05)	3.28	2.32	NS	NS	448		

*Hybrids

Cauliflower (Table 7.3.1.3): Four varieties and three 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 marketable curd (%) was higher in KT-25 followed by 71No (86.3 and 82.2%) but curds size (232.3 cm²), curd weight (677 g), curd yield (9260 kg/ha), total biomass (15730 kg/ha), net returns (Rs. 70,351) and B:C ratio (0.70) were obtained maximum in hybrid US-178. PSBK-1 being next best performing variety in term of yield (8300 kg/ha) and net return of Rs. 54,837/ha.

Table 7.3.1.3: Yield and yield attributes of cauliflower under organic condition at Bajaura

Varieties/ hybrids	Curd yield (kg/ha)	Biomass (kg /ha)	Curd size (cm ²)	Curd weight (g)	Marketable curd (%)	Net Return (Rs/ha)	B:C ratio
PSBK-1	8300	14530	225.1	569	78.9	54837	0.56
PSB-1	4950	10080	201.6	410	64.4	-7385	-0.07
Madhuri*	8230	14730	225.9	557	78.7	53318	0.54
KT 25	5270	10440	205.0	465	86.3	7830	0.09
US-178*	9260	15730	232.3	677	75.6	70351	0.70
Chamdramukhi*	7540	14110	214.6	524	78.7	35630	0.34
71No.*	7650	14350	220.1	533	82.2	40515	0.40
CD (P=0.05)	470	623	10.0	19.3	3.06	8723	0.08

.*Hybrid

Pea (Table 7.3.1.4): Eight varieties and including three hybrids of pea were evaluated for their performance and suitability under organic farming during *rabi*. Significant differences were observed among the varieties for all traits except plant height and shelling per cent. Among the varieties NP-20 attained the maximum plant height (53.6 cm) followed by Nirali (53.5 cm). Number of pods (30), number of seeds (7.0), yield (7440 kg/ha) were higher in Azad P-1 along with highest net returns (Rs 76,912) and B:C ratio (1.23) and found best performing variety followed by Ten plus which recorded 6550 kg/ha pod yield whereas length of pod (8.0 cm) was recorded maximum in Pb-89.

Table 7.3.1.4: Yield attributes and yield of Pea under organic condition at Bajaura

Varieties/ hybrids	Plant height(cm)	No. of Pods/plant	No. of seeds/pod	Pod length(cm)	Shelling (%)	Days taken to flowering	Pod yield (kg/ha)	Net Returns (Rs./ha)	B:C ratio
GC 477	50.6	20	5.0	6.0	63.3	107	4730	26097	0.42
Pb-89	53.3	26	6.7	8.0	63.0	94	6050	50870	0.81
Azad P-1	52.4	30	7.0	7.8	64.2	93	7440	76912	1.23
Lincon	49.8	24	6.0	7.0	64.7	102	5010	31259	0.50
Palam Triloki	51.2	25	5.7	6.5	62.7	94	5490	42261	0.70
Nirali*	53.5	27	5.7	6.9	62.2	110	5970	38491	0.52
NP-20*	53.6	25	6.0	7.0	63.6	111	5640	32354	0.44
Ten Plus*	52.9	28	6.7	7.8	64.4	109	6550	49394	0.67
CD (P= 0.05)	NS	3.47	1.15	1.03	NS	3.67	439	8254	0.12

*Hybrid

Tomato (Table 7.3.1.5): Total twelve varieties including seven hybrids were evaluated for their performance under organic conditions during summer. Significant differences were observed among the varieties/hybrids for different measured variables like fruit yield, no. of fruits/plant, fruit size, plant height, number of days taken to flowering and TSS. Among the tomato varieties, hybrid Red Gold attain maximum plant height (104.6 cm), highest number of fruits per plant (42.3), fruit size (28.9 cm²), highest yield (10480 kg/ha), net returns (Rs. 1,56,820) and B:C ratio (1.49) followed by RK-123 which recorded yield of 9000 kg/ha with Rs of 1,19,867 as net return.

Table 7.3.1.5: Yield and yield attributes of summer tomato varieties/hybrids under organic condition at Bajaura

Varieties/hybrids	Fruit yield (kg/ha)	No. of fruits/plant	Fruit size (cm ²)	Plant height (cm)	Days taken to flowering	TSS (°Brix)	Net Returns (Rs/ha)	B:C
Yash*	6060	34.7	22.9	102.4	41	5.5	46164	0.44
Naveen 2000*	5660	32.0	22.4	101.6	42	5.3	36195	0.34
Manisha*	5480	29.3	20.0	99.7	51	5.3	31861	0.30
Red Gold*	10480	42.3	28.9	104.6	44	5.5	156820	1.49
Hybrid 7730*	7140	38.0	25.2	102.1	43	5.1	73231	0.70
Roma	4770	24.0	19.5	89.4	50	5.1	20950	0.21
Sioux	3260	22.0	17.8	95.6	42	5.1	-16772	-0.17
Best of All	3380	22.7	17.2	95.7	44	5.5	-13928	-0.14
Palam Pink	3110	21.3	16.1	91.2	44	5.3	-20545	-0.21
Mar Globe	4880	25.0	23.0	99.5	41	4.9	23536	0.24
RK 123*	9000	41.3	23.5	103.5	43	5.4	119867	1.14
Heem Sohna*	8600	39.3	23.5	101.8	47	5.5	109657	1.04
CD (P=0.05)	629	3.35	2.78	3.49	3.18	0.28	15713	0.15

*Hybrid



Best performing varieties/hybrids of okra, frenchbean, cauliflower, pea and tomato at Bajaura

**Bhopal** (Table 7.3.2.1-7.3.2.4)

Different varieties of soybean, maize, wheat and chickpea was evaluated for their yield response to screen out as promising varieties for organic management practices for central India. Twelve varieties for each soybean and maize during *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 Soybean (Table 7.3.2.1): Soybean variety JS-20-29 attain significantly tallest plant (60.0 cm) but among the varieties, RVS-2002-4 resulted in higher seed yield (1516 kg/ha) owing to higher pods/plant (51) and numbers of seeds/pod (3.2) and was statistically on par with RVS-2002-6 by in significantly higher than other. JS-97-52 recorded lower soybean yield (963 kg/ha) with least pods/plant (39) and seeds/pod (2.47). Nutritional quality constituents such as protein and oil content were determined in seeds of different varieties of soybean and significant variation was also observed for protein and oil content. The percentage of protein among different varieties of soybean seeds was been in the range from 36.31 to 37.11% however, 8% more oil was recorded in RVS-2002-7 compared to JS 20-34 which was lowest in oil content.

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 (%)
JS-335	56	42	2.93	1233	4249	36.85	19.40
JS-93-05	48	41	2.53	986	3256	36.89	19.08
JS-95-60	44	45	2.93	1095	3350	36.81	18.71
JS-20-41	55	46	3.13	1243	4154	36.48	19.41
NRC-7	57	45	2.73	1104	3777	36.39	18.76
NRC-37	52	43	2.67	1000	3342	36.55	18.63
JS-20-29	60	46	3.00	1332	4208	37.11	19.47
RVS-2002-4	54	51	3.20	1516	4615	36.38	19.48
RVS-2002-6	48	49	2.67	1421	4509	36.31	19.53
RVS-2002-7	52	46	2.73	1239	4141	36.65	19.79
JS-97-52	53	39	2.47	963	3224	36.59	18.66
JS-20-34	51	44	2.73	1221	4115	36.68	18.33
CD (P= 0.05)	5.0	5.0	0.40	100	171	0.25	0.23

Performance of Maize (Table 7.3.2.2): Among the maize varieties grown under similar nutrient source and doses, Proagro 4412 was outperformed in yield (2867 kg/ha) followed by Kanchan (2837 kg/ha). Proagro 4412 was the leading variety in plant height (160 cm) and biomass yield (6727 kg/ha) whereas cobs/plant (1.4) and seeds per row (18) were found similar in both variety Kanchan and Proaagro 4412. Nutritional quality was determined in grains of different varieties of maize and differ significantly for protein, tryptophan content and ash. The higher values of protein concentration recorded in Proagro-4412 (9.94%) followed by CPBG 4202 (9.86%).

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)	Total biomass (kg/ha)	Protein (%)	Tryptophan (g/16 g N)	Ash (%)
Kanchan	155	1.4	11.9	18	2837	6693	9.73	0.88	1.65
Pratap 5	152	1.3	10.7	17	2610	6573	9.55	0.86	1.50
Arawali	137	1.2	10.5	16	2240	5620	9.81	0.78	1.59
Sona 222	147	1.3	10.4	16	2080	4630	9.68	0.85	1.52
Pratap 6	152	1.3	10.2	16	2333	5203	9.44	0.79	1.56
JM 216	147	1.2	10.0	16	2357	5110	9.74	0.76	1.52
Popcorn 1	114	1.0	9.9	13	1150	2643	9.58	0.72	1.48

Variety	Plant height (cm)	Cobs/ plant	Rows/ Cob	Seeds/ Row	Seed yield (kg/ha)	Total biomass (kg/ha)	Protein (%)	Tryptophan (g/16 g N)	Ash (%)
JM 8	145	1.2	10.4	16	2433	6110	9.66	0.87	1.49
JM 12	148	1.1	10.4	14	1937	4663	9.37	0.82	1.50
Proagro 4412	160	1.4	11.3	18	2867	6727	9.94	0.90	1.64
Sweet Corn	116	1.0	10.0	14	1400	2893	9.26	0.73	1.48
CPBG 4202	144	1.2	10.6	15	2057	4520	9.86	0.83	1.43
CD (P= 0.05)	8.0	0.22	0.87	0.6	267	306	0.21	0.03	0.10



Best performing variety of soybean (RVS-2002-4) and maize (Proagro) under organic conditions at Bhopal

Wheat (Table 7.3.2.3): Among the wheat varieties, GW-366 significantly outperformed in number of spikes/meter row length (104.0), seeds/spike (82) resulted in higher grain and biomass yield (4380 and 9017 kg/ha). GW 322 recorded second in yield but on par with Malwashakti, HI 8498 and HI 8663 which recorded of 3962, 3953, 3933 and 3913 kg/ha respectively.

Table 7.3.2.3. Response of wheat varieties for yield attributes and yields under organic management at Bhopal

Variety	Spikes/meter length	Seeds/spike	Grain Yield (kg/ha)	Total biomass (kg/ha)	Harvest index (%)
C-306	88	72	3190	6913	46
HI-8663	97	77	3913	8750	45
HI-1544	93	73	3557	7427	48
Malwashakti	97	75	3953	7830	50
GW-322	102	78	3962	8877	45
GW-366	104	82	4380	9017	49
HI-1531	86	69	3315	7007	47
HI-8498	96	77	3933	8333	47
HI-1500	94	76	3540	7497	47
JW-1202	91	74	3407	7427	46
HD-932	89	72	3150	7387	43
LOK-1	85	69	2917	6250	47
CD (P= 0.05)	5.0	5.3	316	710	

Chickpea (Table 7.3.2.4): Among the varieties, JG-130 recorded significantly higher seed yield (1813 kg/ha), seeds/pod (2.3) and pod/plant (91.2) followed by JG-63 (1717 kg/ha) in term of yield. Highest biomass was found in JG-63 (5223 kg/ha). Rest of varieties were ranged from 1043 to 1813 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	84.9	2.1	1580	4800	33
JG-16	82.5	1.9	1523	4303	35
JGK-3	75.8	2.0	1043	3120	33
RVG-203	81.9	2.1	1443	4243	34
JG-11	77.2	2.1	1413	4173	34
JG-684.6	2.0	1560	5200	30	
JG-130	91.2	2.3	1813	4933	37
JG-315	85.6	2.1	1550	4317	36
JG-63	86.3	2.1	1717	5223	33
JG-74	82.6	2.0	1257	4107	31
VIRAT	78.7	2.0	1267	3590	35
UJJWALA	76.7	2.0	1233	3547	35
CD (P=0.05)	6.6	NS	174	456	

Calicut (Table 7.3.3.1)

Among the 12 varieties of turmeric, maximum yield was recorded by Suguna (48000 kg/ha) followed by Pragati (44500 kg/ha), these were statistically on par. Variation in other turmeric varieties was recorded in range from 16300 kg/ha (Alleppey Supreme) to 35000 kg/ha (Kanthi). In term of quality of turmeric, Pragati and Prathibha recorded maximum oil content (5.80%) which was on par and the least oil content was noticed in Sudarsana (4.2%). Prabha recorded maximum oleoresin 14.90% whereas Pragati recorded highest curcumin content of 6.28% among the turmeric varieties. Variation in curcumin content found to be 69.3% between highest curcumin content varieties of Pragati to lowest with Kanthi.

Table 7.3.3.1 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 (%)
Prathibha	24200	5.80	12.10	6.10
Alleppey Supreme	16300	5.40	12.15	6.01
Varna	31800	4.80	10.35	4.21
Sobha	34700	5.00	9.60	4.04
Sona	34600	4.40	9.85	4.12
Kanthi	35000	4.80	10.10	3.71
Suvarna	33700	4.60	10.55	6.02
Suguna	48000	5.70	14.35	6.13
Sudarsana	42000	4.20	14.10	5.97
Kedaram	25000	5.40	13.95	6.23
Prabha	23700	5.40	14.90	6.08
Pragati	44500	5.80	14.55	6.28
Mean	32800	5.11	12.21	5.41
(CD=0.05)	2180	0.11	0.08	0.05

Coimbatore (Table 7.3.4.1)

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 among rice varieties evaluated under organic condition. Variety Red Kavuni recorded tallest plant (157.5 cm) while IR 2- been smallest (96.8 cm). Variation in productive tillers (numbers/hill) recorded in range from 12.6 to 19.4. White Ponni had the maximum productive tillers (19.4 numbers/hill) while Red Kavuni had least numbers of productive tillers/ hill (12.6). Maximum panicle length (27.8 cm), number of filled grains panicle (290.8) were recorded under Seeraga Samba. Grain yield difference was observed significantly among the rice varieties ranged from 2578 to 4898 kg/ha. CO(R) 48 recorded highest grain yield (4898 kg/ha) while CO (R) 51 had lowest grain yield (2578 kg/ha). Mappillai Samba recorded highest straw yield of 10833 kg/ha followed by CB05022 of 9349 kg/ha. Rice variety Improved White Ponni fetched the highest net return of Rs.58,286/ha followed by Mappillai samba (Rs.56,245/ha). Lowest net return per hectare was observed in rice variety CO 51 (Rs.1,868/ha). Likewise benefit cost ratio was also obtained with Improved White Ponni of 2.06.

Table 7.3.4.1: Response of rice varieties suitable for organic farming at Coimbatore

Varieties	Plant height at harvest (cm)	Productive tillers/hill (Nos.)	Panicle length (cm)	No. of filled grains panicle ⁻¹	Grain yield (kg/ha)	Straw yield (kg/ha)	Gross return (Rs./h)	Net return (Rs./h)	B:C ratio
Bhavani	139.5	16.8	27.6	203.6	4161	7451	81039	28170	1.53
IW Ponni	126.5	19.4	23.5	190.1	4762	8749	111156	58286	2.10
Mappillai Samba	155.8	16.9	26.8	204.3	4385	10833	109294	56245	2.06
Kitchili Samba	151.4	18.8	27.0	200.4	3102	6855	85372	32323	1.61
IR 20	96.8	18.7	25.4	171.2	3539	6492	69309	16440	1.31
CO 43	113.6	17.3	24.3	186.4	3781	7640	75821	22952	1.43
CO(R) 48	119.2	17.9	27.2	192.8	4898	8884	95673	42803	1.81
CO(R) 51	108.9	14.4	24.1	111.1	2578	6426	54738	1868	1.04
CB 05022	128.2	16.7	26.1	202.9	4708	9349	93998	41128	1.78
KDML 105	142.3	16.1	25.8	145.6	2921	6038	69871	16822	1.32
Red Kavuni	157.5	12.6	25.8	183.3	3412	8198	84471	31421	1.59
Seeraga Samba	154.1	16.3	27.8	290.8	2910	6114	88042	34993	1.66
CD (P=0.05)	6.66	2.82	2.35	76.49	570	1230			

Dharwad (Table 7.3.5.1)

Evaluation of response of different varieties of chickpea and wheat for organic farming during *rabi* season.

Yield of chickpea and wheat (Table 7.3.5.1): Significant differences of chickpea and wheat varieties for yield were observed. Among the chickpea varieties, MABC 37 recorded maximum seed yield of 3066 kg/ha which is at par to A1 (2731 kg/ha), whereas MABC 27 produced lowest yield of 2221 kg/ha under organic condition. Among wheat varieties, UAS 446 (DW) recorded maximum grain yield (3141 kg/ha) which was significantly higher to other varieties whereas Bijaga Yellow (DW) recorded minimum grain yield (1788 kg/ha).

Table 7.3.5.1: Yield attributes of chickpea and wheat cultivars under organic condition at Dharwad

Chickpea		Wheat	
Cultivars	Yield (kg/ha)	Cultivars	Yield (kg/ha)
A 1	2731	BIJAGA YELLOW (DW)	1788
MABC 27	2221	UAS 446 (DW)	3141
MABC 37	3066	DWR 2006 (DW)	2424
BGD 103	2476	UAS 347 (BW)	2806
JAKI 9218	2650	NIAW 1415 (BW)	2858
CD (P=0.05)	428	CD (P=0.05)	208

**Jabalpur** (Table 7.3.6.1-7.3.6.3)

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. Among the rice varieties, IR 64 was the leading variety in all the traits attained maximum plant height (67.8 cm), effective tillers/hill (213 nos.), panicle length (25.67 cm), grains/panicle (100.32 nos.), grains weight (24.0 g) resulted in highest grain yield of 4062 kg/ha, straw yield 5235 kg/ha and harvest index 43.7. PS-3, P-4 and Sahyadri also perform better and recorded good yield (3782, 3711 and 3606 respectively) but on par to each other.

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	59.9	158.0	19.7	86.9	21.5	13.0	2755	5025	35.4
Sahyadri	64.8	188.0	22.3	95.8	23.3	14.4	3606	5001	41.9
PS 4	65.6	180.0	23.0	96.9	21.7	13.7	3711	4925	42.9
BVD 109	62.7	178.0	20.3	89.0	23.7	12.8	2976	4931	37.7
JR-201	61.7	173.0	20.0	87.0	23.4	13.0	2871	4954	36.7
Danteshwari	57.0	158.0	16.7	86.1	23.5	17.1	2556	3933	39.5
Madhumati	58.5	160.0	19.3	84.7	22.3	14.9	2685	4581	37.0
IR 36	63.8	180.0	20.7	91.3	23.2	12.8	3140	4919	38.9
MTU 1010	64.7	183.0	21.3	94.6	23.5	14.3	3408	4843	40.8
IR 64	67.8	213.0	25.7	100.3	24.0	13.6	4062	5235	43.7
Pusa basmati 1	63.8	181.0	21.0	93.7	22.8	14.6	3256	4949	39.6
PS 3	66.8	203.0	24.3	97.2	22.1	13.4	3782	5200	42.1
CD (P=0.5)	0.79	0.25	2.17	4.35	1.51	1.02	146	251	2.30

Wheat (Table 7.3.6.2): Among the wheat varieties, all the parameters showed significant differences. Though wheat varieties JW 3020 and HD 4672 recorded significantly higher yield attributing characters compared to others such as effective tillers/m², spike length (cm), grains/ear (nos.) and test weight (g) of 563, 9.5, 51.7 and 38.6 respectively with JW3020 and 55.4, 9.3, 49.3 and 38.4 respectively with HD 4672 but variety JW-17 gave maximum yield (3659 kg/ha) which was statistically on par to other except HD 4672 and HI 1418.

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	Plant Population /m ²	Ear head length (cm)	Seeds/ ear head	Test weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index
JW 17	89.2	498.0	208.0	7.9	44.0	36.3	3659	3873	48.6
JW 3020	87.3	563.0	223.0	9.5	51.7	38.6	3249	5676	36.4
JW 3173	89.9	518.0	209.0	8.2	45.3	36.7	3242	5284	38.0
JW 3269	85.2	500.0	223.0	8.1	45.0	36.4	3403	4286	44.3
JW 3288	84.2	477.0	240.0	7.6	41.7	36.2	3386	4391	43.5
HI 1531	84.1	485.0	211.0	7.8	43.0	36.3	3232	5336	37.7
HI 1500	87.3	534.0	207.0	8.4	47.0	37.5	3368	4702	41.7
C 306	89.6	539.0	241.0	8.7	47.7	37.9	3536	4156	46.0
HD 2004	85.4	531.0	205.0	8.4	46.0	37.3	3291	5301	38.3
HI 2987	90.8	545.0	220.0	9.1	48.7	38.3	3358	5011	40.1
HD 4672	91.7	554.0	244.0	9.3	49.3	38.4	3025	5518	35.4
HI 1418	89.7	540.0	216.0	8.8	48.3	38.0	2927	5697	34.0
CD (P=0.5)	0.23	44.66	NS	0.34	4.36	2.25	553	638	3.17

Rice equivalent yield and economics of different varieties of rice and wheat (Table 7.3.6.3): The monetary returns with different varieties has been computed by including price of seed yield and straw yield both. Cost of cultivation for all rice varieties was equal of Rs. 95,359/ha. Among the rice varieties, though rice equivalent yield (REY) recorded maximum with IR-64 of 4237 kg/ha but gross return, net return and benefit ratio was higher in Pusa Sugandha-3 (Rs. 1,56,480, 61,121/ha and 1.64 respectively) which was closely followed by Pusa Sugandha 4 with the value of Rs 58006 ha⁻¹ and 1.61, respectively as net return and B:C ratio. The cost of wheat production under organic condition amounted of Rs. 74244 ha⁻¹ for all varieties. Among different varieties, JW-17 gave maximum net monetary returns of Rs 51,018 and the B:C ratio of 1.69 which was closely followed by the values with variety C306 (Rs. 48,460 ha⁻¹ and 1.65).

Table 7.3.6.3: Economic of different rice and wheat varieties under organic farming at Jabalpur

Kharif					Rabi				
Rice varieties	REY (Kg/ha/yr)	Gross Return (Rs/ha)	Net Return (Rs/ha)	B:C Ratio	Wheat varieties	REY (Kg/ha/yr)	Gross Return (Rs/ha)	Net Return (Rs/ha)	B:C Ratio
PS 5	2881	115225	19866	1.21	JW 17	4175	125262	51018	1.69
Shehdri	3731	149241	53882	1.57	JW 3020	4006	120174	45930	1.62
PS 4	3834	153365	58006	1.61	JW 3173	3947	118396	44152	1.59
BVD 109	3140	94211	-1148	0.99	JW 3269	3974	119234	44990	1.61
JR – 201	3036	91084	-4275	0.96	JW 3288	3971	119144	44900	1.6
Dhanteshwari	2687	80613	-14746	0.85	HI 1531	3943	118304	44060	1.59
Madhuri	2800	111981	16622	1.17	HI 1500	3995	119848	45604	1.61
IR 36	3304	99119	3760	1.04	C 306	4090	122704	48460	1.65
MTU 1010	3569	107083	11724	1.12	HW 2004	3998	119934	45690	1.62
IR 64	4237	127095	31736	1.33	HI 2987	4026	120784	46540	1.63
Pusa 1	3380	135189	39830	1.42	HD 4672	3761	112822	38578	1.52
PS 3	3912	156480	61121	1.64	HI 1418	3687	110598	36354	1.49



High yielding variety (IR 64) of rice at Jabalpur



Best variety of wheat (JW 17) rice at Jabalpur

Karjat (Table 7.3.7.1 and 7.3.7.2)

Fifteen varieties of rice and groundnut each were evaluated for their suitability under organic farming in the system mode with same level and sources of nutrients.

Rice (Table 7.3.7.1): Fifteen varieties of rice including early, mid-late and late maturity category (4 varieties in each) including 3 popular among the farmers were evaluated for their suitability under organic condition. Variation for grain yield among the rice varieties ranged from 3033 to 4691 kg/ha. Among the rice varieties grouped in four categories, rice variety Sahyadri-4 (early maturing), Sahyadri-3 (mid-late maturing),



Sahyadri-5 (late maturing) and karjat-3 which is popular among farmers recorded significantly higher grain yield (4563, 4649, 4691 and 4209 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.

Groundnut (Table 7.3.7.1): Significantly higher pods yield (2374 kg/ha) of groundnut recorded in Konkan Gaurav followed by TG-26 and TAG 24 but these are statistically on par to each other. The variation in other varieties of groundnut from 1289 to 2155 kg/ha. Kopergaon-1 produced lower yield among the varieties. Haulm weight (3142 kg/ha) was also recorded higher in Konkan Gaurav over rest of the varieties.

Table 7.3.7.1: Evaluation of response for different varieties of rice on yields under organic condition at Karjat

<i>Kharif</i>				<i>Rabi</i>		
Rice varieties / hybrids		Grain yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)	Groundnut varieties /hybrids	Dry pods yield (kg/ ha)	Haulm weight (kg/ ha)
Early	Karjat - 4	3373	4663	Phule-6021	2066	2916
	Karjat-7	3501	5102	SB XI	1481	2289
	Ratnagiri-1	3430	5159	Western-44	1502	2235
	Sahyadri-4	4563	6590	Western-66	1828	2458
Mid-late	Karjat-5	3416	4578	TAG-24	2155	2844
	Karjat-6	3345	4819	TKG-Bold	1559	2352
	Palghar-1	3387	4578	Kopergaon-1	1289	1986
	Sahyadri-3	4649	6704	Phule Pragati (JL-24)	1377	2200
Late	Ratnagiri-2	3175	4422	JL-220	1351	2146
	Ratnagiri-3	3033	3897	JL-776	1977	2707
	Karjat-8	3430	4478	JL-501	1800	2542
	Sahyadri-5	4691	6746	TG-37 A	16.11	2519
Grown by Farmers	Karjat-3	4209	5045	TG-26	2276	3109
	Jaya	3519	4507	Konkan Gaurav	2374	3142
	Karjat-2	3359	4379	RHRG-6083	1712	2319
CD (P=0.05)		346	1426	CD (P=0.05)	209	433

System equivalent yield and economics (Table 7.3.7.2): Significantly higher rice equivalent yield (REY 18922 kg/ha), net return (Rs. 1,79,303/ha) and benefit cost ratio (2.10) were recorded with system 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 12286 kg/ha and Rs. 59,253/ha respectively

Table 7.3.7.2. Response of different varieties of rice and groundnut in rice-groundnut system on system equivalent yield and economics under organic management at Karjat

Rice	Groundnut	System's equivalent yield (kg ha ⁻¹)	Gross returns (Rs. ha ⁻¹)	Net returns (Rs. ha ⁻¹)	B:C ratio
Karjat - 4	Phule-6021	16691	302940	139205	1.85
Karjat-7	SB XI	13604	246912	83177	1.51
Ratnagiri-1	Western-44	13581	246501	82766	1.51
Sahyadri-4	Western-66	17086	310118	146383	1.89
Karjat-5	TAG-24	17163	311505	147770	1.90
Karjat-6	TKG-Bold	13806	250575	86840	1.53
Palghar-1	Kopergaon-1	12286	222988	59253	1.36
Sahyadri-3	Phule Pragati (JL-24)	14688	266585	102850	1.63

Rice	Groundnut	System's equivalent yield (kg ha ⁻¹)	Gross returns (Rs. ha ⁻¹)	Net returns (Rs. ha ⁻¹)	B:C ratio
Ratnagiri-2	JL-220	12315	223512	59777	1.37
Ratnagiri-3	JL-776	15633	283748	120013	1.73
Karjat-8	JL-501	15220	276251	112516	1.69
Sahyadri-5	TG-37 A	16079	291829	128094	1.78
Karjat-3	TG-26	18922	343438	179703	2.10
Jaya	Konkan Gaurav	18578	337192	173457	2.06
Karjat-2	RHRG-6083	14601	265003	101268	1.62
CD (P=0.05)		1307	23731	23731	0.14

Ludhiana (Table 7.3.8.1-7.3.8.2)

Sixteen varieties of rice and nine varieties of wheat were evaluated in rice-wheat system for their suitability under organic management. The field was green manured with sunn hemp before transplanting whereas wheat field was prepared by applying farmyard manure (FYM) to supply equivalent to 125 kg N/ha.

Rice (Table 7.3.8.1): Basmati rice variety Basmati 386 attained the highest plant height (151.3 cm) which was statistically at par with Basmati 370 and significantly higher than the other varieties. The lowest plant height was observed in Punjab Basmati 4 (93.5 cm).. The highest number of effective tillers/m² (358) was recorded in genotype RYT 3425, which was statistically at par with the RYT 3677 (awn less) and significantly higher than all the other varieties. The Basmati 370 recorded the lowest number of effective tillers/m² (255). The highest panicle length (29.5 cm) was observed in RYT 3425, however the differences among all the varieties were non-significant. The highest number of grains per panicle (70.3) was observed in RYT 3425, which was significantly higher than all the other varieties. Thousand-grain weight was not significantly affected with different varieties/genotypes.

Grain yields of basmati rice varied from 1630-3950 kg/ha with a maximum percent variation of 58.7. Basmati genotype RYT 3425 recorded the highest grain yield (3950 kg/ha), which was statistically at par with RYT 3677 (awn less), Pusa Basmati 1509, RYT 3649, Pusa Basmati 1121 and Punjab Basmati 4 but significantly higher than all the other varieties/genotypes. The lowest grain yield (1630 q/ha) was recorded with Basmati 370.

Table 7.3.8.1: Performance of basmati rice varieties/hybrids under organic management at Ludhiana

Rice varieties / hybrids	Plant height (cm)	Effective tillers/m ²	Panicle length (cm)	Grains/panicle	1000 grain weight (g)	Grain yield (kg/ha)	Straw yield (q/ha)
Punjab Basmati 5	116.3	307	25.9	54.3	25.3	3050	6050
Punjab Basmati 4	93.5	332	27.5	57.8	26.9	3580	6130
Punjab Basmati 3	108.6	325	27.3	57.2	27.1	3440	6240
Punjab Basmati 2	124.1	320	27.1	56.3	26.6	3400	6450
Pusa Basmati 1121	113.4	337	28.5	60.3	26.8	3600	6490
Pusa Basmati 1509	98.6	342	28.9	62.4	27.4	3680	6230
CSR 30	142.0	270	25.8	65.4	25.4	2270	6820
Basmati 386	151.3	261	25.4	64.2	24.3	1840	6950
Basmati 370	150.8	255	25.3	64.0	24.8	1630	7100
Pusa Basmati 1718	116.3	326	27.3	59.0	26.7	3460	6450
RYT3677(Awnless)	106.2	350	29.1	62.7	28.4	3770	6760
RYT 3425	121.3	358	29.5	70.3	28.6	3950	7070
RYT 3522	96.3	264	25.0	55.6	27.9	2390	5730
RYT 3649	98.6	340	28.6	62.4	27.7	3610	6320
RYT 3818	126.5	320	27.4	60.4	26.5	3430	6530
RYT 3677 (Awned)	95.8	314	27.0	58.9	25.9	3290	6630
CD (P=0.05)	5.1	10.2	NS	3.7	NS	4.3	4.33

Wheat (Table 7.3.8.2): Significant differences were observed among the varieties for plant height, effective tillers and grain yield. The variation for plant height was observed from 91.2 to 132.4 cm, variety C 306 attained tallest plant while Unnat PBW-550 been smallest 91.2 cm. The variation for number of effective tillers meter² (294.3), spike length (9.7cm), number of grains/spikes (44.8), thousand grains weight (44.8 g) and grain yield of 3460 kg/ha among different varieties significantly higher in Unnat PBW 550 it was statistically at par with BWL 3504 for effective tillers/m², spike length, grains/spike, 1000-grains weight and grain yield of 290.7 nos., 9.7 cm, 44.1 nos., 41.2g and 3330 kg/ha respectively. The lowest grain yield was recorded with fortified variety PBW 1 Zn (2520 kg/ha).

Table 7.3.8.2: Performance of wheat varieties/hybrids under organic management at Ludhiana

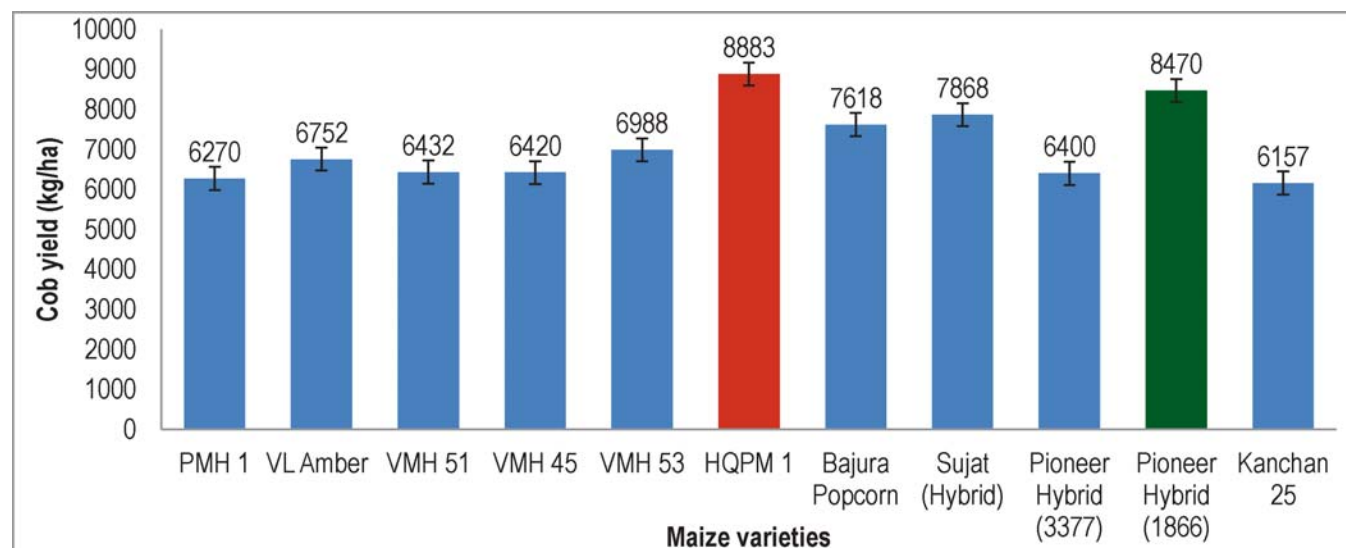
Wheat varieties/hybrids	Plant height (cm)	Effective tillers/m ²	Spike length (cm)	Grains/spike	1000 grains weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
PBW 1Zn	106.3	270.3	9.2	37.5	38.8	2520	4030
C 306	132.4	277.0	9.2	39.3	39.1	2870	5680
BWL 3500	104.5	281.3	9.4	39.6	39.6	2990	4860
PBW 175	102.5	274.7	9.1	38.9	39.4	2860	4630
PBW 660	102.8	283.0	9.5	40.1	40.2	3070	5210
BWL 3498	110.5	287.0	9.5	42.5	40.5	3130	5670
Unnat PBW 343	99.6	284.3	9.6	40.8	40.2	3090	5320
Unnat PBW 550	91.2	294.3	9.7	44.8	41.3	3460	5960
BWL 3504	109.3	290.7	9.7	44.1	41.2	3330	5780
CD (P=0.05)	6.5	10.8	NS	NS	NS	3.8	6.99

Modipuram

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

Maize: Among the tested varieties of maize, highest cob yield (8883 kg/ha) was recorded under HQPM 1 variety followed by Pioneer hybrid 1866 (8470 kg/ha) and Sujata (Hybrid) (7868 kg/ha) varieties (Fig). Cost of cultivation was similar among different varieties and highest net return was found under HQPM 1 followed by Pioneer hybrid 1866 and Sujata (Hybrid) varieties (Table 7.3.9.1).

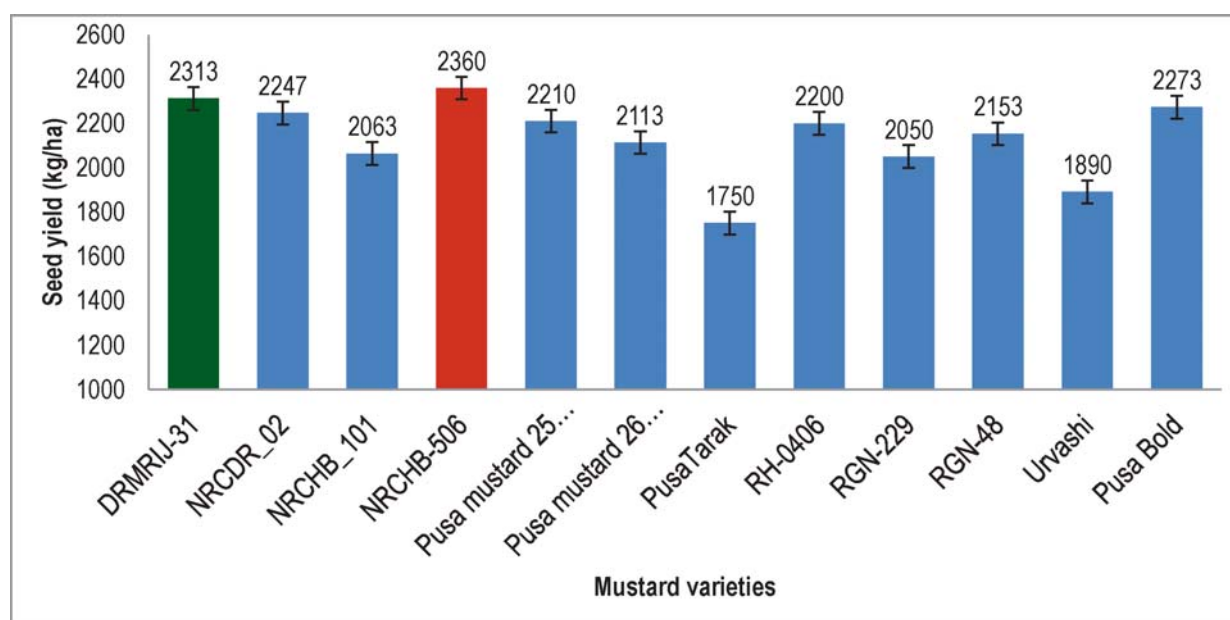
Mustard: Among the varieties of mustard, highest seed yield (2360 kg/ha) was recorded under NRCHB 506 followed by DRMRIJ 31 (2313 kg/ha) and Pusa Bold (2273 kg/ha) varieties (Fig...). Cost of cultivation was similar among different varieties and highest net return was found under Pusa Bold variety followed by Pusa Tarak and RGN 229 varieties (Table 7.3.9.2.).



Performance of different varieties of maize under organic farming.

Table 7.3.9.1: Economics of different of maize varieties under organic farming at Modipuram

Maize varieties/ hybrids	Cost of cultivation (Rs/ha/annum)	Gross return (Rs/ha/annum)	Net Returns (Rs/ha/annum)	B:C ratio
PMH 1	38266	62700	24434	1.64
VL Amber	38266	67520	29254	1.76
VMH 51	38266	64317	26051	1.68
VMH 45	38266	64200	25934	1.68
VMH 53	38266	69883	31617	1.83
HQPM 1	38266	88833	50567	2.32
Bajura Popcorn	38266	76183	37917	1.99
Sujata (Hybrid)	38266	78683	40417	2.06
Pioneer Hybrid (3377)	38266	64000	25734	1.67
Pioneer Hybrid (1866)	38266	84700	46434	2.21
Kanchan 25	38266	61567	23301	1.61



Seed yield of different varieties of mustard under organic farming.



Overview of Maize and Mustard varietal trial at Modipuram

**Table 7.3.9.2: Economics of mustard varieties under organic farming at Modipuram**

Variety	Cost of Cultivation (Rs/ha)	Gross return (Rs/ha)	Net returned (Rs/ha)	Benefit cost ratio
DRMRIJ-31	30932	127956	97024	4.14
NRCDR_02	30932	124269	93337	4.02
NRCHB_101	30932	114128	83196	3.69
NRCHB-506	30932	130538	99606	4.22
Pusa mustard 25 (NPJ112)	30932	122241	91309	3.95
Pusa mustard 26 (NPJ113)	30932	116894	85962	3.78
PusaTarak	30932	96797	65865	3.13
RH-0406	30932	121688	90756	3.93
RGN-229	30932	113391	82459	3.67
RGN-48	30932	119106	88174	3.85
Urvashi	30932	104541	73609	3.38
Pusa Bold	30932	125744	94812	4.07

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 107 to 143 cm. Pant Sugandha Dhan-21 recorded tallest varieties while Pant Sugandha Dhan-27 been smallest. Number of effective tillers/m² was in range from 191-257 and variety Pusa-1509 (257) recorded highest effective tillers/m² which was found at par with Pant Sugandha Dhan-27 (253) and Pant Basmati-2 (252), whereas, Pant Sugandha Dhan-15 produced lowest effective tiller/m² (191). Among different varieties, grain weight/panicle ranged from 1.49 to 2.02 g and significantly higher grain weight/panicle was observed in Pant Sugandha Dhan-25 (2.10 g) being at par with Pant Sugandha Dhan-17. Though 1000-grains weight among the rice varieties was found higher in Pant Basmati-2 (29.7 g) which was at par with Pant Sugandha Dhan-21 (29.6 g) & Pusa Sugandha-5 (28.4g) however, higher grain yield of rice was observed significantly with Pant Sugandha Dhan-27 (4095 kg/ha) which was at par with Pant Basmati-2 (4059 kg/ha), Pant Sugandha Dhan-21 (3904 kg/ha), Pusa Sugandha Dhan-5 (3976 kg/ha), Pant Basmati-1 (3833 kg/ha), Pusa-1509 (3702 kg/ha) and Pant Sugandha Dhan-25(3642 kg/ha).

Relative economics of different rice varieties under organic mode of cultivation: Cost of cultivation of different rice varieties was Rs. 37,751 for all varieties. Relative economics of different rice varieties under organic mode of cultivation showed that maximum net returns (Rs. 90210/ha) and B: C ratio (2.39) was obtained with Pant Sugandha dhan-27 followed by Pant Basmati-2 (Rs. 89094/ha and 2.36, respectively).

Table 7.3.10.1. Response for yield attributes and yield of rice varieties under organic cultivation 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	Net returns (Rs/ha)	B:C ratio
Pant Basmati-2	129	252	1.98	29.7	4059	4946	0.45	89094	2.36
Pusa Sugandha-4	125	243	1.87	26.9	3619	4307	0.46	75331	2.00
Pant Sugandha Dhan-21	143	237	1.96	29.6	3904	4745	0.45	84258	2.23
Pusa Basmati-1612	108	235	1.78	25.9	3475	4142	0.46	70867	1.88
Pusa Basmati-1	125	237	1.75	21.6	3571	4055	0.47	73843	1.96
Pusa Sugandha-5	119	241	1.86	28.4	3976	4196	0.49	86490	2.29
Taraori	114	225	1.75	21.4	2845	3807	0.43	51152	1.35
Pant Basmati-1	133	242	1.92	22.9	3833	4156	0.53	82026	2.17

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	Net returns (Rs/ha)	B:C ratio
Type-3	133	219	1.49	21.4	2535	3104	0.45	41481	1.10
Pusa-1509	112	257	1.80	26.3	3702	4121	0.47	77935	2.06
Pant Sugandha Dhan-17	119	206	2.02	22.2	3392	4147	0.45	68263	1.81
Pant Sugandha Dhan-15	128	191	1.95	23.4	3047	3861	0.44	57476	1.52
Pant Sugandha Dhan-25	131	215	2.10	23.7	3642	4413	0.45	76075	2.02
Pant Sugandha Dhan-27	107	253	1.86	26.0	4095	4934	0.45	90210	2.39
CD (P=0.05)	7.8	12.4	0.17	1.94	439	258	0.04		

Nutrient Uptake by Paddy (Table 7.3.10.2): Significant difference 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 52.6 to 86.3 kg/ha for N, 15.5 – 26.2 kg/ha for P, 48.3 – 79.3 kg/ha for K and 10.9 – 16.7 kg/ha for S. Nitrogen uptake among rice varieties was found to be significantly higher in Pant Sugandha Dhan-27 (86.3 kg/ha) which was at par with Pant Basmati-2 (84.3 kg/ha). P uptake was significantly higher in Pant Sugandha Dhan-27 (26.2 kg/ha) which was at par with Pusa Sugandha-5 (25.3 kg/ha). K uptake was significantly higher in Pant Sugandha Dhan-27 (79.3 kg/ha) which found at par with Pant Basmati-2 (77.2 kg/ha). Sulphur uptake among rice varieties was found to be significantly higher in Pusa-1509 (16.7 kg/ha) it was at par with Pant Sugandha Dhan-27 (16.3 kg/ha).

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

Treatments	N uptake (kg/ha)	P uptake (kg/ha)	K uptake (kg/ha)	S uptake (kg/ha)
Pant Basmati-2	84.3	24.7	77.2	14.3
Pusa Sugandha-4	72.4	21.5	70.0	13.1
Pant Sugandha Dhan-21	77.8	23.3	74.3	14.8
Pusa Basmati-1612	65.2	22.5	63.6	15.1
Pusa Basmati-1	63.7	20.2	64.7	14.5
Pusa Sugandha-5	71.9	25.3	68.8	15.0
Taraori	55.1	19.1	59.3	11.9
Pant Basmati-1	65.6	21.4	59.3	14.8
Type-3	52.6	15.5	48.3	10.9
Pusa-1509	71.4	22.1	67.4	16.7
Pant Sugandha Dhan-17	69.6	22.8	67.1	13.7
Pant Sugandha Dhan-15	64.0	21.4	60.4	13.4
Pant Sugandha Dhan-25	72.8	23.5	72.0	15.0
Pant Sugandha Dhan-27	86.3	26.2	79.3	16.3
CD(P=0.05)	9.73	3.27	10.85	2.3

Wheat (Table 7.3.10.3): Significant variation among the wheat varieties were observed for 1000-grains weight whereas plant height, spike/m², grain yield, straw yield and harvest index found to be non-significant difference. Plant height at harvest of different wheat varieties ranged from 85.3 to 93.4 cm, tallest variety was being UP-2684, (93.4 cm) followed by UP- 2565 (92.4 cm) while smallest was recorded with WH-1105 (85.3 cm). Spikes/m² of wheat varieties were in range from 189 to 265 and was found to be higher in DBW-17 (265) while lower was in PBW-550 (189). Test weight (1000-grains weight) of different wheat varieties recorded in range from 39.3 to 50.4 g. Grain weight per spike of wheat was observed highest under HD-2967 (1.83g), followed by PBW-550 (1.79g) and minimum found with DPW-17 (1.29g). Although, test weight of different wheat varieties ranged from 39.3 g to 50.4 g and significantly higher in UP-2425 (50.4g) than other varieties and lowest found with the DPW-62150(39.3g). Grain yield of different wheat varieties recorded in range from 2562 to 2904 kg/ha. Highest grain yield was noticed in UP–2565 (2904 kg/ha) which was at par with HD-2967 (2853 kg/ha) but lowest recorded with UP-2841 (2562 kg/ha). Percent increase in variety UP-2565 was 27.4% higher than UP-2841 the lowest yielding variety. Economic analysis of different wheat varieties revealed that highest net returns (Rs. 35029/ha) & B:C ratio (1.01) were observed under the variety UP-2565 followed by HD-2967 (Rs. 33811/ha and 0.97, respectively).



Table 7.3.10.3: Response for yield attributes and yields of wheat varieties under organic management at Pantnagar

Wheat varieties/ hybrids	Plant height (cm)	spikes/ m ²	grain wt./ spike(g)	1000- grain wt. (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest Index	Net returns (Rs/ha)	B:C ratio
WH-1105	85.3	204	1.66	42.0	2805	3162	0.47	32638	0.94
PBW-550	83.6	189	1.79	41.0	2665	2933	0.48	29284	0.84
UP-2628	89.7	231	1.50	43.1	2641	2834	0.48	28713	0.82
UP-1109	90.4	207	1.69	42.3	2687	2947	0.48	29801	0.86
UP-2425	88.6	217	1.70	50.4	2628	2897	0.48	28382	0.81
UP-2843	90.5	202	1.37	41.3	2571	2868	0.47	27009	0.78
UP-2841	91.7	224	1.48	39.6	2562	2930	0.47	26801	0.77
UP-2572	89.8	204	1.69	44.9	2734	3181	0.46	30942	0.89
DPW-62150	85.9	214	1.60	39.3	2614	2988	0.48	28042	0.80
UP-2565	92.4	198	1.77	45.5	2904	3158	0.48	35029	1.01
HD-2967	89.7	193	1.83	42.3	2853	3187	0.47	33811	0.97
UP-2684	93.4	256	1.34	40.4	2678	3027	0.47	29592	0.85
DBW-17	88.1	265	1.29	39.9	2714	2957	0.48	30464	0.87
UP-2784	90.7	230	1.53	43.1	2745	3113	0.47	31204	0.90
CD (P=0.05)	NS	NS	NS	1.76	NS	NS	NS		

Nutrients uptake by wheat crop (Table 7.3.10.4): Significant differences were observed for nitrogen and sulphur uptakes, while, phosphorus and potassium uptake varied non-significantly among different wheat varieties. Among different wheat varieties, highest uptake of nitrogen was recorded with WH-1105 (57.4 kg/ha) which was at par with UP-2565 (56.5 kg/ha), HD-2967 (55.3 kg/ha), UP-2684 (51.9 kg/ha) and UP-2784 (53.1 kg/ha). Phosphorus uptake among different wheat varieties observed maximum with UP-2572 (15.3 kg/ha) followed by UP-2843 (14.3 kg/ha) while potassium uptake was recorded highest with WH-1105 (68.2 kg/ha) followed by UP-2784 (66.0 kg/ha) and minimum found with UP-2628 (59.1 kg/ha). Although sulphur uptake (20.1 kg/ha) was found highest with HD-2967 followed by UP-2784 (19.1 kg/ha) and minimum found with UP-2628 (13.3 kg/ha).

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

Treatments	N uptake (kg/ha)	P uptake (kg/ha)	K uptake (kg/ha)	S uptake (kg/ha)
WH-1105	57.4	13.6	68.2	18.8
PBW-550	51.5	13.4	62.1	16.3
UP-2628	48.6	11.2	59.1	13.3
UP-1109	51.2	13.1	60.9	16.6
UP-2425	49.9	12.0	62.4	15.5
UP-2843	49.7	14.3	61.3	16.4
UP-2841	49.8	13.8	62.0	17.8
UP-2572	53.7	15.3	61.7	19.7
DPW-62150	49.4	12.6	60.0	17.9
UP-2565	56.5	13.5	64.9	18.0
HD-2967	55.3	13.6	65.2	20.1
UP-2684	51.9	12.5	62.9	18.2
DBW-17	49.9	13.5	62.5	18.8
UP-2784	53.1	13.9	66.0	19.1
CD(P=0.05)	5.59	NS	NS	2.61



Best Performing varieties of rice (Pant Sugandha Dhan-27) and wheat (UP 2565) under Organic farming at Pant Nagar

Raipur (Table 7.3.11.1 – 7.3.11.3)

To assess the response of rice varieties including traditional and improved scented rice and improved chickpea varieties were evaluated under organic production system.

Traditional short grain aromatic rice (Table 7.3.11.1): Among the traditional short grain aromatic rice, variety Gangabaru recorded tallest plant (186.0 cm) while Dubraj Sel.01 recorded smallest plant (137.0 cm). The number of tillers hill⁻¹ was significantly higher in Tarunbhog Sel.01 (11.15 hill⁻¹) over other varieties whereas the maximum no. of filled grains panicle⁻¹ was obtained in variety Gangabaru and Karigilas (189) which was significantly superior over rest of the rice varieties. Other yield attributing characters like panicle length (cm) was higher in Gopapl Bhog (31.64 cm). As regards to test weight of the scented rice varieties, the highest test weight was achieved by Karigilas (37.78 g) while the lowest test weight in Vishanu Bhog Sel.01 (15.81g). Grain yield of traditional scented rice varieties to organic farming was influenced significantly and majority of varieties behaved differently to organic farming. Among tall traditional short grain aromatic rice varieties, Karigilas produced the highest yield (5449 kg/ha) which was significantly higher over rest of the traditional varieties. Among the other traditional short grain aromatic rice varieties Vishnubhog, Sel-1, Gopalbhog, shyamjeera and Badshahbhog gave similar yields to the tune of 3757 kg ha⁻¹ to 4327 kg ha⁻¹.

Improved scented rice (Table 7.3.11.1): growth and yield attributes of improved scented rice varieties indicate that the plant height was significantly higher in CR Sugandha Dhan-907 which is tall in nature, while other varieties, recorded in ranged 126-139. Maximum number of tillers hill⁻¹ was recorded in C.G. Sugandhit Bhog, followed by Sugandhmati, Similar trend was observed in number of grains/panicle and panicle length, however test weight was higher in Sugandhmati (24.98 g). Among the improved scented rice varieties the highest grain yield of scented rice was recorded in C.G. Sugandhit Bhog (5857 kg ha⁻¹) followed by Sugandhmati (5573 kg ha⁻¹) which were significantly superior over rest of the varieties. On the basis of seven years stability analysis, variety Karigilas, Badsahbhog, Gopalbbhog, Vishnubbhog and Tarunbhog, Sel-1 in traditional short grain aromatic rice and C.G. Sugandhit bhog and Indira sugandhit dhan in improved scented rice performed equally well under organic farming.

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

Varieties	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	Yield stability index	Net return (Rs/ha)	B:C ratio
I. Traditional short grain aromatic varieties											
Badshah Bhog Sel.01	183	10.22	157	30.29	15.57	3757	10538	26.25	0.85	59793	2.59
Gopapl Bhog	171	10.12	176	31.64	20.56	3953	13128	23.32	0.77	66210	2.76
Vishanu Bhog Sel.01	176	10.23	177	26.60	15.81	4274	12420	25.68	0.78	72854	2.94
Shyamajeera	162	9.39	180	26.13	16.12	4327	10176	29.88	0.57	71836	2.91



Varieties	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	Yield stability index	Net return (Rs/ha)	B:C ratio
Kubri mohar	161	10.19	142	26.85	17.23	2867	10136	21.98	0.70	38301	2.02
Dubraj Sel.01	137	9.59	157	26.65	21.19	3538	12794	22.56	0.78	61791	2.64
Lohandi	171	10.02	148	27.40	18.59	2844	11543	19.72	0.78	39185	2.04
Gangabaru	186	9.50	189	25.40	15.96	3538	14506	22.36	0.63	72490	2.93
Karigilas	176	9.91	189	27.52	37.78	5449	12407	30.53	0.77	99801	3.65
Lalu 14	117	6.40	97	20.35	16.19	1518	5970	20.43	0.52	3185	1.08
Tarun bhog Sel.01	174	11.15	173	23.36	16.20	3538	14957	19.10	0.89	58530	2.56

II. Improved scented rice varieties

C.G. Sugandhit Bhog	128	11.84	235	29.42	22.08	5857	10381	36.04	0.77	107137	3.85
IndiraSugandhit dhan	126	8.68	203	26.73	22.88	4843	8387	36.64	0.69	81893	3.18
Sugandhmati	139	10.48	214	26.76	24.98	5573	10911	33.71	0.48	101164	3.69
CR Sugandha dhan 907	179	10.19	163	24.71	19.06	4447	14477	23.49	0.74	78881	3.10
SEm ±	6.51	0.46	10.72	1.34	0.52	309	715	1.35	-	-	-
CD (P = 0.05)	19.08	1.35	31.45	3.94	1.52	908	2098	3.95	-	-	-

Chickpea (Table 7.3.11.2): All the growth and yield parameters of different chickpea varieties were influenced significantly. Variety BGD-128 (47.00 cm) attained the maximum plant height followed by Vaibhav, smallest plant was recorded in JG-11 (40.33cm). Variation in number of branches plant⁻¹ were from 3.54 - 5.16 whereas Jaki and RG2003-28 had the maximum nos. of branches while JG-14 had minimum. Number of pods/plants (54.43), seed yield (2034 kg/ha), net return and B:C ratio (Rs 96371/ha & 4.49) recorded significantly higher in BGD-128 followed by RG 2009-01 which recorded yield of (1863kg/ha) and found to be statistically at par to each other.

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	Yield (kg/ha)	Stover yield (kg/ha)	Harvest Index	Yield stability index	Net return (Rs/ha)	B:C ratio
Vaibhav	46.2	5.0	48.5	55.3	1765	1863	48.64	0.85	79941	3.90
JG-226	44.9	4.6	43.1	57.6	1324	1598	45.29	0.75	53056	2.92
Jaki	46.0	5.2	43.1	51.7	1201	1284	48.32	0.68	45588	2.65
RG2009-01	45.1	4.4	48.7	52.4	1863	1988	48.25	0.72	85916	4.11
RG2009-16	45.4	4.6	47.2	49.4	1814	1962	47.98	0.79	82928	4.00
RG2003-28	44.0	5.2	43.2	63.1	1225	1432	46.09	0.56	47081	2.71
Vishal	43.6	4.5	40.3	43.5	1250	1419	46.32	0.73	48575	2.76
JG-16	41.7	4.7	48.2	60.9	1706	1896	47.49	0.83	76344	3.77
Vijay	44.3	3.7	46.2	52.9	1716	2013	46.10	0.65	76954	3.79
JG-11	40.3	4.7	46.3	48.9	1625	1853	46.82	0.84	71397	3.59
JG-14	41.7	3.5	44.9	47.8	1593	1809	47.05	0.79	69486	3.52
Daftari-21	41.9	4.0	42.0	51.1	1225	1339	47.32	0.72	47081	2.71
JG-130	42.6	4.6	47.7	50.5	1765	1883	48.36	0.72	79941	3.90
PKV Kabuli	41.2	4.0	37.9	44.7	1127	1318	46.11	0.68	41107	2.49
BGD-128	47.0	4.7	54.4	56.7	2034	2212	47.89	0.76	96371	4.49
CD (P=0.05)	5.86	1.32	6.29	NS	263	223	3.86	-	-	-

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. The ranged for organic carbon was found to be between 0.74 to 0.78%, whereas, the ranged for available N was from 264 – 268 kg/ha, available P from 21.4 to 22.96 kg/ha and K were in range from 356-359 kg/ha respectively.

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

Varieties	Organic Carbon (%)	Available N (Kg ha ⁻¹)	Available P (Kg ha ⁻¹)	Available K (Kg ha ⁻¹)
Vaibhav	0.77	267	21.42	356
JG-226	0.77	267	22.16	357
Jaki	0.75	266	21.42	358
RG2009-01	0.76	265	21.37	358
RG2009-16	0.78	265	21.86	361
RG2003-28	0.77	267	21.41	359
Vishal	0.76	266	21.85	359
JG-16	0.77	267	21.74	359
Vijay	0.75	264	22.07	359
JG-11	0.75	265	21.94	357
JG-14	0.77	265	21.24	356
BGD-128	0.74	264	22.96	358
Daftari-21	0.77	265	21.27	359
PKV Kabuli	0.75	266	22.48	359
JG-130	0.74	268	21.86	356
CD (P=0.05)	NS	NS	NS	NS



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

Ranchi (Table 7.3.12.1 – 7.3.12.4)

Twelve varieties each of rice and wheat were evaluated for their suitability under organic farming in the system mode.

Rice (Table 7.3.12.1): Significant differences was observed for yield and yield contributing characters among rice varieties. Variation for effective tillers/m² among the rice varieties ranged from 224 to 281 cm. Significantly higher effective tillers/m² (281) was recorded in Akhchhay medium duration variety. Grains/panicle, 1000-grains weight, grain and straw yield) was highest in late duration variety M.T.U.-1010 (113, 24.53 g, 4494 and 6928 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 (3115kg/ha).



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

Rice varieties	Effective tillers/m ²	Grains/panicle	1000 grain weight (g)	Grain yield of rice (kg/ha)	Straw yield (kg/ha)
Short Duration Rice					
B.V.D. 110	263	96	22.42	3115	5270
Anjali	261	101	21.64	3205	5806
Sahbhagidhan	249	97	22.79	3467	5694
Birsa vikas dhan 203	224	106	22.22	3870	6250
Medium duration Rice					
Naveen	234	109	21.60	3989	6191
Akhchhay	281	99	23.38	3314	5608
Birsa dhan 201	251	105	23.06	3809	6169
Lalat	253	110	23.24	4306	6634
Late duration Rice					
Birsamati	269	108	20.01	4066	6386
Birsa vikas sugandha 1	228	108	21.36	3795	6239
Pusa sugandha	235	112	20.95	3813	6045
M.T.U. 1010	265	113	24.53	4494	6928
CD (P=0.05)	35.7	17.1	1.93	640	960

Wheat (Table 7.3.12.2): Variation for yield attributes and yield were found to be significant among the wheat varieties. Number of tiller m⁻² was in ranged between 275- 348, number of grains/spike was between 30.7 -40.6 and the variation in 1000-grains weight of the wheat was in ranged between 42.61 -48.30. Among the wheat varieties, Raj 4229 recorded significantly higher number of No. of spikes/m² (348 nos.). Although number of grains/spike (40.6) and 1000-grains weight (48.3 g) was higher in WR 544 however, variety K-0307 resulted in significantly higher yield of 3313 kg/ha which was statistically at par with Raj 4229 (3176 kg/ha), DBW 39 (2997 kg/ha), GW 366 (2950 kg/ha) and BG-3 (2828 kg/ha).

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

Wheat varieties	No. of spikes/m ²	Grains/spike	1000 grain weight (g)	Grain yield of wheat (kg/ha)	Straw Yield (kg/ha)
Timely Sown Wheat					
Raj 4229	348	38.1	44.55	3176	4671
HD2733	275	36.4	42.61	2243	4613
K 0307	312	34.8	42.99	3313	4421
DBW 39	284	36.2	46.51	2997	4550
Late sown Wheat					
BG 3	317	38.0	47.65	2828	4499
DBW 14	301	35.0	44.90	2638	4175
GW366	329	35.8	45.80	2955	4255
K 9107	304	36.8	43.21	2745	4429
Very late sown Wheat					
HI 1563	286	38.4	46.90	2503	4060
NW-2036	323	30.7	43.71	2653	4017
Raj 4250	311	32.2	44.87	2288	4033
WR 544	292	40.6	48.30	2575	4110
CD (P=0.05)	38.4	6.27	3.22	478	554

Systems equivalent yield and economics of varieties of rice and wheat (Table 7.13.12.3): Different combinations of rice and wheat varieties evaluated in system mode for system equivalent yield found to be significant and maximum systems equivalent yield of 725kg/ha was recorded with combination T12 - Rice (M.T.U. 1010) – Wheat (WR 544) which was statistically on par with T8 - Rice (Lalat) – Wheat (K 9107) of 7217 kg/ha. During *kharif*, rice variety MTU-1010 resulted in significantly higher net return (Rs. 81159/ha) and B:C ratio (2.13) over other varieties but it remained at par with Lalat (net return Rs. 76167/ha and B:C 2.0) and Birsamati (net return Rs. 70086/ha and B:C ratio 1.84). In *rabi* wheat variety K-0307 registered significantly more net returns (Rs. 38430/ha) however, it was at par with Raj 4229 (Rs 35298 /ha) and also showed the highest benefit: cost ratio (0.80) over rest of the varieties. In terms of system economics of rice-wheat cropping sequence rice MTU1010 and wheat WR-544 gave highest system net returns (Rs. 101637/ha) and system B:C ratio (2.59). While, the lowest system net return (Rs. 61906/ha) and B: C ratio (1.58) was obtained in Anjali (Rice) – HD2733 (Wheat) cropping sequence.

Table 7.3.12.3: Systems equivalent yield, net returns (Rs/ha) and B:C ratio of different varieties of rice and wheat for organic farming

Cropping system	Systems equivalent yield (kg/ha)	Rice (<i>kharif</i>)		Wheat (<i>Rabi</i>)		System	
		Net Returns (Rs/ha)	B:C ratio	Net Returns (Rs./ha)	B:C ratio	Net Returns (Rs./ha)	B:C ratio
Short Duration Rice - Timely Sown Wheat							
T1- Rice (B.V.D. 110) -Wheat (Raj 4229)	6484	45728	1.20	35298	0.80	81025	2.00
T2 - Rice (Anjali) – Wheat (HD2733)	5584	49103	1.29	12803	0.29	61906	1.58
T3 – Rice (Sahbhagi dhan) Wheat (K 0307)	6981	54774	1.44	38430	0.87	93205	2.31
T4 - Rice (Birsa vikas dhan 203) – Wheat (DBW 39)	7048	65299	1.71	30899	0.70	96198	2.41
Medium duration Rice - Late sown Wheat							
T5 - Rice (Naveen) – Wheat (BG 3)	6988	67860	1.78	26801	0.61	94661	2.39
T6 - Rice (Akhchhay) – Wheat (DBW 14)	6111	51079	1.34	22026	0.50	73105	1.84
T7 - Rice (Birsa dhan 201) – Wheat (GW366)	6943	63713	1.67	29720	0.67	93433	2.35
T8 - Rice (Lalat) – Wheat (K 9107)	7217	76167	2.00	24760	0.56	100927	2.56
Late duration Rice - Very late sown Wheat							
T9 - Rice (Birsamati) – Wheat (HI 1563)	6720	70086	1.84	18714	0.42	88800	2.26
T10 -Rice (Birsa vikas sugandha 1) –Wheat (NW-2036)	6609	63578	1.67	22297	0.51	85875	2.17
T11 - Rice (Pusa sugandha) – Wheat (Raj 4250)	6240	63500	1.67	13523	0.31	77024	1.97
T12 - Rice (M.T.U. 1010) – Wheat (WR 544)	7225	81159	2.13	20478	0.46	101637	2.59
CD (P=0.05)	809	14639	0.38	5723	0.13	14728	0.38

Soil nutrient status at the end of cropping cycle (Table 7.3.12.4): 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 (6.29) in rice (B.V.D. 110) - wheat (Raj 4229) system of their initial value of 5.5. After completion of cropping cycle, higher organic carbon (0.73%) was found similar in rice (B.V.D. 110) -wheat (Raj 4229) rice (B.V.D. 110) -wheat (Raj 4229), rice (Akhchhay) – wheat (DBW 14) and Rice (Pusa sugandha) – Wheat (Raj 4250) system and it was increased by 73.8% to their initial value of 0.42. Availability of N in the soil after completion of cropping cycle was also higher in Rice (Akhchhay) – Wheat (DBW 14) of 279.67 kg/ha to their initial value. However, availability P and K in the soil was found to be higher in combination of rice and wheat variety i.e. rice (Pusa sugandha) – wheat (Raj 4250). Uptake of nutrients by the rice –wheat system recorded maximum by cropping sequence, MTU-1010(rice) – WR-544 (wheat) registered the highest N (155.23 kg/ha) uptake as well total NPK uptake (312.95 kg/ha) of the system.

Table 7.3.12.4: Soil nutrient status of different varieties of rice and wheat under organic management practices at Ranchi

Treatment	pH	OC %	After harvest of <i>rabi</i> crops			Systems nutrients uptake		
Cropping system			Avail. N	Avail. P	Avail. K	N	P	K
Short Duration Rice - Timely Sown Wheat								
T1- Rice (B.V.D. 110) -Wheat (Raj 4229)	6.29	0.73	262.76	44.17	224.21	132.78	28.06	106.75
T2 - Rice (Anjali) – Wheat (HD2733)	6.19	0.69	252.31	42.33	207.37	129.42	27.48	103.75
T3 – Rice (Sahbhagi dhan)–Wheat (K 0307)	6.04	0.70	256.18	43.25	216.24	142.35	29.80	109.29
T4 - Rice (Birsa vikas dhan 203) – Wheat (DBW 39)	6.07	0.69	249.67	38.17	202.35	151.46	29.99	122.35
Medium duration Rice - Late sown Wheat								
T5 - Rice (Naveen) – Wheat (BG 3)	6.08	0.72	255.14	41.57	211.46	149.70	17.09	121.92
T6 - Rice (Akhchhay) – Wheat (DBW 14)	6.19	0.73	279.67	42.24	220.67	132.79	28.73	108.98
T7 - Rice (Birsa dhan 201) – Wheat (GW366)	6.04	0.67	249.51	40.19	204.65	139.45	29.08	112.47
T8 - Rice (Lalat) – Wheat (K 9107)	6.00	0.69	256.82	43.21	218.55	154.92	31.94	125.62
Late duration Rice - Very late sown Wheat								
T9 - Rice (Birsamati) – Wheat (HI 1563)	6.07	0.72	257.98	43.45	219.15	145.61	31.60	118.82
T10 -Rice (Birsa vikas sugandha 1) –Wheat (NW-2036)	6.03	0.69	256.43	43.22	210.39	137.84	16.21	115.30
T11 - Rice (Pusa sugandha) – Wheat (Raj 4250)	5.99	0.73	267.24	44.47	224.63	140.89	29.71	114.74
T12 - Rice (M.T.U. 1010) – Wheat (WR 544)	6.04	0.69	252.41	43.19	209.37	155.23	31.66	126.06
CD (P=0.05)	0.29	0.04	8.07	3.84	6.10	16.21	3.60	13.40
Initial	5.5	0.42	230	32.25	162			

Umiam

The experiment consisted of three major crops viz., Maize, French bean 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 were local varieties. For tomato crop, 20 varieties/lines were screened under the experiment.

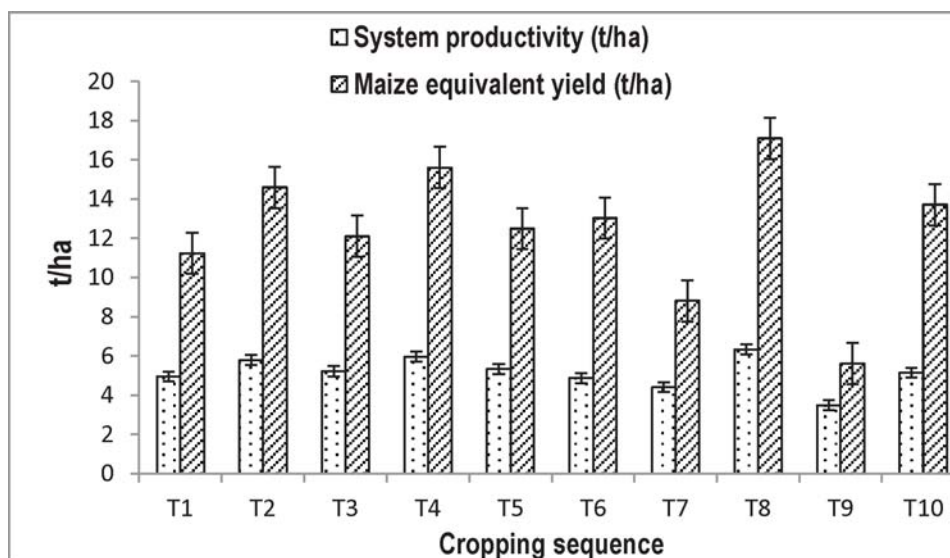


Fig.... System productivity and maize equivalent yield (seed yield basis) as influenced by different varieties of maize-French bean cropping systems

Performance of different varieties of Maize and French bean

In order to identify suitable lines of major crops for mid hills of Meghalaya, a total of 11 varieties/lines of Maize (8 composites, 1 hybrid and 2 local lines) and 10 varieties/lines of French bean (8 HYV and 2 local) were evaluated under organic management practices. French bean was sown in furrows between two rows of maize fallow under no till conditions. The highest system productivity (6.33 t/ha/year) was recorded by the cropping system T-8 (maize cultivar RCM 1-61 followed by French bean cultivar Naga local) followed by T-4 (maize variety RCM 75 followed by French bean variety RCM FB 18). The lowest system productivity was recorded in T-9 (local yellow of maize followed by Maram of French bean). The better performances of the cropping sequence T-8 and T-4 for higher system productivity is due to higher grain and seed yield of maize cultivars (cv. RCM 1-61 & RCM 75) and French bean cultivars (cv. Naga local & RCM FB 18) French bean varieties. The maximum maize equivalent yield (MEY) was also observed for maize cultivar RCM 1-61 - Naga local (French bean) followed by maize cultivar RCM 75 - French bean cultivar RCM FB 18 system. Higher yield along with good market price for French bean was one of the major causes for getting high MEY in the sequence. So, these varieties of maize (viz. RCM 1-61, RCM 75) and French bean (Naga local, RCM FB 18) fit perfectly within the cropping system and should be promoted for high system productivity.

Evaluation of maize varieties/genotype against insect pests and diseases: Though, all the maize varieties were infested by Fall Armyworm, *Spodoptera frugiperda* (J. E. Smith) (Noctuidae: Lepidoptera) at early vegetative stage but all infested plants did not produce dead hearts. Plant infestation were varied from 20.56 (RCM 1-1) to 35.45% (Vijay composite). Among the varieties, RCM 1-61, RCM-75, RCM 1-1 and RCM 1-2, recorded relatively less dead heart ranged from 8.32 to 17.04%. Among the different varieties of French bean screened, highest yield in terms of green pod was recorded Naga local (8.57 t/ha) followed by RCM-FB-18 (7.95 t/ha). Although, aphid incidence was found in most of the French bean lines, the infestation level was not so severe in economics point of view.

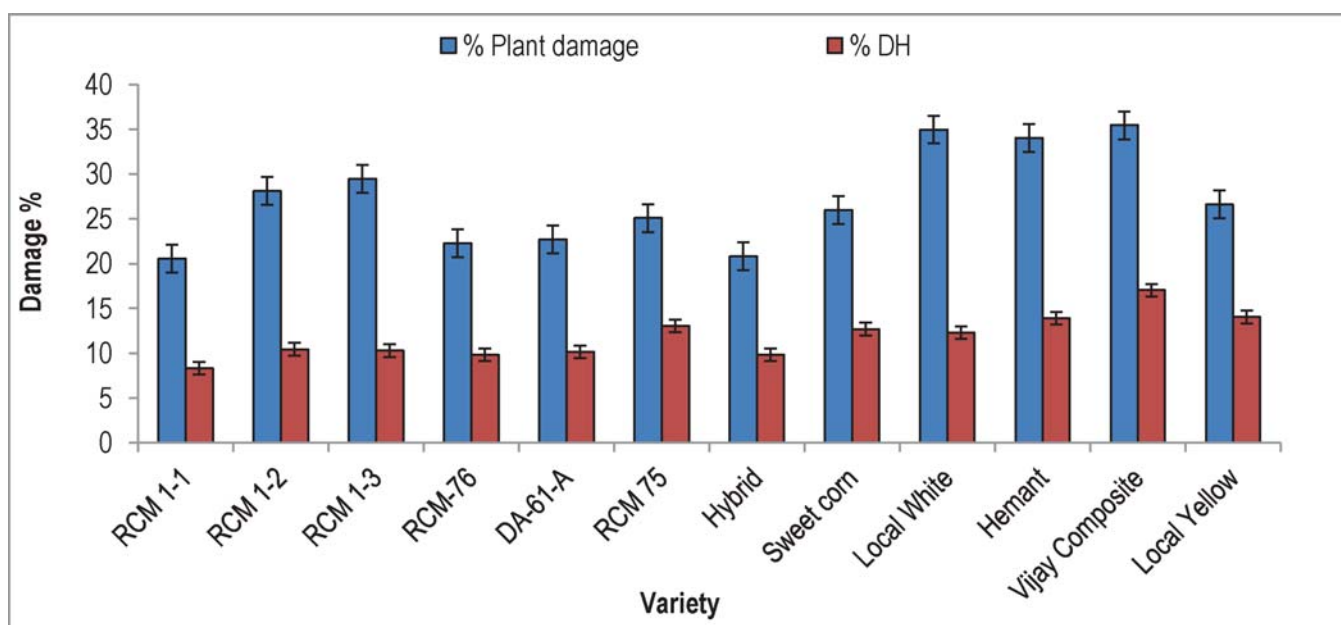


Fig..... Evaluation of maize varieties/genotype against fall armyworm

Soil chemical and physical properties (Table 7.3.13.1): The soil pH was not influenced by the cultivars of maize or French bean grown in sequence. The soil pH did not changed significantly due to the maize varieties. The SOC is considered as an important index of soil health and was significantly influenced by various cultivars of maize and French bean in sequence. However, the highest SOC (2.18) was recorded under the sequence of maize (DA 61-A) - French bean (Naga local) sequence which was followed by the sequence of RCM 75 (maize) - RCM FB 18 (French bean). Highest available N was recorded in Maize Local yellow - French bean Maram (217.3 kg/ha) and the lowest in Maize RCM 75 - French bean Nagaland Local 1 (199.8 kg/ha). However, the available P and K status in soil was not significantly influenced by the varieties of Maize and French bean grown in sequence.

Table 7.3.13.1: Soil physical and chemical properties after maize-French bean cropping system under organic production system at 0-15 cm soil depth

Maize-French bean system cropping	Soil pH	SOC (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
RCM 1-1 - RCM FB 61	5.04	2.11	210.8	18.4	200.9
RCM 1-2 - RCM FB 19	5.10	2.11	213.9	19.3	203.2
RCM 1-3 - RCM FB 37	4.98	2.16	214.7	20.2	204.4
RCM 75 - RCM FB 18	4.99	2.17	203.2	19.2	197.5
RCM 76 - RCM FB 62	5.13	2.14	203.5	18.4	197.8
Vijay composite - RCM FB 80	5.09	2.13	206.2	18.9	195.5
Hemant - Nagaland local 1	4.96	2.11	201.1	18.1	196.5
DA 61 A – Naga local	5.04	2.18	199.8	19.3	189.8
Local yellow - Maram	5.14	2.10	217.3	18.9	202.9
Local white - Nagaland local 3	4.98	2.12	213.3	20.2	198.8
CD ($p=0.05$)	NS	0.07	7.99	2.51	NS



Frenchbean and tomato crop at Umiam Meghalaya

Ajmer (Table 7.3.14.1--7.3.14.6)

Different varieties of seed spice crops coriander and fennel in *rabi* followed by green gram and cluster bean in *kharif* were evaluated/screened under organic condition. The total eight varieties each crop was evaluated of their suitability for organic farming.



Best Performance varieties green gram (MUM-2) and cluster bean (RGC-1038) under 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 (58.1 cm), number of primary branches (4.7), number of seeds/pod (10.9), also for seed yield and biomass yield. It recorded 799 kg/ha seed yield which was statistically on par with RMG-975 (788 kg/ha). Variety Ganga-1 produced lower yield of 623 kg/ha.

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 (155.0 cm) followed by RGC-12-1 (121.3 cm) but, variety RGC-1038 performed better among the different cluster bean varieties which produced highest nos. of primary branch/plant (7.3), pods/plant (72.4), seeds/pod (8.7) and seed yield (1595 kg/ha). Variety RGC-1055 being at par which recorded ns. pods/plant (68.9), seeds/pod (8.3) and seed yield of 1517 kg/ha yield. Lowest performance was observed in variety RGC-986 in term of yield attributes and yield.

Table 7.3.14.1: Performance of green gram 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)	Harvest index
RMG-975	57.4	4.5	26.5	10.8	788	2432	24.5
RMG-62	56.1	4.1	21.6	10.3	687	2278	23.3
MSG-118	50.1	3.7	25.9	8.5	637	2103	23.3
RMG-492	54.8	4.3	23.4	9.4	678	2663	20.3
SML-668	45.1	3.7	20.9	9.5	652	2035	24.5
GANGA-1	54.5	4.1	25.4	9.6	623	1957	24.3
IPM-02-3	51.5	4.1	23.9	10.0	652	2142	23.4
MUM-2	58.1	4.7	25.7	10.9	797	2438	24.6
CD(P=0.05)	5.61	0.52	2.55	1.4	121	391	5.3

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)	Harvest index
RGC-936	113.0	5.6	50.5	8.0	1308	3603	26.6
RGC-1001	108.2	5.3	47.9	7.9	1393	4113	25.5
RGC-1003	107.6	6.0	61.3	8.3	1372	4153	24.8
RGC-1038	119.3	7.3	72.4	8.7	1595	4337	27.0
RGC-986	155.0	3.0	29.9	7.9	613	3160	16.4
RGC-1055	116.1	6.5	68.9	8.3	1517	4140	26.9
RGC-1066	113.3	0.3	58.6	8.2	1323	3623	26.7
RGC-12-1	121.3	5.5	64.5	8.3	1313	3708	26.1
CD(P=0.05)	12.6	1.2	10.3	0.5	222	645	4.1

Coriander (Table 7.3.14.3): Growth and yield parameter of coriander showed significant variation. Variety Azad Dhan-1 outperformed superior over rest of varieties. It recorded tallest plant (126.7 cm), no. of primary and secondary branches/plant (7.2 & 21.1 respectively), number of umbels/plant (41.4), number of umbellets/umbel (6.73) and seed yield (1707 kg/ha). Variety ACr-1 being the next best performing variety which recorded 1693 kg/ha seed yield while RCr- 436 been lowest performing variety recorded nos. of primary and secondary branches/plant (5.5 and 16.3) and seed yield of 1327 kg/ha.

Fennel (Table 7.3.14.4): Yield contributing characters and yield of fennel varieties showed significant variation. Among fennel varieties, GF-12 performed superior with all yield attributes and yield. It recorded highest plant height (202.5 cm), number of primary and secondary branches (9.9 & 19.7), umbels per plant (36.3), umbellets per umbel (26.8) and seed yield per hectare (2800 kg). Varieties Af-1, RF-101 and RF-281 statistically at par with GF-12 for yield.

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 ⁻¹	No. of secondary branches plant ⁻¹	No. of umbel plant ⁻¹	No. of umbellate /umbel	Seed yield (kg/ha)
ACr-1	125.8	7.0	20.8	39.1	6.67	1693
Azad Dhania-1	126.7	7.2	21.1	41.4	6.73	1707
RCr- 435	112.8	5.3	17.4	30.6	6.30	1442
RCr- 436	111.7	5.5	16.3	32.4	6.07	1327
RCr- 446	101.6	5.7	17.9	29.9	5.47	1497
RCr- 684	97.5	6.1	18.7	34.1	5.87	1483
Hissar Sugandha	103.1	5.9	17.1	35.3	5.93	1507
Hissar Anand	107.1	5.8	18.7	37.3	6.40	1550
CD(P=0.05)	11.7	1.18	3.03	4.21	0.57	222.6

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 ⁻¹	No. of secondary branches plant ⁻¹	No. of umbel plant ⁻¹	No. of umbellate /umbel	Seed yield (kg/ha)
AF-1	195.7	9.7	19.2	35.8	26.0	2750
RF-101	178.7	7.1	14.1	27.2	20.7	2633
Co-1	176.9	5.9	13.1	27.0	23.5	2492
Rajendra Saurabha	175.1	6.0	13.8	26.9	23.9	2350
GF-12	202.5	9.9	19.7	36.3	26.8	2800
RF-281	180.9	6.7	16.5	29.9	21.0	2510
RF-125	165.7	7.1	16.9	31.5	24.1	2378
GF-02	182.6	5.2	12.9	27.2	23.2	2298
CD(P=0.05)	20.3	1.68	2.57	4.39	2.92	330.2



Best performing variety of coriander (Azad Dhania-1) 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 (51.21 kg/ha) followed by Azad dhania-1 (49.83 kg/ha) while lowest was in RCr-684 (38.14 kg/ha). P and K uptake was significantly higher in Azad dhania-

1 (10.49 & 71.53 kg/ha) followed by ACr-1 (10.31 & 71.48 kg/ha) while lowest uptake was in RCr-436 (7.77 & 55.04 kg/ha). Nitrogen uptake among fennel varieties was found to be significantly higher in AF-1 (83.85 kg/ha) followed by GF-12 (81.52 kg/ha) and lowest uptake by GF-02 (63.48 kg/ha). P and K uptake was significantly higher in GF-12 (17.80 and 121.44 kg/ha respectively) followed by AF-1 (17.53 and 120.59 kg/ha respectively) which was at par with RF-101 (16.33 and 115.26 kg/ha respectively).

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		51.21	10.31	71.48
Azad Dhanai-1		49.83	10.49	71.53
RCr- 435		39.03	8.96	59.68
RCr- 436		37.39	7.77	55.04
RCr- 446		43.49	8.92	59.36
RCr- 684		38.14	8.73	60.59
Hissar Sugandha		41.79	8.98	61.94
Hissar Anand		41.99	8.62	63.72
CD(P=0.05)				
Fennel				
AF-1		83.85	17.53	120.59
RF-101		75.68	16.33	115.26
Co-1		71.02	15.03	104.50
Rajendra Saurabha		64.15	14.81	102.38
GF-12		81.52	17.80	121.44
RF-281		72.27	15.81	114.69
RF-125		65.60	14.50	104.87
GF-02		63.49	13.80	98.97
CD(P=0.05)		9.47	1.75	14.35

Gangtok (Table 7.3.15.1--7.3.15.2)

Varietal evaluation of maize and buckwheat under organic management in maize-buckwheat cropping system

Maize (Table 7.3.15.1): Yield attributes and yield of maize cultivars influenced significantly under organic management condition. Maximum plant height at flowering stage was recorded with Seti makkai (305 cm) which performed statistically similar with Baiguini makkai but significantly superior over other remaining cultivars. Significantly higher dry matter accumulation at tasseling stage was found under Rato makkai (81 g plant⁻¹) as compared to other cultivars. Highest value of leaf area index (4.35) was noticed under Vivek Sankul-35 which was statistically at par with Rato makkai, Baiguini makkai and significantly higher than other cultivars. Maximum cob length (16.7 cm) was recorded under RCM 1-1 which was statistically at par with Seti makkai, Rato makkai but significantly higher than other cultivars. Significantly higher value of cob girth (13.4 cm) was registered under Vivek sankul-31 compared to other cultivars, but it was remained statistically at par with Vivek Sankul-37 and Vivek Sankul-35. Significant higher number of rows cob⁻¹ (12.9) was noticed under Vivek Sankul-35 as compared to Rato makkai, Satheya, RCM 1-1 but remained statistically at par with remaining cultivars. Maximum number of grains row⁻¹ (36.8) was observed under Kalo makkai which was statistically at par with Rato makkai, Vivek Sankul-31 but significantly higher than other cultivars. Significantly higher value of grain yield (2140 kg ha⁻¹) was observed under Vivek Sankul-35 as compared to other cultivars but remained statistically at par with Seti makkai and Vivek Sankul-31.

Table 7.3.15.1. Evaluation of maize composite under organic management condition

Cultivars	Plant height at flowering stage (cm)	Dry matter accumulation at tasselling (g plant ⁻¹)	LAI at Silking stage	Days to 50% tasselling	Coblenth (cm)	Cobgirth (cm)	No. of rows cob ⁻¹	No. of grains row ⁻¹	Grain yield (t ha ⁻¹)
Seti Makkai	305	72.4	3.07	72.7	16.0	11.4	11.4	31.0	2020
Pahenlo Makkai	237	50.5	3.25	68.0	14.9	11.6	11.3	33.7	1650
Rato Makkai	277	81.0	4.25	71.0	16.1	11.3	11.0	36.6	1400
Baiguni Makkai	296	43.2	4.34	71.0	15.4	11.2	11.5	30.4	1490
Kalo Makkai	258	46.8	3.48	67.3	14.0	10.4	8.67	36.8	1170
Satheyra	264	45.6	3.51	63.0	13.4	10.6	9.07	28.0	1270
RCM 1-1	219	46.5	3.66	65.8	16.7	10.4	10.6	29.4	1880
RCM 1-3	225	45.2	3.47	68.0	15.2	11.6	11.3	27.1	1910
RCM 75	231	49.7	3.95	67.7	15.3	11.7	11.6	32.2	1810
Vivek Sankul-31	149	22.8	3.33	62.8	13.4	13.4	11.6	34.5	2060
Vivek Sankul-37	157	24.2	3.74	62.0	11.3	12.0	12.4	30.4	1960
Vivek Sankul-35	138	31.4	4.35	61.0	12.2	13.2	12.9	30.7	2140
CD (P=0.05)	27.8	3.09	0.13	2.66	1.20	1.60	1.96	3.02	290

Economics of different cultivars of maize influenced significantly under organic management condition revealed that significant and maximum value of gross returns (8.56 (¹ × 10³ ha⁻¹), returns rupee⁻¹ invested (1.98) and PE (5.86 kg/ha/365) was noticed under Vivek sankul-35 as compared to other cultivars but it was remained statistically at par with Seti makkai, RCM 1-1, RCM 1-3, Vivek sankul-31 and Vivek sankul-37. Highest net returns (4.24 ¹ × 10³ ha⁻¹) was registered under Vivek sankul-35 which was statistically at par with Seti makkai, Vivek sankul-31 and significantly higher than other remaining cultivars. Maximum LUE (38.4%) was found under RCM 75 which was statistically at par with RCM 1-1 and significantly higher than remaining cultivars (Table 7.3.15.2).

Table 7.3.15.2. Economics of different cultivars of maize influenced by organic management condition

Cultivars	GrossReturn (¹ × 10 ³ ha ⁻¹)	Net Return (¹ × 10 ³ ha ⁻¹)	Return rupee ⁻¹ invested	PE (kg/ha/365)	Profitability Rs/ha/day	LUE (%)
Seti Makkai	8.07	3.75	1.87	5.53	102.8	34.1
Pahenlo Makkai	6.59	2.27	1.53	4.51	62.3	34.0
Rato Makkai	5.59	1.27	1.30	3.83	34.9	33.4
Baiguni Makkai	5.98	1.66	1.39	4.09	45.5	32.0
Kalo Makkai	5.38	1.06	1.25	3.68	29.1	36.5
Satheyra	5.73	1.42	1.33	3.93	38.8	34.7
RCM 1-1	7.52	3.21	1.74	5.15	87.9	38.0
RCM 1-3	7.64	3.33	1.77	5.24	91.2	35.9
RCM 75	7.23	2.91	1.68	4.95	79.8	38.4
Vivek Sankul-31	8.23	3.92	1.91	5.64	107.3	36.3
Vivek Sankul-37	7.86	3.54	1.82	5.38	97.0	34.5
Vivek Sankul-35	8.56	4.24	1.98	5.86	116.2	35.5
CD (P=0.05)	1.27	0.61	0.29	0.87	34.6	1.35

Buckwheat (Table 7.3.15.3): Grain yield and economics of buckwheat cultivars were influenced significantly under organic management. Among the buckwheat varieties, IC 104727 recorded days to maturity (110 days) as minimum days taken to maturity while maximum days taken to maturity was recorded in IC 49671 (128 days). Differences among the buckwheat varieties for yield ranged from 1420 to 2670 kg/ha.

Maximum grain yield (2670 kg ha^{-1}) was recorded under IC 109433 which was statistically at par with local Meethay, IC109729, IC49671 but significantly higher than remaining cultivars. Highest value of gross return ($10.69 \times 10^3 \text{ ha}^{-1}$), return rupee⁻¹ invested (2.45), PE (7.32 kg/ha/365) and Profitability ($173.5 \text{ }^1 \text{ /ha/day}$) was recorded under IC 109433 which was statistically at par with local Meethay, IC 109729, IC 49671 but significantly superior over all remaining cultivars. Maximum net return ($6.33 \times 10^3 \text{ ha}^{-1}$), was observed under IC 109433 which was statically at par with Local Meethay and IC 109729 and significantly higher than other cultivars. Maximum LUE (35.1%) was noticed under IC 49671 among the buckwheat varieties.

Table 7.3.15.3. Evaluation of varietal Buckwheat under organic management condition

Variety	Days to Maturity	Grainyield (kg ha^{-1})	Gross Return ($^1 \times 10^3 \text{ ha}^{-1}$)	Net Return ($^1 \times 10^3 \text{ /ha}^{-1}$)	Return rupee ⁻¹ invested	PE (kg/ha/365)	Profitability ($^1 \text{ /ha/day}$)	LUE (%)
Local Meethay	112	2580	103.0	59.7	2.37	7.07	163.5	30.6
Local Teethay	115	1770	70.8	27.2	1.63	4.85	74.6	31.6
IC 104727	110	1730	69.2	25.6	1.59	4.74	70.2	30.1
IC 36805	121	1850	74.0	30.4	1.70	5.07	83.3	33.3
IC 109729	119	2460	98.6	55.0	2.26	6.75	150.7	32.6
IC 15393	112	1840	73.8	30.2	1.69	5.05	82.8	30.8
IC 109433	123	2670	106.0	63.3	2.45	7.32	173.5	33.8
IC 49671	128	2460	98.2	54.7	2.26	6.73	149.8	35.1
IC 2018742	121	1810	72.3	28.7	1.66	4.95	78.7	33.1
PRB -1	123	1420	56.7	13.1	1.30	3.88	35.9	33.7
VL- Ugal	126	1510	60.3	16.8	1.39	4.13	46.0	34.5
Sangla B-1	118	1540	61.8	18.2	1.42	4.23	49.9	32.5
SEm $\pm$	1.42	0.07	3.00	3.27	0.07	0.20	8.10	0.39
CD @ 5 %	4.16	0.22	8.82	8.50	0.20	0.60	24.0	1.14



Sardarkrushinagar (Table 7.3.16.1 – 7.3.16.4)

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 and yield attributes characters and economics showed significant variations among groundnut varieties under organic condition. Ground nut variety GG-5 (B1) attained the maximum plant height (47.0 cm) while GJG-HPS-1(S) being the smallest in height. Significantly higher number of branches/plant (7.9), number of pods/plants (25), pod weight (11.5g), were recorded in GJG 17 (s).



Significantly higher pod yield (2346 kg/ha) were also recorded in GJG 17 which was at par with all other varieties except (GG 7 (B)) and (GG 5 (B1)) varieties, while higher haulm yield (3673 kg/ha) was noted under GJG17 (B) variety as compare to other variety. Economic performance of GJG 17 (S) recorded the best performance as compare to other variety under organic condition with net return (127503 ¹ /ha) and B:C ratio (2.58), at the same time as GG 5 (B1) variety of groundnut performed lowest in yield and economics parameter under organic package of practices.

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

Groundnut Varieties	Plant height at harvest (cm)	Number of branches/plant	Number of pods/plants	Pod weight/plant	Pod yield (kg/ha)	Haulm yield (kg/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C Ratio
GJG-HPS-1(S)	42.5	7.5	20.5	8.6	1898	3488	144638	95312	1.93
GG- 20 (SS)	46.8	7.7	23.5	10.7	1944	3611	148281	98955	2.01
GG-7 (B)	46.5	6.9	19.5	7.9	1759	2623	132228	82902	1.68
TG-37 (A) (B)	43.7	7.6	21.7	8.6	2037	3580	154734	105408	2.14
GJG-9 (B)	43.7	7.0	19.9	8.1	1852	3272	140718	91392	1.85
GG-5 (B1)	47.0	6.8	14.0	6.8	1420	2068	106563	57237	1.16
GJG-17 (S)	43.1	7.9	25.0	11.5	2346	3673	176829	127503	2.58
KDG-123 (B)	43.3	7.3	20.1	8.1	1883	2963	141973	92648	1.88
CD (P=0.05)	NS	NS	1.33	1.30	526	NS	-	-	-

Wheat (Table 7.3.16.2): Tillers per meter row length, number of grain per ear head and test weight of grain was non-significant while plant height, grain yield and straw yield showed significant variation among the wheat varieties. GW 272 being the tallest variety whereas GW 451 was the smallest. Difference for the effective tillers was ranged in 2.3 – 2.7 per meter row length. Spike length was in ranged from 6.7 cm to 10 cm in length. Nos. of grains/spike recorded in ranged from 28.3-31.3. Among the different wheat varieties, grain yield varies from 2315 - 3287 kg/ha. Maximum wheat yield was recorded in variety GW-451 (3287 kg/ha) which was on par with GW 496 and GW 273, but significantly higher than GW 322, 366, 1139 and GDW1255 and HI 8498. Highest straw yield was also obtained in GW 451 (4907 kg/ha). Gross return (96,898¹ /ha), net return (30,517 ¹ /ha) and B:C ratio (0.46) was also obtained in GW 451 and being the best performing varieties as compared to other among the wheat variety.

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

Wheat Varieties	Plant height at harvest (cm)	Effective tiller/meter row length	Spike length (cm)	No. of grains/spike	Test weight (100 gm)	Grain yield (kg/ha)	Straw yield (kg/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C Ratio
GW 451	71.7	2.4	6.7	28.3	13	3287	4907	96898	30517	0.46
GW 366	79.2	2.4	7.4	29.3	11	2407	3912	71921	5540	0.08
GW 322	76.6	2.5	10.0	29.0	12	2338	3681	69491	3110	0.05
GW 273	89.7	2.5	10.0	29.7	12	2824	4398	83796	17415	0.26
GW496	81.5	2.5	9.9	31.3	11	3102	4676	91574	25193	0.38
GDW 1255	72.3	2.6	8.3	30.0	12	2546	4167	76157	9777	0.15
GW1139	73.2	2.3	8.1	30.3	0	2477	3958	73796	7415	0.11
HI 8498	75.9	2.7	8.5	32.0	0	2315	3472	68287	1906	0.03
CD (P=0.05)	1.81	NS	NS	NS	NS	619	884	-	-	-

Green gram (Table 7.3.16.3): Yield attributes characters did not differ except number of seeds pod⁻¹ among the green gram varieties whereas yield and straw yield showed significant variations. Differences in plant height (cm), number of branches and pods /plant (nos.) and 100-seeds weight were found in range from 27.5"31.8, 4.0"4.7, 7.8 "10.2, 35.7 " 38.3 respectively. Although maximum plant height was recorded in Meha but GM 4 recorded highest number of branches plant⁻¹ (4.7), number of pods plant⁻¹ (10.2), number of seeds pod⁻¹ (5.2) resulted in significantly

higher seed yield (698 kg/ha) and higher stover yield (926 kg/ha). Economic performance of GM 4 variety recorded highest as compared to other variety under organic condition in gross return (63,812¹ /ha), net return (35,235¹ /ha) and B:C ratio (1.23), even as IPM 410-3 variety of green gram performed lowest in yield and economics under organic package of practices

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

Green gram Varieties	Plant height at harvest (cm)	Number of branches plant ⁻¹	Number of pods plant ⁻¹	Number of seeds pod ⁻¹	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	29.4	4.67	10.20	5.20	35.67	698	926	63812	35235	1.23
Meha	31.8	4.47	9.07	4.87	36.67	472	864	43912	15335	0.54
K 851	27.5	4.33	8.80	4.73	37.00	426	710	39398	10821	0.38
PDM 139	30.6	4.27	7.80	4.40	38.33	373	602	34483	5906	0.21
IPM 410-3	30.6	4.00	6.80	4.53	36.00	355	540	32677	4100	0.14
GM 5	31.2	4.60	9.13	5.13	37.00	556	895	51296	22719	0.80
PKVAKM 4	31.2	4.33	8.73	4.53	37.33	414	679	38225	9648	0.34
BGS 9	30.7	4.27	8.40	4.47	37.67	401	664	37099	8522	0.30
CD (P=0.05)	NS	NS	NS	0.65	NS	92	173	-	-	

Soil fertility status at the end of the crop sequence (Table 7.3.16.4): All the soil characteristics were improved from their initial value. At the end of cropping cycle, soil organic carbon found in range from 0.221–0.264%. Crops combination GG-5 (B1) “GDW 1255” GM 5 and GJG-17 (S) “GW1139” PKVAKM 4 recorded maximum soil organic carbon of 0.264% which was 38.9% higher to its initial value of 0.190%. Among the different combinations of groundnut-wheat-green gram, highest availability of N (182 kg/ha) in the soil was with treatment T₃ and T₅, available P (18.97 kg/ha) was higher in treatment T₂, while available K (186 kg/ha) recorded under T₃ treatment. Maximum water holding capacity (32.16%) was observed under treatment.

Table 7.3.16.4: Soil properties after completion of groundnut- wheat- green gram crop sequence under organic farming at SK Nagar

Groundnut-wheat-green gram	SOC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)	EC (dSm ⁻¹)	pH	MWHC (%)	BD (gm/cc)
T ₁ GJG-HPS-1(S) “GW 451” GM 4	0.253	173	18.14	179	0.10	7.74	32.16	1.416
T ₂ GG- 20 (SS) “GW 366” Meha	0.236	172	18.97	185	0.09	7.38	31.26	1.420
T ₃ GG-7 (B) “GW 322” K-851	0.221	182	18.08	186	0.09	7.29	31.05	1.412
T ₄ TG-37 (A) (B) “GW 273” PDM 139	0.254	173	17.26	179	0.10	7.04	29.70	1.413
T ₅ GJG-9 (B) “GW496” IPM 410-3	0.247	182	17.45	170	0.10	6.95	30.76	1.409
T ₆ GG-5 (B1) “GDW 1255” GM 5	0.264	172	17.73	184	0.09	6.83	28.58	1.419
T ₇ GJG-17 (S) “GW1139” PKVAKM 4	0.260	171	17.44	177	0.10	7.60	30.55	1.391
T ₈ KDG-123 (B) “HI 8498” BGS 9	0.264	181	18.34	174	0.10	7.62	30.91	1.415
Initial	0.190	147	10.92	140	0.09	7.14	26.62	1.480

Thiruvananthapuram (Table 7.3.17.1-7.3.17.2)

Growth attributes yield and economics of cassava (Table 7.3.17.1): Sree Swarna attained the maximum height (238.9 cm), but on par with M4. Sree Pavithra was the smallest variety (149.7 cm). Sree Swarna had the highest leaf production at 6 MAP (326) stem girth but on par with CR-24-4. Although, Sree Pavithra recorded highest average tuber weight/plant (342.49 g) followed by CR-24-4 but tuber length, tuber girth and tuber yield was recorded significantly higher in CR24-4 of 36.0 cm, 16.78 cm and 36970 kg/ha respectively among the cassava

varieties. Sree Vijaya was the next best performer variety in term of yield. The variety, Sree Reksha also generated higher profit (Rs. 6,87,275 ha⁻¹) and B:C ratio (3.90) followed by Sree Vijaya (Rs. 4,36,345 ha⁻¹ profit and 2.84 B:C ratio) under organic mode (Fig. 26).

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)	Tuber yield (kg ha ⁻¹)	Average weight of tuber (g/plant)
H-226	182.1	162	8.89	30.0	15.67	12750	139.5
H-165	194.4	144	8.44	32.2	15.67	21300	207.2
Sree Athulya	186.2	129	8.00	29.2	16.44	16050	162.5
Sree Swarna	238.9	326	15.22	15.0	6.22	12020	208.5
Sree Jaya	215.6	237	9.44	16.0	6.53	21540	229.3
Sree Vijaya	182.6	191	7.56	13.8	6.00	26940	215.0
Kalpaka	158.0	151	6.33	13.0	6.88	16390	270.8
Vellayani Hraswa	157.3	216	8.11	12.7	6.80	17370	248.1
Sree Pavithra	149.7	132	6.67	29.6	15.39	25800	342.5
Sree Visakhham	181.9	160	6.67	32.0	16.56	13380	217.3
CR-24-4	216.8	203	11.22	36.0	16.78	36970	291.9
M-4	227.8	191	9.33	37.0	15.96	9370	86.6
CD (0.05)	52.6	65.80	3.93	8.2	5.61	8690	125.5

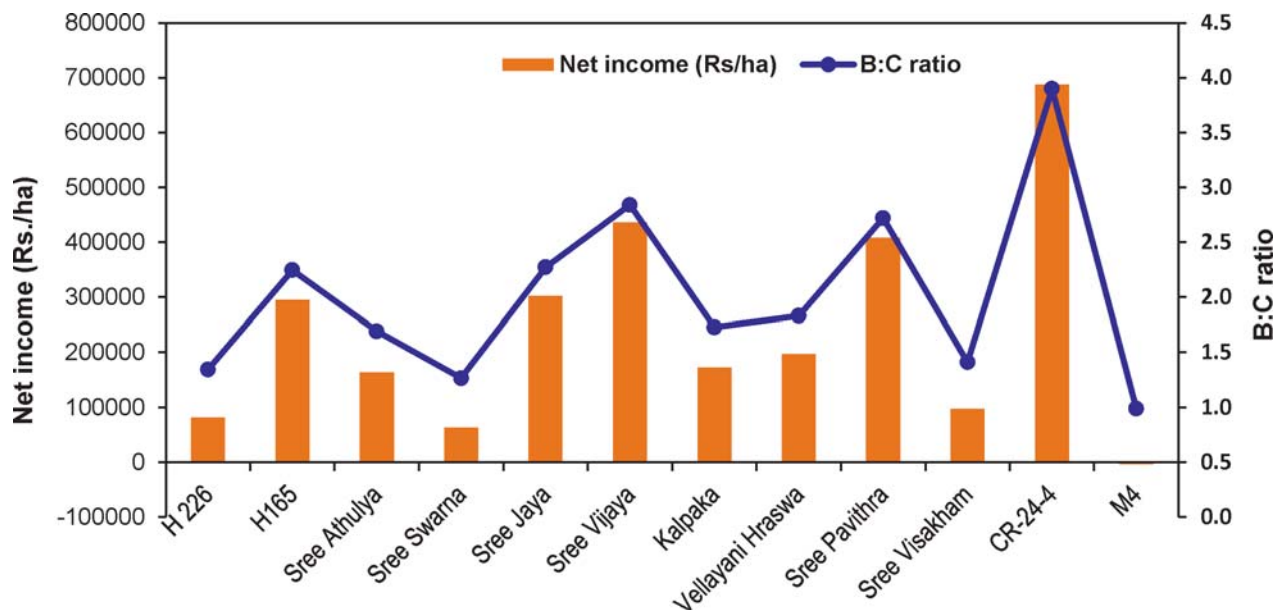


Fig. Economics of cultivation of cassava varieties under organic practice

Yield trend over four years and stability analysis: The trend showed that Sree Reksha (CR-24-4) maintained the highest productivity in all the years compared to the other varieties. Industrial varieties like H-226, Sree Athulya had good yield of tuber during the initial years, but under continuous organic management practices, yield of such varieties decreased. Next to Sree Reksha (CR 24-4), Sree Pavithra produced higher tuber yield over the years (Fig.....). Based on combined analysis, varieties varied significantly under organic management practices. Sree Reksha (CR-24-4) yielded the highest (36.67 t ha⁻¹), followed by Sree Pavithra (25.43 t ha⁻¹).

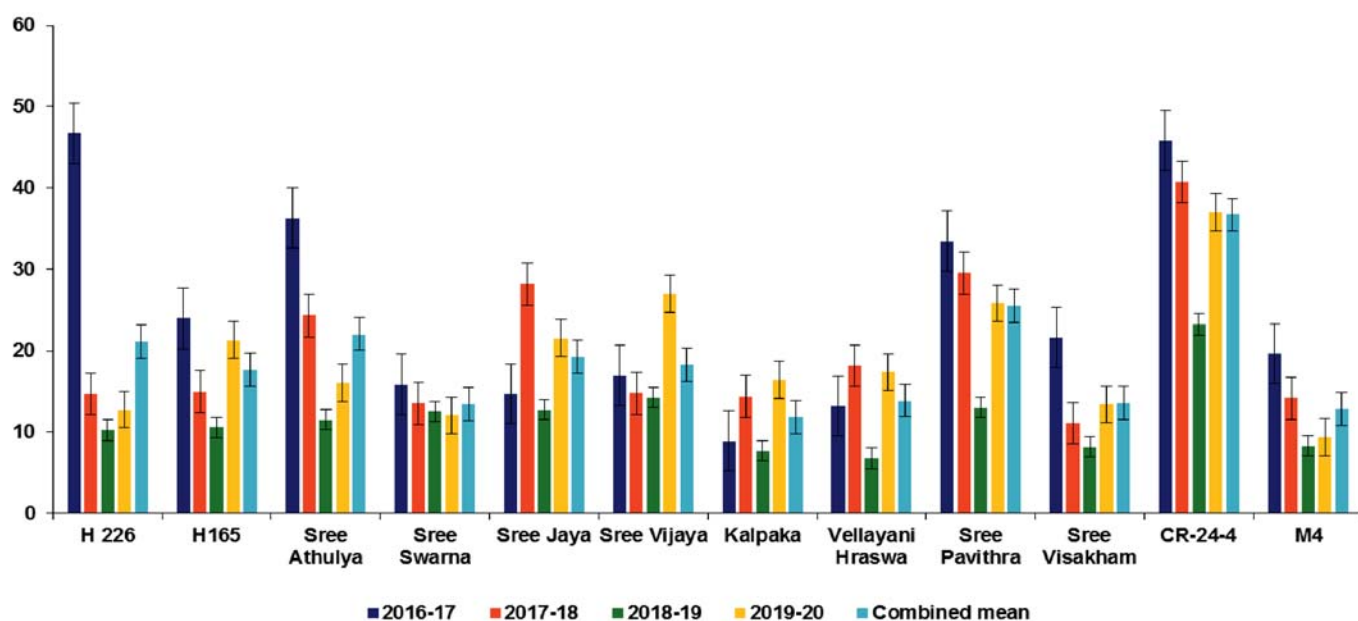


Fig. Yield ($t\ ha^{-1}$) trend over four years and stability analysis

Tuber quality of cassava (Table 7.3.17.2): The tuber quality did not vary significantly among the varieties. Cassava variety H-22 ha highest tuber dry matter, starch and total sugars of 32.21%, 25.43% and 0.45% on fresh weight basis.

Table 7.3.17.2. Biochemical composition of tubers of cassava varieties under organic management

Varieties	Dry matter (%)	Starch(% FW)	Total sugars(% FW)
H-226	32.31	25.43	0.45
H-165	27.85	21.58	0.36
Sree Athulya	30.92	22.11	0.38
Sree Swarna	28.56	20.33	0.32
Sree Jaya	27.03	18.54	0.36
Sree Vijaya	22.71	16.10	0.28
Kalpaka	27.43	18.52	0.37
Vellayani Hraswa	23.17	16.68	0.34
Sree Pavithra	28.52	19.42	0.41
Sree Visakham	28.78	19.50	0.37
CR-24-4	29.38	22.12	0.31
M-4	27.54	18.92	0.37
CD (0.05)	NS	NS	NS



Best performing variety of cassava CR 24-4 at Thiruvananthapuram

**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: Maize variety Pratap Hybrid Maize-3 among maize grain varieties, Sugar-75 among sweetcorn varieties, PM-3 among baby corn varieties, VL Amber Popcorn among popcorn varieties and Navjot in local varieties outperformed better for 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 (128.6 g and 259 g, respectively) as compared to other varieties.

Yield and economics of different varieties of maize (Table 7.3.18.2): Among the different maize grain varieties, Pratap Hybrid Maize-3 recorded significantly higher maize yield (6000 kg/ha) as compared to PQPM-1 (5722 kg/ha) and PM-9 (4445 kg/ha). Among sweet corn varieties, sugar-75 gave significantly higher maize yield (5360 kg/ha) as compared to Madhula variety (3820 kg/ha) and MAHY-103 (4350 kg/ha). In case of baby corn varieties, PM-3 recorded higher yield (1522kg/ha) as compared to PM-5 variety (1240 kg/ha). Among popcorn varieties, VL-Amber observed significantly higher maize yield (3200 kg/ha) as compared to Amber (1680 kg/ha). Among local varieties, Navjot gave significantly higher maize yield (4300 kg/ha) as compared to Farmer's selection (3790 kg/ha).

Among different maize varieties, Sugar-75 recorded significantly higher gross return (Rs.1,95,285/ha) and net return (Rs. 1,16,465/ha) as compared to other varieties. In case of hybrid varieties, PHM-3 recorded significantly higher gross and net return (Rs. 1,30,315 and Rs.74,445 /ha, respectively) as compared to PM-9 but it was at par with PQPM-1 (Rs. 1,24,146 and Rs.68,276 /ha). Among the sweet corn, sugar-75 recorded significantly higher gross and net return (Rs.1,95,285 and Rs.1,16,465 /ha). In case of baby corn varieties, PM-3 recorded significantly higher gross and net return (Rs.73,627 and Rs.18,007/ha) and was at par with PM-5 (Rs.59,530 and Rs.3910/ha, respectively). In case of popcorn, VL-Amber gave significantly higher gross and net return (Rs.1,48,877 and Rs.93,817/ha) as compared to Amber popcorn. Among local varieties, Navjot gave significantly higher gross and net return (Rs. 95,190 & Rs.39870 respectively) as compared to Farmer's Selection.

Table 7.3.18.1: Evaluation of response of different varieties of maize on yield attributes and yield at Udaipur

Varieties	Number of cobs/plant	Number of grain rows /cob	Number of grains/row	Number of grains/cob	Weight of grain/cob (g)	Test weight (g)
Maize (Grain)						
Pratap QPM Hybrid-1	2.0	16.0	33.0	528.2	99.4	188.0
PM – 9	2.0	14.0	30.0	420.1	82.0	195.0
Pratap Hybrid Maize-3	1.5	16.0	31.0	496.1	128.6	259.0
Sweet corn						
Sugar 75	2.0	16.0	29.0	464.1	43.2	93.0
Madhula	1.0	14.0	23.8	334.6	20.1	60.0
MAHY-103	2.0	14.0	26.0	364.7	23.4	64.0
Baby corn						
PM- 3	1.3	0.0	0.0	0.0	0.0	0.0
PM- 5	1.5	0.0	0.0	0.0	0.0	0.0
Pop corn						
VL Amber	2.0	14.0	33.5	469.2	65.7	140.0
Amber	2.0	12.0	30.0	360.5	30.7	85.0
Local varieties						
Navjot	1.5	16.0	32.0	512.2	87.2	170.0
Farmers selection	1.0	14.0	26.0	364.3	68.3	187.0
CD (P=0.05)	0.09	0.73	2.27	49.8	9.1	6.7

Table 7.3.18.2: Maize equivalent yield and economics of different varieties of maize grown under organic farming at Udaipur

Varieties	Yield (kg/ha)	Fodder yield (kg/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	Net return per rupee invested
Maize (Grain)					
Pratap QPM Hybrid – 1	5722	7513	124146	68276	1.22
PM – 9	4445	5788	96192	40322	0.72
Pratap Hybrid Maize – 3	6000	7905	130315	74445	1.33
Sweet corn					
Sugar 75	5360	6762	195285	116465	1.48
Madhula	3820	5033	140269	61449	0.78
MAHY-103	4350	5579	158951	80131	1.02
Baby corn					
PM- 3	1522	1905	73627	18007	0.32
PM- 5	1240	1461	59530	3910	0.07
Pop corn					
VL Amber	3200	4093	148877	93817	1.70
Amber	1680	2151	78171	23111	0.42
Local varieties					
Navjot	4300	6018	95190	39870	0.72
Farmer's selection	3790	5124	82984	27664	0.50
CD (P=0.05)	249	348	6993.9	6993.9	0.11

Response of different varieties of wheat under organic farming at Udaipur

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 (53.5) as compared to other, but it was at par with HI-8627 (51.0) while maximum number of spikelets/ear (18.9 nos.) was recorded in HI-1531 as compared to other wheat varieties and it was at par with HI-8713 (18.5). 1000-grains weight was significantly higher in MPO-1215 (53 g) than HI-1531, MP-3288, HI-1500, Lok-1 and C-306 but on par with rest of varieties.

Yield and economics of wheat (Table 7.3.18.4): Among 12 wheat varieties, HI-8713 recorded significantly higher grain yield (5840 kg/ha), net return (Rs. 1,73,736 /ha) and NRPRI (3.7) as compared to other varieties. Among *Triticum aestivum* varieties, variety MP-3288 recorded



Best performing variety of maize (PHM-3) at Udaipur



Best performing variety of wheat (HI 8713) at Udaipur



significantly higher grain yield (4585 kg/ha), net return (Rs. 1,26,313 /ha) and NRPRI (2.69) as compared to other wheat varieties. In case of *Triticum durum* varieties, variety HI-8713 gave significantly higher grain yield (5840 kg/ha) net return (Rs. 1,73,736 /ha) and NRPRI (3.7) as compared to other durum varieties and it was at par with HI-8663 (5359 kg/ha and Rs. 1,54,115 /ha, respectively). In local wheat varieties, variety C-306 recorded significantly higher grain yield (4175 kg/ha), net return (Rs. 1,08,519/ha) and NRPRI (2.31) as compared to Lok-1(3730 kg/ha Rs. 96,045/ha, respectively).

Table 7.3.18.3: Yield attributes of wheat varieties grown under organic farming at Udaipur

Varieties	Number of spikelet/ ear	Ear length (cm)	Number of grains/ ear	Test weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index (%)	Gross return (Rs ha ⁻¹)	Net return (Rs ha ⁻¹)	Net return per rupee invested
<i>Triticum aestivum</i>										
HI-1531	18.9	7.6	46.0	48.0	4320	6048	41.7	1,58,544	1,11,544	2.37
MP-3288	16.8	11.0	48.0	46.3	4585	7336	38.5	1,73,313	1,26,313	2.69
Raj-3765	17.7	8.6	44.6	48.4	3500	6300	35.7	1,36,150	89,150	1.90
Raj-4037	14.0	7.7	35.4	50.5	4000	5600	41.7	1,46,800	99,800	2.12
Raj-4120	13.7	8.3	43.0	49.9	3620	6407	36.1	1,40,221	93,221	1.98
<i>Triticum durum</i>										
HI-8627	17.2	7.3	52.0	51.0	4490	8082	35.7	1,74,661	1,27,661	2.72
HI-8663	17.4	7.0	48.0	48.5	5360	8307	39.2	2,01,116	1,54,116	3.28
HI-8713	18.5	7.4	53.5	50.0	5840	9341	38.5	2,20,736	1,73,736	3.70
MPO-1215	16.3	6.8	39.0	53.0	4300	6704	39.1	1,61,571	1,14,571	2.44
HI-1500	17.0	8.5	41.3	45.8	3555	5688	38.5	1,34,379	87,379	1.86
<i>Wheat (Local)</i>										
Lok-1	14.5	7.5	34.4	45.4	3730	6341	37.0	1,43,046	96,046	2.04
C-306	16.0	9.5	41.0	46.5	4175	6263	40.0	1,55,519	1,08,519	2.31
CD (P=0.05)	1.6	0.8	4.2	4.9	431	686	0.7	16,126	16,126	0.34

7.4: 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/Bufalo/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 9: out of nine 6 centres reported the results namely Calicut and Thiruvananthapuram (Kerala), Coimbatore (Tamil Nadu), Umiam (Meghalaya), Udaipur (Rajasthan), Sardarkrushinagar (Gujarat) while centres Pantnagar (Uttarakhand), Ludhiana (Punjab) Gangtok (Sikkim) were not reported.

Year of start: 2013-14

Results:

Calicut

The plot with spices, fodder and vegetables combination was established at Chelavoor farm. The crops pepper, turmeric, fodder grasses (Congo signal grass, CO-3, CO-4), Tapioca, Banana, Cowpea, Coconut, were planted and established. 3 cows and their calves were maintaining at IISR farm. Turmeric 560 kg, Banana 150 kg, Tapioca 375 kg and vegetable cowpea 20 kg, coconut 3300 nos, were harvested. Fodder grass fed to the cows that are maintained at IISR farm. A profit of Rs 1.66 lakhs was received from one acre. Employment generated Man days/year is 415. The highest contribution towards the net return by livestock of the model which is 86%.

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		3300 nos.	16	52800	11.7
	Fodder (Co3, Co4, DHN6, Congo Signal)	0.06		300	3.5	1050	
	Turmeric	0.04		560 kg	25	14000	
	Total	0.36	90			67850	
Livestock (2 Cows)	Milk			5082.9L	60	304974	86.0
	Cow dung			12000 Kg	2.4	28800	
	Total	0.01	2.5			333774	
Horticulture	Banana	0.01		150 Kg	40	6000	2.3
	Tapioca	0.005		375 Kg	25	9375	
	Veg cow pea	0.0025		20 Kg	50	1000	
	Total	0.03	7.5			16375	
Grand Total						417999	100
Total Expenditure (Rs)						251420	
Net Profit (Rs)						1,66,576	
Employment generation Man days/year						415	



Coimbatore

In green manure - bhendi - maize cropping system, the net return of Rs. 18515 was realized. In green manure - cotton - sorghum cropping system, the net return of Rs.10319 was obtained. Through dairy component, an income of Rs. 15375/- was fetched. The income realized from recycling of crop residues and other livestock waste was Rs. 6205/ annum, income generated from green fodder (CO (CN) 5) grown in the one-hectare model of IOFS was Rs.12,200/ annum. The green leaf manure yield of 9.5t/ha was observed from *Gliricidia* and *desmanthus* as border crop. An income generated from kitchen garden was Rs. 1,954/ annum. A total net return of Rs. 62,172/- per year was achieved under the IOFS model. The highest contribution towards the total net return was contributed by crop component of the model followed by dairy and horticulture component.

Component wise area, yield and income of IOFS at Coimbatore

Farming System	Area (ha)	Details (Name or value)
Agricultural Crops		
Cotton	0.12	Rs. 5136 / annum
Maize	0.12	Rs. 7067 / annum
Sorghum	0.12	Rs. 5183 / annum
Horticultural crops		
Bhendi	0.12	Rs. 11448 / annum
Dairy	0.10	Rs.15375 / annum
CO (CN) 5 grass	0.06	Rs.12,200 / annum
Pest repellent plants	0.10	105 plants for insect repellent preparations
Agro-forestry		15 Nos. comprising 5 tree species
Perennial border crops		Rs. 7149 / annum from Coconut (24 palms), Banana (14 plants), annual moringa (32 plants) and Curry leaf (12 bushes)
Green leaf manure cum border crop (Glyricidia)		9.5 tonnes
Kitchen garden		Rs. 1,954 / annum
Production from IOFS on equivalent basis (t) (Mention the base crop)		6952 kg (Cotton as base crop)
Market input cost excluding labour		Rs. 29,270/-
Value of recycling excluding family labour		Rs. 8493 / ha
Cost of labour		Rs. 47172/ ha/ annum
Total Cost		Rs. 81212/ ha per annum
Net returns		Rs. 62,172/ ha per annum

Sardarkrushinagar

IOFS model is comprised of different components viz., crops (0.24 ha), green fodder crops (0.15 ha), dairy + vermicompost (0.01 ha) and boundary plantation. Net profit ¹ 30,569 was received by crop component from 0.24 ha area and net profit ¹ 27,937 was received by green fodder unit (0.15 ha). Construction of animal shade and purchases of animals is completed during the year. Arduza, napier grass and lemon grass have been planted around the border and bunds. Total net profit from all the components of IOFS Model was ¹ 59, 723 from 0.40 ha area.

Energy inputs

Data presented in table 3.59 revealed that maximum output energy (1556046 MJ/ha), net energy returns (1488448 MJ/ha), energy use efficiency (69.99) were observed in green fodder components (Multicut fodder bajra - Fodder Maize + Oat - Fodder Bajra), while specific energy (51.68 MJ/kg) noted under crop components.

Yield (kg/ha) and economics (₹/ha) of IOFS Model at Sardarkrushinagar (Gujarat)

Sl. No.	Farming system components	Total Area (ha)	Ground nut Equivalent Yield (kg)	Gross Return (₹)	Cost of cultivation (₹)	Net Returns (₹)
1	Crops (Groundnut, wheat and green gram)	0.24	908	64157	33588	30569
2	Green Fodder (Multi cut fodder bajra, Maize(F)+ Oat, Bajra (summer fodder)	0.15	766	51868	23931	27937
3	Livestock + Vermicompost	0.01	Construction of animal shed, and purchases of animals is completed during the year			
4	Boundary Plantation (Ardusa, Lemon grass, Hy. napier)	-	28	1998	780	1218
	Total	0.40	2644	1701	118023	58299
Employment generation (Man/days)				0.21		
System profitability (₹ /day)				164		

Energy analysis of integrated organic farming systems model (0.4 ha) at Sardarkrushinagar (Gujarat)

Components	Input energy (MJ/ha)	Output energy (MJ/ha)	Net energy returns (MJ/ha)	Energy use efficiency	Energy productivity (kg/MJ)	Specific energy (MJ/kg)
Cropping system	82476	288212	228311	9.81	0.19	51.68
Fodder System	67598	1556046	1488448	69.99	3.89	2.68
Livestock + Vermicompost	-	-	-	-	-	-
Boundary Plantation	220	120924	120704	550.86	2.13	0.47

Thiruvananthapuram

Net returns of Rs. 54,862 could be obtained from cassava based cropping system (with animal components for 4 months started during April 2020) from an area of 75 percent. The marketable equivalent yield (MEY) from the system was 9108 kg and the IOFS could generate 107 man-days. The % share of area and income of the various components of IOFS is given in model.

Description of the tuber crops based IOFS model developed in 75 cents (0.3 ha)

Farming System	Area (ha)	Details (Name or value as applicable)
Crops	0.08 (27%)	Kharif: Taro Summer: Green gram, black gram, groundnut and green manure crops
Fodder	0.06 (20%)	Hybrid Napier grass
Horticulture	0.10 (33%)	Cassava + Vegetable Cowpea (Intercropping)
Fruit 0.012 (4%)	Lemon, Karonda	
Dairy unit (Just started during April 2020)	0.02 (7%)	Adult milking cow: 2 no. Calves: 2 no.
Fishery	—	—
Pest repellent plants	0.02 (7%)	Lemon grass
Other components (Please specify) Recycling unit	0.008 (3%)	Vermicompost unit : 2 nos.
Production from IOFS on equivalent basis (t) (Mention the base crop)	Base crop: Cassava	Production : 9.11 tons/0.30ha
Market input cost excluding labour (Rs)	Rs. 73180	
Value of recycling excluding family labour (Rs)	Rs. 3650	
Cost of labour (Rs)	Rs. 96000	
Total Cost (Rs)	Rs. 172830	
Net returns (Rs)	Rs. 54862	
B:C ratio	1.32	
Energy input (MJ)	16807 MJ	
Energy output (MJ)	54475 MJ	

Cost and income from the various components of IOFS at Thiruvananthapuram

Components	Area (cents)	Marketable surplus produced (MEY in kg)	Recurring cost (Rs.)	Gross Income (Rs.)	Net Income (Rs.)	Income share (%)	Man days
Crops	20	1831.68	35090.40	45792	10702	20.11	22
Fodder	15	900.00	13050	22500	9450	9.88	5
Horticulture	25	1080.00	17421	27000	9579	11.86	10
Pest repellent plants	5	88.00	3620	2200	-1420	0.97	3
Recycling unit	2	0	3650				
Dairy unit	10	5208	100000	130200	30200	57.18	67
Total	75	9107.68	172831	227692	54861		107



Taro : Sree Kiran



Hybrid Maize (Grain) var. Co-H(M)-6



Hybrid Napier grass



Cassava + bushy vegetable cowpea



Black gram



Green gram



Dairy unit



Green manure and Lemon grass in IOFS



Crop and dairy unit at Thiruvananthapuram (Kerala)

Udaipur

An integrated organic farming system model for 0.45 ha consisting of field crops in 0.25 ha (sweet corn + black gram 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 & brinjal in *kharif*, cabbage & cauliflower in *rabi* and okra in *zaid*), fruit crop in 0.04 ha (guava) and compost unit in 0.01 ha were evaluated during 2019-20. The total maize equivalent yield of 5149 kg/ha and a net return of Rs. 58769 /ha was obtained from the farming system model during 2019-20.

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 + Black gram	0.25	375 (Sweet corn) +70 (Black gram)	1170	12322	20910	8588	0.69
Rabi	Wheat		1240	2397	12000	48231	36231	3.01
2. Fodder								
Kharif	Fodder Maize + Cowpea	0.05	2000 (Cowpea failed due to poor germination)	720	6000	10800	4800	0.80
Rabi	Berseem		2750	862	3780	12930	9150	2.42
Zaid	Sesbania		Used as green manuring					
3. Vegetable								
Kharif	Okra	0.10	Crop failed due to water logging					
Rabi	Carrot		-					
4. Fruits	Guava	0.04	Guava is under 4 th year of planting					
	Total			5149		58769		
5. Compost unit	NADEP compost	0.01	7500 kg					
	Vermicompost		1500 kg					
	Compost	1200 kg						
	Vermiwash	80 lit						
	BD 500	1.8 kg						
	BD 501	1.92 kg						
	Earthworms	25 kg						



Sweet corn + blackgram (2:2)



T. Aestivum variety Raj-4120



Green manure crop (*Sesbania rostrata*)



Guava (Lalit and Shweta)



Experimental site



BD 500



Masha Khodh



Earthworm culture



Beejamrit



Jeevamrit



Teekha sat



Different types of compost



Neemastra

Components of integrated farming system model at NPOF, Udaipur

Umiam

The IOFS model is comprised of 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 fishpond 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. A total net return of Rs. 73,903/- per year was achieved under the IOFS model which is about Rs. 1,85,821/ha and 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 followed by dairy and fishery component. The fish production was 115 kg.

For 0.43 ha area, on farm nutrient recycling in IFOS could produce an amount of 63.6 kg N, 19.6 kg P₂O₅ and 55.50 kg K₂O. Hence, 94.4% of the total N requirement, 81.1% of the total P₂O₅ requirement and total of 98.2% K₂O requirement could be met within the model itself and only 4.6% of the total N requirement, 17.9% of the total P₂O₅ requirement and 1.8% of K₂O is required to be met from the external source to sustain the model.

Economics of the IOFS model (area=0.43 ha) at Umiam

Farming System components	Total area (ha)	Rice Equivalent Yield (tonne)	Cost (Rs)	Net returns (Rs)	Net return (Rs/ha)
Crops	0.37	5.02	26,235	49,103	-
Dairy (1 milch cow + 1 calf)	0.004	2.61	21,450	17,700	-
Fishery (Composite)	0.046	1.08	4,950	11,300	-
Nutrient cycling (Vermicompost/FYM/etc.)	0.007	-	4,200	-4,200	-
Total	0.431	8.71	56,835	73,903	1,85,821
Net income/day	-	-	-	202	509

On-farm nutrient supply balance sheet under IOFS model (Area=0.43 ha) at Umiam

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)	21.0	7.5	17.4	6.6	2.3	12.3	-14.4	-5.2	-5.1
Horticultural crops (Vegetables, Fruits)	33.1	11.8	27.6	15.0	3.1	11.2	-18.1	-8.7	-16.4
Dairy	0.0	0.0	0.0	12.1	4.5	6.1	12.1	4.5	6.1
Others (Oilseeds, Pulses, Green manuring crop, fodder, etc.)	12.1	4.3	10.0	29.9	9.6	25.5	17.8	5.3	15.5
Total	66.2	23.6	55.0	63.6	19.6	55.0	-3.7	-4.4	-1.0
Nutrient demand met from the system	94.4 %	81.1 %	98.2 %						



Different vegetables and Vermicompost unit under IOFS model at Umiam Meghalaya

7.5. 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

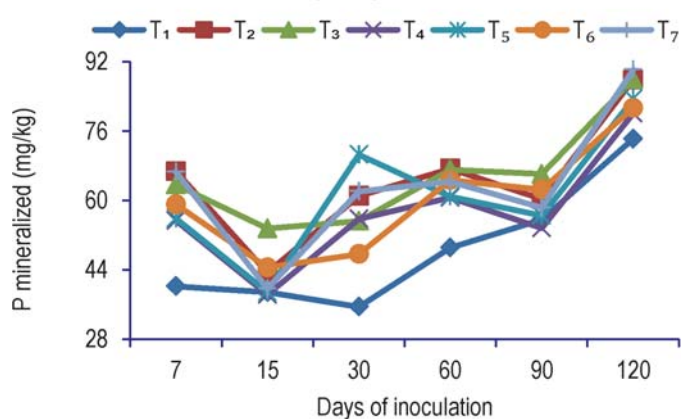
Only Almora reported the results

Almora

Farm wastes were composted with different proportion of raw materials and inoculation of different microbes and earthworm. The highest cost was recorded with vermicomposting with the 3:1:1 ratio of CR:CDS:LR. The highest N was recorded with inoculation of *Pleurotos sajorcaju* + *Trichoderma harzianum* + *Biominalizer* + *Aspergillus niger* + *Azotobacter spp.* to the 3:1:1 ratio of CR - Cereal residue:CDS - Cattle dung slurry:LR - Legume residue during composting. Vermicomposting with the 3:1:1 ratio of CR:CDS:LR provided the highest P content among different composts. The K content was highest with inoculation of *P. sajorcaju* + *T. harzianum* to the 4:1 ratio of CR:CDS, respectively. The highest Fe content was recorded with vermicomposting with the 3:1:1 ratio of CR:CDS:LR (Table 2). The highest Mn, Zn and Cu were recorded with inoculation of *Pleurotos sajorcaju* + *Trichoderma harzianum* + *Biominalizer* + *Aspergillus niger* + *Azotobacter spp.* to the 3:1:1 ratio of CR - Cereal residue:CDS - Cattle dung slurry:LR - Legume residue during composting.

The highest P mineralization was recorded with vermicomposting with the 3:1:1 ratio of CR:CDS:LR, respectively. The highest K mineralization was recorded with inoculation of *Pleurotos sajorcaju* + *Trichoderma harzianum* to the 4:1 ratio of CR - Cereal residue:CDS - Cattle dung slurry : during composting.

P mineralization of composts prepared from farm waste recycling



K mineralization of composts prepared from farm waste recycling

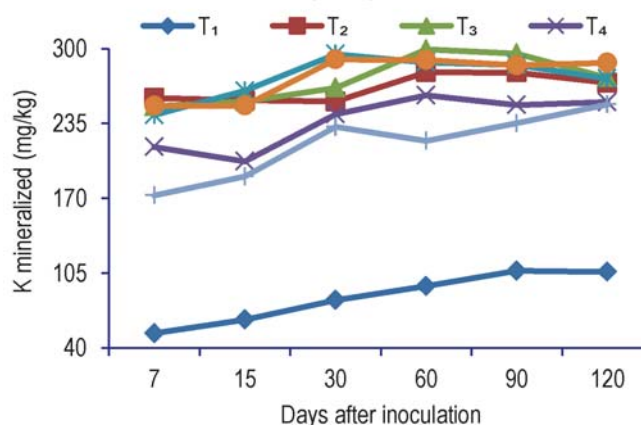




Table 7.5.1.1: Compost yield and its nutrient analysis as influenced by the effect of waste decomposer and compost culture on different farm wastes.

Sl.No.	Treatment details	Weight of waste (composting) (kg)	Compost yield(kg)	Cost of inputs (Rs)	N content (%)	P ₂ O ₅ content (%)	K ₂ O content (%)	Micronutrient (mg/kg)			
								Fe	Mn	Zn	Cu
1	Control (CR:CDS ¹) = 4:1	60	72	74	1.014	0.141	0.384	4864	336	277	65
2	Vermi-compost (CR:CDS = 4:1)	60	56	174	1.382	0.224	0.816	6221	293	208	38
3	Vermi-compost (CR:CDS:LR = 3:1:1)	60	55	176	1.404	0.240	0.772	6308	302	201	40
4	CR:CDS = 4:1 + <i>Pleurotus sajorcaju</i> + <i>Trichoderma harzianum</i>	60	55	94	1.373	0.161	0.828	4989	369	291	71
5	CR:CDS:LR = 3:1:1 + <i>P. sajorcaju</i> + <i>T. harzianum</i>	60	54	96	1.399	0.205	0.749	5025	374	297	74
6	CR:CDS = 4:1 + <i>P. sajorcaju</i> + <i>T. harzianum</i> + Biominerizer + <i>Aspergillus niger</i> + <i>Azotobacter</i> spp.	60	50	134	1.388	0.180	0.835	5086	388	316	75
7	CR:CDS:LR = 3:1:1 + <i>P. sajorcaju</i> + <i>T. harzianum</i> + Biominerizer + <i>Aspergillus niger</i> + <i>Azotobacter</i> spp.	60	48	136	1.427	0.212	0.754	5123	401	324	78

¹CR - Cereal residue, CDS - Cattle dung slurry, LR - Legume residue,

²PS - *Pleurotus sajorcaju*; TH - *Trichoderma harzianum*; Biom = Biominerizer = Microbial consortia of P & Zn solubilizer and PGPR; Asp - *Aspergillus niger*; Azot - *Azotobacter* spp.

7.6. 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

Only Ajmer and Udaipur reported the results

Results:

Ajmer

- Aak, datura and karanj leaf (10 kg all) are take in equal ratio and ferment with cow urine (15.0 lit) for 8-10 days. After fermentation process, used 10% prepared solution for control of aphid in moong bean and other crops.
- Neem leaves, asafoetida powder and cow urine after mixing boiled and when gets cool mixed with buttermilk. Use with irrigation water and foliar spray. This ITK is used to control termite and other sucking pests in cereals and pulses.

Udaipur

ITK 1: Evaluation of efficacy of herbal bio-pesticides on disease and yield of cauliflower

Treatments:

T ₁ :	Control
T ₂ :	Dashparni (10 %) at 30, 45 and 60 DAS
T ₃ :	Trichoderma (1 %) at 30, 45 and 60 DAS + Dashparni (10 %) at 30, 45 and 60 DAS
T ₄ :	Trichoderma (1 %) at 30, 45 and 60 DAS + Dashparni (10 %) at 30, 45 and 60 DAS + Vermiwash (10 %) at 30, 45 and 60 DAS

Result: Application of Dashparni (10%) at 30, 45 and 60 DAS + vermiwash (10%) at 30, 45, 60 DAS + *Trichoderma* (1%) at 30, 45, 60 DAS resulted in significantly maximum plant height (48.50 cm), curd yield (19006 kg/ha), net return (Rs 330962/ha) and BC ratio (6.73) of cauliflower among treatments. Minimum downey mildew (PDI 14.41) in cauliflower was also observed in the similar treatment i.e. Dashparni (10 %) at 30, 45 and 60 DAS + vermiwash (10 %) at 30, 45 and 60 DAS + *Trichoderma* (1 %) at 30, 45 and 60 DAS while maximum (PDI 44.50) was observed in control.

Table 7.6.1.: Evaluation of efficacy of herbal bio-pesticides on growth parameters and yield of cauliflower

Treatments	Plant height at harvest (cm)	Diameter of curd (cm)	Curd yield (kg/ha)	Downey mildew(PDI)	Cost of Cultivation (Rs/ha)	Net Return (Rs/ha)	B:C ratio
Control	45.83	10.6	13510	44.50	41000	229200	5.59
Dashparni (10 %) at 30, 45 and 60 DAS	46.55	11.9	15488	33.48	43400	266361	6.14
Dashparni (10 %) at 30, 45 and 60 DAS + <i>Trichoderma</i> (1 %) at 30, 45 and 60 DAS	47.20	12.9	16308	15.26	45560	280601	6.16



Treatments	Plant height at harvest (cm)	Diameter of curd (cm)	Curd yield (kg/ha)	Downey mildew(PDI)	Cost of Cultivation (Rs/ha)	Net Return (Rs/ha)	B:C ratio
Dashparni (10 %) at 30, 45 and 60 DAS + Vermiwash (10 %) at 30, 45 and 60 DAS + Trichoderma (1 %) at 30, 45 and 60 DAS	48.50	13.6	19006	14.41	49160	330962	6.73
CD at 5 %	6.69	2.02	3723	2.49	-	74465	1.59

ITK 2: Evaluation of efficacy of herbal bio-pesticides on pest disease and yield of cabbage

Treatments:

T ₁ :	Control
T ₂ :	Dashparni (10 %) at 30, 45 and 60 DAS
T ₃ :	Trichoderma (1 %) at 30, 45 and 60 DAS + Dashparni (10 %) at 30, 45 and 60 DAS
T ₄ :	Trichoderma (1 %) at 30, 45 and 60 DAS + Dashparni (10 %) at 30, 45 and 60 DAS + Vermiwash (10 %) at 30, 45 and 60 DAS

Results: Application of Dashparni (10 %) at 30, 45 and 60 DAS + Vermiwash (10 %) at 30, 45 and 60 DAS + *Trichoderma* (1 %) at 30, 45 and 60 DAS recorded significantly maximum plant height (34.24 cm), head diameter (20.60 cm), head yield (16750 kg/ha) and net return (Rs 285840/ha). Minimum alternaria blight and downey mildew (PDI 20.85 and PDI 15.53 respectively) in cabbage were also observed in same treatment i.e Dashparni (10 %) at 30, 45 and 60 DAS + Vermiwash (10 %) at 30, 45 and 60 DAS + *Trichoderma* (1 %) at 30, 45 and 60 DAS while maximum alternaria blight and downey mildew (PDI 65.40 and PDI 45.70, respectively) were observed in control.

Table 7.6.2.: Evaluation of efficacy of herbal bio-pesticides on growth parameters and yield of cabbage

Treatments	Plant at height harvest (cm)	Cabbage head diameter (cm)	Cabbage yield (kg/ha)	Alternaria blight (PDI)	Downey mildew (PDI)	Cost of Cultivation (Rs/ha)	Net Return (Rs/ha)	B:C ratio
Control	29.86	17.21	13596	65.40	45.70	271921	230921	5.63
Dashparni (10 %) at 30, 45 and 60 DAS	32.17	18.77	16085	45.67	34.18	321700	278300	6.41
Dashparni (10 %) at 30, 45 and 60 DAS + Trichoderma (1 %) at 30, 45 and 60 DAS	32.50	19.00	16250	21.60	16.12	325000	279440	6.13
Dashparni (10 %) at 30, 45 and 60 DAS + Vermiwash (10 %) at 30, 45 and 60 DAS + Trichoderma (1 %) at 30, 45 and 60 DAS	34.24	20.60	16750	20.85	15.53	335000	285840	5.81
CD at 5 %	2.89	2.27	2268	3.56	2.54	45366.78	45366.78	1.00



Control



Dashparni (10 %) at 30, 45 and 60 DAS

Dashparni (10 %) at 30, 45 and 60 DAS +
Trichoderma (1 %) at 30, 45 and 60 DASDashparni (10 %) at 30, 45 and 60 DAS +
Vermiwash (10%) at 30, 45 and 60 DAS +
Trichoderma (1 %) at 30, 45 and 60 DAS

Evaluation of efficacy of herbal bio-pesticides on pest-disease and yield of cabbage

ITK 3: Effect of plant products on storage of maize grains and black gram seed**Treatment details**

Maize		Black gram	
A. Neem oil	1%	A. Neem oil	1%
	2%		2%
	3%		3%
	Control		Control
B. Maize Cob Powder	1%	B. Mustard oil	1%
	2%		2%
	3%		3%
	Control		Control
C. Dried Neem Leaves	1%	C. Dried Neem Leaves	1%
	2%		2%
	3%		3%
	Control		Control



Results: Evaluation of bio-efficacy of plant products against stored pests in different stored grains was conducted in vitro condition in the department of Entomology, Rajasthan College of Agriculture, MPUAT, Udaipur

Maize grain damage (%): Per cent grain damage by rice weevil, *Sitophilus oryzae* (L.) has been presented in Table 4.7. The data reveals that all the treatments were found significantly superior over control. The percent grain damage caused by rice weevil ranged from 14.40 to 40.80 per cent in all three sets of treatments. In the set –I, the minimum per cent grain damage 16.40 per cent was recorded in grain treated with neem oil (3%), in set – II, the minimum per cent grain damage 32.40 per cent was recorded in grain treated with maize cob powder (3%) and in set – III, the minimum per cent grain damage 14.40 per cent was recorded in grain treated with dried neem leaves (3%).

Table 7.6.3.: Efficacy of plant products against rice weevil, *Sitophilus oryzae* of stored grains of maize and black gram

Plant products	Maize			
	Total no. of Grains	Damaged Grains	Damage (%)	Weight of Damaged grains
A. Neem oil				
Neem Oil 1%	250	59	23.6	3.06
Neem Oil 2%	250	47	18.8	2.44
Neem Oil 3%	250	41	16.4	2.13
Control	250	223	89.2	11.59
B. Maize Cob Powder				
Maize Cob Powder 1%	250	102	40.8	5.30
Maize Cob Powder 2%	250	94	37.6	4.88
Maize Cob Powder 3%	250	81	32.4	4.21
Control	250	165	66.0	8.58
C. Dried Neem Leaves				
Dried Neem Leaves 1%	250	65	26.0	3.38
Dried Neem Leaves 2%	250	51	20.4	2.65
Dried Neem Leaves 3%	250	36	14.4	1.87
Control	250	174	69.6	9.04

Black gram grain damage (%): The data recorded on per cent grain damage by pulse beetle, *Callosobruchus chinensis* (L.) has been presented in Table 8. The data reveals that all the treatments were found significantly superior over control. The percent grain damage caused by pulse beetle ranged from 9.10 to 20.10 per cent in all three sets of treatments. In the set –I, the minimum per cent grain damage 9.60 per cent was recorded in grain treated with mustard oil (3%), in set – II, the minimum per cent grain damage 9.10 per cent was recorded in grain treated with neem oil (3%) and in set – III, the minimum per cent grain damage 14.20 per cent was recorded in grain treated with dried neem leaves (3%).

Table 7.6.4: Efficacy of plant products against pulse beetle, *Callosobruchus chinensis* infesting stored grains of black gram

Treatments	Total No. of Grains	Damaged Grains	Damage%	Weight of damaged grains
A. Mustard Oil				
Mustard Oil 1%	1000	171	17.10	0.427
Mustard Oil 2%	1000	129	12.90	0.322
Mustard Oil 3%	1000	96	9.60	0.240
Control	1000	735	73.50	0.183
B. Neem oil				
Neem Oil 1%	1000	154	15.40	0.385
Neem Oil 2%	1000	101	10.10	0.252
Neem Oil 3%	1000	91	9.10	0.227
Control		740	74.00	1.85

Treatments	Total No. of Grains	Damaged Grains	Damage%	Weight of damaged grains
C. Dried Neem Leaves				
Dried Neem Leaves 1%	1000	201	20.10	0.502
Dried Neem Leaves 2%	1000	177	17.70	0.442
Dried Neem Leaves 3%	1000	142	14.20	0.355
Control	1000	698	69.80	1.740



3% Neem Oil (Maize)



3% Maize cob powder (Maize)



3% Maize cob powder (Blackgram)



3% Neem Oil (Blackgram)



Maize grain with different treatments



Blackgram seed with different treatments

Storage of maize grain and blackgram seed

ITK 4: Evaluation of bio-efficacy of silica diatomous earth against rice weevil in stored maize

Treatment Details

1. Silica diatomous earth (1%)
2. Silica diatomous earth (2%)
3. Silica diatomous earth (3%)
4. Silica diatomous earth (4%)
5. Mustard Oil (2%)
6. Groundnut Oil (2%)
7. Neem seed kernel powder (1%)
8. Control

Result:

Grain damage (%): The data recorded on mean per cent grain damage by rice weevil, *Sitophilus oryzae* (L.) at 30, 60 and 90 days after storage period has been presented in Table 9. The data reveals that all the treatments were found significantly superior over control. The mean percent grain damage was caused by rice weevil ranged from 4.41 to 7.91 per cent. The minimum mean per cent grain damage 4.41 per cent was recorded in grain treated with active silicon (4%) that was at par with the treatment of active silicon (3%) which was 4.84 mean per cent grain damage. The next effective treatment was neem seed kernel powder (1%) with mean grain damage of 5.23 per cent and was found at par with treatment of mustard oil (2%) which resulted 5.73 mean per cent grain damage. The maximum per cent grain damage of 30.85 per cent was recorded in control. The minimum protection with maximum per cent grain damage 7.91 per cent was recorded in the treatment of active silicon (1%) followed by 7.37 and 6.50 mean per cent grain damage in groundnut oil (2%) and active silicon (2%).

Weight loss (%)

The relative bio-efficacy of different treatments in terms of mean per cent weight loss of maize grains were found significantly superior over untreated control. Silica diatomous earth (4%) were found highly effective in terms of mean per cent weight loss (4.36 per cent) of maize grains due to the rice weevil, *S. oryzae* which was at par with the treatment of silica diatomous earth (3%) that caused 4.76 mean per cent grains weight loss. The treatment of neem seed kernel powder (1%) proceed to the next effective treatment in reducing the weight loss and resulted in 5.72 mean per cent grains weight loss which was at par with grains treated by mustard oil (2%) at after all the storage periods and caused 6.09 mean per cent weight loss of maize grains. Silica diatomous earth (2%) and groundnut oil (2%) were next in order of effectiveness and recoded 6.83 and 7.19 mean per cent weight loss in maize grains due to rice weevil respectively. Silica diatomous earth (1%) was found least effective treatment and resulted in 7.53 mean per cent weight loss of maize grains, though the per cent weight loss in the grains treated with active silicon (1%) was found significantly better over untreated check (Table-1).

Adult mortality (%):

The data recorded on the bio-efficacy of different treatments in terms of mean per cent adult mortality of rice weevil, *Sitophilus oryzae* (L.) in maize grains reveal that all the treatments were found significantly superior over untreated control. The maximum adult mortality 92.42 per cent was recorded in the treatment of silica diatomous earth (4%), which was at par with silica diatomous earth (3%) and caused 89.54 mean per cent adult mortality of rice weevil. The neem seed kernel powder (1%), mustard oil (2%) and silica diatomous earth (2%) followed by the above treatments were recorded significantly effective from each other for the per cent adult mortality at all the storage periods and caused 86.50, 84.18 and 83.80 mean per cent adult mortality respectively. The minimum mean per cent adult mortality 79.20 per cent by rice weevil in maize grains was recorded in active silicon (1%) followed by 80.98 mean per cent adult mortality in groundnut oil (2%). The untreated control resulted in minimum 11.45 mean per cent adult mortality by rice weevil in maize grains (Table-4.9).



Effect of silica diatomous earth on maize seed in comparison to control against stored pests

Table 7.6.4.1: Effect of silica diatomous earth on the grain damage, weight loss and adult mortality by rice weevil, *Sitophilus oryzae* (L.) in maize.

Treatment	Mean grain damage (%) by rice weevil, <i>S. oryzae</i>	Mean weight loss (%) by rice weevil, <i>S. oryzae</i>	Mean adult mortality (%) by rice weevil, <i>S. oryzae</i>
Silica diatomous earth (1%)	7.91 (16.33)	7.53 (15.92)	79.20 (62.91)
Silica diatomous earth (2%)	6.50 (14.77)	6.83 (15.15)	83.80 (66.27)
Silica diatomous earth (3%)	4.84 (12.71)	4.76 (12.60)	89.54 (71.21)
Silica diatomous earth (4%)	4.41 (12.12)	4.36 (12.05)	92.42 (74.07)
Mustard Oil (2%)	5.73 (13.85)	6.09 (14.28)	84.18 (66.61)
Groundnut Oil (2%)	7.37 (15.75)	7.19 (15.56)	80.98 (64.18)
Neem seed kernel powder (1%)	5.23 (13.22)	5.72 (13.83)	86.50 (68.55)
Control	30.85 (33.74)	35.83 (35.77)	11.45 (19.77)
CD(P=0.05)	0.507	0.496	3.220

ITK 5: Evaluation of bio-efficacy of silica diatomous earth against pulse beetle in stored soybean

Treatment details:

- | | |
|--------------------------------|---------------------------------|
| 1. Silica diatomous earth (1%) | 5. Neem seed kernel powder (1%) |
| 2. Silica diatomous earth (2%) | 6. Mustard oil (2%) |
| 3. Silica diatomous earth (3%) | 7. Groundnut oil (2%) |
| 4. Silica diatomous earth (4%) | 8. Control |

Result:

Grain damage (%): The grains of soybean treated with different concentration of silica diatomous earth, edible oil and plant products and were stored to know the effect on mean per cent grain damage by pulse beetle, *C. chinensis*. It is evident from the Table 4.10 that all the treatments were found significantly superior over the untreated control. Among all the treatments, the mean per cent grain damage was ranged from 4.22 to 7.07 per cent at all the storage periods. The silica diatomous earth (4%) was recorded most effective treatment and caused 4.22 mean per cent grain damage, which was showed statistically at par result with silica diatomous earth (3%) and caused 4.61 mean per cent grain damage, whereas neem seed kernel powder (1%) and mustard oil (2%) were resulted 5.37 and 5.74 mean per cent grain damage and recoded statistically at par with each other. Among all the treatments the maximum 7.07 mean per cent grain damage was recorded in silica diatomous earth (1%) followed by 6.88 and 6.14 mean per cent grain damage in groundnut oil (2%) and silica diatomous earth (2%) respectively, as compared to untreated control (36.99%).

Weight loss (%): The data depicted in (Table 4.10) on mean per cent weight loss showed that among all the treatments were recorded significantly superior over the untreated control. The minimum mean per cent weight loss by pulse beetle, *C. chinensis* in soybean grains, 4.27 per cent was recorded in grains treated with silica diatomous earth (4%) and result showed statistically at par with next to effective treatment silica diatomous earth (3%) as 4.70 mean per cent grain weight loss. The treatment of neem seed kernel powder (1%) proceed to be the next effective treatment in reducing the weight loss and resulted 5.86 mean per cent grain weight loss followed by mustard oil (2%) with 6.20 mean per cent grain weight loss, however statistically no significant difference between both the treatments. The minimum protection with maximum mean per cent grain weight loss 7.91 per cent was recorded in the treatment of silica diatomous earth (1%) followed by 7.41 and 7.06 mean

per cent grain weight loss in groundnut oil (2%) and silica diatomous earth (2%) respectively. The maximum mean per cent grain weight loss (39.08%) was recorded in untreated control.

Adult mortality (%)

The data recorded on mean per cent adult mortality of pulse beetle, *C. chinensis* at 30, 60 and 90 days after storage period has been presented in Table 4.10. The data reveals that all the treatments were found significantly superior over control. The mean per cent adult mortality of pulse beetle was ranged from 77.11 to 91.29 per cent. The maximum mean per cent adult mortality 91.29 per cent was recorded in treatment grain treated with silica diatomous earth (4%) which was statistically at par with the treatment of silica diatomous earth (3%) that resulted 88.96 mean per cent adult mortality. The treatments of neem seed kernel powder (1%) followed by the above treatment and proceed to be next effective treatment with mean per cent adult mortality of 84.02 per cent, followed by mustard oil (2%) that resulted in 78.63 mean per cent adult mortality. The minimum mean per cent adult mortality of 12.25 per cent was recorded in control. The minimum protection with minimum per cent adult mortality 77.11 per cent was recorded in the treatment of silica diatomous earth (1%) followed by 77.62 and 77.87 mean per cent adult mortality in groundnut oil (2%) and silica diatomous earth (2%) and these treatments were recorded statistically at par with each other.



Effect of silica diatomous earth on soybean seed in comparison to control against pulse beetle

Table 7.6.5: Effect of silica diatomous earth on the grain damage, weight loss and adult mortality by pulse beetle, *Callosobruchus chinensis* (L.) in soybean.

Treatment	Mean grain damage (%) by pulse beetle, <i>C. chinensis</i>	Mean weight loss (%) by pulse beetle, <i>C. chinensis</i>	Mean adult mortality (%) by pulse beetle, <i>C. chinensis</i>
Silica diatomous earth (1%)	7.07 (15.42)	7.91 (16.33)	77.11 (61.47)
Silica diatomous earth (2%)	6.14 (14.35)	7.06 (15.41)	77.87 (61.94)
Silica diatomous earth (3%)	4.61 (12.40)	4.70 (12.52)	88.96 (70.72)
Silica diatomous earth (4%)	4.22 (11.85)	4.27 (11.93)	91.29 (72.99)
Neem seed kernel powder (1%)	5.37 (13.40)	5.86 (14.00)	84.02 (66.57)
Mustard oil (2%)	5.74 (13.86)	6.20 (14.42)	78.63 (62.55)
Groundnut oil (2%)	6.88 (15.21)	7.41 (15.80)	77.62 (61.77)
Control	36.99 (37.46)	39.08 (38.69)	12.25 (20.49)
CD(P=0.05)	0.454	0.530	4.199

7.7 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

Ajmer

Evaluation of IPM Modules against aphid infesting coriander and fennel

To evaluate the relative efficacy of six organic based IPM modules (including control) against aphid on coriander and fennel. Observations were recorded from randomly selected five tagged plants per plot right 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 population was recorded in module M-3 (garlic extract 10 ml/lit + azadirachtin 0.03% EC @ 5ml/lit + tumba fruit extract 10ml/lit.), which was 77.00% on coriander and 79.50% on fennel followed by M-2 (field sanitation + NSKE 5ml/lit + Ker extract 10 ml/li.), where population reduction were 75.37% and 77.47%, both on coriander and fennel respectively.

IPM Modules against thrips infesting coriander and fennel

A similar field experiment was also conducted to evaluate the relative efficacy of six organic based IPM modules (including control) against thrips on coriander and fennel. Observations were recorded from randomly selected five tagged plants per plot right from pests' initiation on crop to harvesting. The results showed that all IPM modules were found significantly superior over control. The maximum percent reduction in thrips population was recorded under IPM module M-3 (garlic extract 10 ml/lit + azadirachtin 0.03% EC @ 5ml/lit + tumba fruit extract 10ml/lit.), which was 70.15 % on coriander and 71.45 % on fennel followed by M-2 (field sanitation + NSKE 5ml/lit + Ker extract 10 ml/li.), where population reduction were 67.97 and 69.70 percent both on coriander and fennel respectively.

Almora

organic pest management options for pests of soybean

The organic pest management options for soybean pests. Table 3 shows the sucking bug, *Chauliops choprai* infestation in the treatments. The infestation of soybean crop by sucking bug, *Chauliops choprai* and aphids in the season was low to moderate. The application of 10% extract of *Melia azederach* and *nimbidine* 3 mL/L provided at par reduction of the sucking bug population up to 74%. However, against aphids, parthenium leaf extract 5% and 10% extract of *Melia azederach* provided reduction of 46.9 and 46.5%, respectively.

Table 7.7.1. Effect of organics on the management of sucking bug of soybean

Treatment	Per cent Reduction (pre-treatment count)			
	C. choprai	Aphids	C. choprai	Aphids
<i>Melia azederach</i> extract 5%	62.16	36.34	4.14	17.08
<i>Melia azederach</i> extract 10%	73.81	46.52	27.92	39.37
Nimbidine 3 mL/L	73.81	36.39	27.92	39.25
<i>Beauveria bassiana</i> 3g/L	56.00	45.64	21.10	19.01
Parthenium extract 5%	67.50	46.89	10.55	16.26
Cartap hydrochloride 1g/L	79.07	87.85	42.39	73.41
Control	-65.625	-22.43	-	-



Among the pest management modules tested, the insecticide *cartap hydrochloride* @ 1g/L provided cent per cent mortality of the test insect within 24 hours after treatment. Among the organic pest management modules, extracts of *Parthenium*, *Melia azederach* and commercial *Nimbecidine* caused up to 25% mortality after 72 hours after treatment.

Table 7.7.2. Effect of organics on the management of sucking bug of soybean in the laboratory

Treatment	Per cent mortality (Hours after treatments)			Average
	24	48	72	
<i>Melia azederach</i> extract 5%	0	3.3	6.7	3.33
<i>Melia azederach</i> extract 10%	0	10.0	23.3	11.10
Nimbecidine 3 mL/L	0	16.7	23.3	13.33
<i>Beauveria bassiana</i> 3g/L	6.7	6.7	6.7	6.70
<i>Parthenium</i> extract 5%	3.0	6.7	26.7	12.13
<i>Metarhizium anisopliae</i> 3g/L	6.7	13.3	13.3	11.10
Cartap hydrochloride 1g/L	100.0	-	-	100.0
Control	0	0	0	0.00

Effect of organics in the management of aphids in toria

An experiment was conducted in the laboratory to evaluate the organic pest management options for the management of aphids in toria. The twigs infested with toria aphids were brought to laboratory and used for bioassay. A total of six different organic options were tested against toria aphids in the laboratory which contains three botanical extracts of bataan, artemisia and pine; two bioagents, a commercially available neem oil formulation (Nimbecidine) and a chemical pesticide, Acetamiprid. The insecticide, acetamiprid was found to reduce the infestation of aphids in toria considerably with more than 93.5% mortality in aphid population. The second best treatment was the commercial neem oil (Nimbecidine) which was found to cause 39.3% mortality in aphid population at 3 mL/L. The commercial fungal biocontrol agents, *Metarhizium anisopliae* and *Beauveria bassiana* did not report any mortality of the aphid.

Organic management of toria aphids

Organic pest management options for the management of aphids in toria. Pretreatment count shows severe infestation of aphids which accounts to 100% plants infested with aphids. None of the bioagents or botanicals was found effective against toria aphid. Only insecticide, acetamiprid was found to reduce the infestation of aphids in toria up to 87%. Among organic management, Nimbecidine reduced 22% aphid.

Pest incidence in organic production system

Incidence of insect pests in nutrient management experimental plots was noted as follows. The infestation/damage of leaf webber in grain amaranth grown in full organic conditions was 6.8%, whereas it was 11.0% damage in full inorganic plots (Table 3). Soybean grown under full organic condition was found to harbour more number of sucking bug, *Chauliops choprai* (13.8 bugs per 3 leaves) and 100% inorganic had the least number of sucking bugs (8.2 bugs per 3 leaves). The infestations of aphids in toria under wheat + toria intercropping were 48, 44 and 56 and 60% for application of 100% N requirement of crop through FYM, 75% N requirement of crop through FYM + 3% Panchagavya + Vermiwash, INM and 100% inorganic conditions, respectively. No insect pest incidence was observed in wheat crop.

Disease infestation in organic and inorganic production system

In general, the disease severity was high in the rabi season crops (Table 4). But, the intensity of different diseases in different crops during *kharif* and rabi season was relatively higher under inorganic management system compared to other systems (Table 5 and 6). The management with organic inputs recorded very low infestation of various pathogens.

The intensity of different diseases in different crops during *kharif* season was relatively higher under inorganic management system compared to other systems (Table 9). The management with organic inputs recorded very low infestation of various pathogens.

Table 7.7.3. Disease index in different crops under organic and inorganic production system during rabi 2019-20

Treatment	Wheat + toria intercropping				
	Wheat			Toria	
	Yellow rust	Brown rust	Powdery mildew	Alternaria leaf spot (%)	
100% Organic	20S	10S	3	2	
75% Organic + 3% Panchagavya + Vermiwash	40S	10S	5	5	
50% Organic + 50% inorganic	10S	5S	1	10	
100% Inorganic	40S	-	1	10	
Treatment	Wheat + lentil intercropping				
	Wheat			Lentil	
	Yellow rust	Brown rust	Powdery mildew	Wilt (%)	Root rot (%)
100% Organic	60S	0	3	2	0
75% Organic + 3% Panchagavya + Vermiwash	60S	5S	1	5	1
50% Organic + 50% inorganic	60S	TS	3	8	2
100% Inorganic	60S	0	5	10	2

* Scale for yellow rust and brown rust of wheat = 0-100S scale, Scale for powdery mildew of wheat = 0-9 scale, Scale for alternaria leaf spot of toria; and wilt and root rot of lentil = 0-100%

Table 7.7.4. Disease index in different crops under organic and inorganic production system during rabi

Treatment	Finger millet + black soybean intercropping			
	Finger millet		Black soybean	
	Fingerblast*	Leaf spot	Frog eye leaf spot	Bacterial pustule
100% Organic	1	5	1	2
75% Organic + 3% Panchagavya + Vermiwash	1	5	3	3
50% Organic + 50% inorganic	3	7	3	3
100% Inorganic	3	7	5	5
Treatment		Anthracnose in grain amaranth		
100% Organic		7		
75% Organic + 3% Panchagavya + Vermiwash		7		
50% Organic + 50% inorganic		5		
100% Inorganic		3		

*Scale for fingerblast and leaf spot of finger millet; Frog eye leaf spot, Bacterial pustule of black soybean; Anthracnose of Grain amaranth = 0-9 scale

Gangtok

Organic insect pest management in large cardamom

Result: Insects that cause infestation in Large Cardamom are Leaf caterpillars, Tea Mosquito bug, Shoot fly, Stem borer and Root mealy bug. The present study was conducted to study the effect of bio-pesticides and organically permitted chemicals on insect pest management in organic large cardamom. All the bio-pesticide treatments showed very effective results on control of insect pests over control plot. Application

of Spinosad 45 SC @ 0.3 ml/l reduced the infestation of insect pests in crop which ranged from 70.39 to 78.88 % over control followed by neem oil (1500 ppm) @ 4 ml/l (59.95 to 73.45 % reduction of infestation over control) and petroleum agrospray @ 2ml/lit (43.94 to 69.44 % reduction of infestation over control).

Table 7.8.5 Effect of biopesticides on insect of large cardamom

Treatments	Percent reduction in damage over control				
	Leaf caterpillar damage	Tea Mosquito bug damage (%)	Shootfly damage (%)	Root mealy bug incidence (%)	Stem borer damage (%)
Neem oil (1500 ppm @ 4 ml/l)	73.4	67.8	59.9	*	62.7
<i>Beauveria bassiana</i> 7 g/l	41.7	11.0	52.1	*	52.2
<i>Metarhiziumanisopliae</i> 5 ml/l	44.5	8.35	41.9	*	41.4
Petroleum oil based agrospray @ 10 ml/l	59.2	69.4	43.9	*	44.2
Petroleum oil based horticultural spray @ 10 ml/l	51.9	63.2	51.7	*	53.5
<i>Bacillus thuringiensis</i> @ 2 g/l	47.4	11.1	56.3	*	58.2
Spinosad 45 SC @ 0.3 ml/l	78.8	75.3	71.6	*	70.3
SEm±	1.82	1.35	1.77	*	3.35
CD (P=0.05)	5.62	4.15	5.46	*	10.3

Note: * Treatments not considered for evaluation of root mealy bug incidence



Spraying of Biopesticides of large cardamom



Shoot Fly Damage of large cardamom



Tea Mosquito bug damage of large cardamom

Organic insect pest management in maize-based cropping system

Result

Efficacy of the selected bio-pesticides against infestation of army worm and stem borer in maize crop. Among all the tested biopesticides, Spinosad 45 SC showed the best result in Stem borer infestation (%) with 79.0 % damage control and increase in grain yield of maize (3.64 t/ha) followed by *Beauveria bassiana* @ 7 g/l (3.32 t/ha) as compared to control. Similar trend was followed in the lowest percent damage before spray, percent damage after spray and damage control by stem borer infestation was observed. The lowest disease incidence was observed in the Spinosad 45 SC @ 0.3 ml/l (15.7%). The study can be under taken for more to examine the behavior and mechanism of resistance. The TLB disease scoring was done using 1- 5 scale suggested by Payak and Sharma (1983) on five random plants in each entry at the time of tasseling and at 20 days after tasseling.

Effect of biopesticide on organic insect pest and disease management in maize-based cropping system

Treatments	Stem borer infestation (%)					TLB
	Insect Score (0-9 scale)	Percent damage before spray	Percent damage after spray	Percent damage control	Grain yield (t/ha)	Disease incidence (%)
Neem oil (1500 ppm @ 4 ml/l)	3.29	9.01	6.19	68.47	2.66	39.5
<i>Beauveria bassiana</i> @7 g/l	1.48	8.28	5.53	73.09	3.32	21.7
<i>Metarhizium anisopliae</i> @5 ml/l	3.15	8.55	6.21	69.83	2.91	24.4
Petroleum oil based agrospray @ 10 ml/l	4.65	9.83	7.10	65.55	2.03	41.4
Petroleum oil based horticultural spray @ 10 ml/l	2.30	7.41	5.92	71.29	3.19	23.46
<i>Bacillus thuringiensis</i> @ 2 g/l	4.00	9.60	6.78	67.11	2.53	40.1
Spinosad 45 SC @ 0.3 ml/l	1.00	5.61	4.32	79.06	3.64	15.7
Control	5.98	9.15	20.55	-	0.91	51.97
Mean	3.23	8.43	7.82	70.62	2.81	-
CD (P=0.05)	0.92	1.08	0.65	-	0.28	-



Fig: Spraying of bio pesticide after severe incidence of insect in maize plant



7.8 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 (Rajasthan) and Gangtok (Sikkim)

Ajmer

Results

Management of *Sclerotium* rot of coriander

Among the all treatments 21 days summer soil solarization was found most effective (PDI 3.5) followed by neem cake (PDI 6.71) and *Trichoderma* (PDI 8.72) while the disease was recorded maximum (PDI 15.45 in control (Table 4.1). Total number of weeds /m² area were counted after fifteen days of sowing where the minimum weed count (46.75) per metre square were reported in 21 days soil solarization followed by in neem cake (79.5) while the maximum weed /m² (129.5) recorded in control . There was no significant difference was recorded of these treatments effects on Powdery mildew disease on organic coriander. The maximum yield (7.78 q/ha) was recorded in the treatments 21 days summer soil solarization followed by *Trichoderma* (7.46 q/ha) (Table 7.8.1.1).

Table 7.8.1.1: Influence of different treatments on *Sclerotium* rot disease of coriander

Treatments	<i>Sclerotium</i> Rot (PDI)	PM (PDI)	No. weeds /M ²	Yield (kg/ha)
Soil solarization (21 days)	3.50	10.75	46.75	7.78
<i>Trichoderma</i> (Soil & Seed App.)	8.98	11.50	118.5	7.46
Neem cake (0.5 T/ha)	6.71	13.13	79.5	7.42
Caster cake (0.5 T/ha)	7.78	13.75	83.5	6.01
Control	15.45	15.12	129.5	5.28
SEm±	1.38	1.04	3.35	0.52
CD at 0.05%	1.30	3.23	10.43	1.63
CV				

Management of *Ramularia* blight of fennel (*Foeniculum vulgare*)

Organically in fennel an experiment was conducted comprising five treatments including ariel spray of neem oil (0.5%), castor oil (0.5%), garlic extract (0.5%), onion extract (0.5%) and control. The experiment was designed with four replications for each treatment. The plot size of the experimental plots was kept 3x3 meters. Statistically the experiment was designed in RBD (Randomized block design). The spray schedule of different botanicals was adopted. The data depicted in the table 2 showed that among all the treatments garlic extract was found most effective (PDI 0.57) followed by onion extract (PDI 1.12) while the disease was recorded maximum (PDI 3.62 in control. The maximum yield (19.0 q/ha) was recorded in the treatments garlic extract followed by onion extract (17.7 q/ha). (Table 7.8.1.2).

Table 7.8.1.2: Influence of different treatments on weed seed yield and *Ramularia* blight disease of fennel.

Treatments	No. Weeds /m ²	<i>Ramularia</i> Blight	Yield kg/ha
Neem oil (0.5%)	98	1.37	17.2
Castor oil (0.5%)	105	2.0	15.3
Garlic extract (0.5%)	110	0.57	19.0
Onion extracts (0.5%)	104	1.12	17.7
Control	114	3.62	14.4
SEm±	3.61	0.129	0.53
CD at 0.05%	10.87	0.401	1.66
CV 7.87	14.78	6.42	

Gangtok

Organic disease management in large cardamom

Results

Evaluation of the botanicals, bio-control agents and organically permitted fungicides against the three major diseases which are of economic importance in the present scenario. The diseases included chirkey disease caused by Large Cardamom Chirke Virus (*Maclura virus*), Foorkey disease caused by Cardamom Bushy Dwarf virus (Nano virus), leaf blight disease complex associated with group of pathogenic fungi including *Colletotrichum* spp, *Pestalotiopsis* spp, *Fusarium* spp, *Pestalotia* spp. In the third year of trial, both in vitro and in vivo trials were undertaken to evaluate the efficacy of the treatments. Under in vivo studies, a total of 11 treatments were used including control plot the details of which are mentioned in Table 8.

Table 7.8.2.1 List of treatments used against the diseases under in vivo studies

	Treatments	Concentration %
T1	Garlic	2.50%
T2	Common mugwort (<i>Artemisia vulgaris</i>)	2.50%
T3	Needlewood (<i>Schima wallichii</i>)	2.50%
T4	Commercial neem based formula (Azadirachtin 1500 ppm) @ 0.15%	0.30%
T5	<i>Trichoderma viride</i>	6.50%
T6	<i>Pseudomonas fluorescens</i>	0.50%
T7	Copper oxychloride 50% WP	0.25%
T8	Copper hydroxide 75% WP	0.25%
T9	Bordeaux Mixture	0.25%
T10	Sulphur 80% WP	0.10%
T11	Control	-

Among the treatments, significant difference was observed. The results showed that the least disease incidence of 27% was observed in neem based compound (Azadirachtin 1500 ppm) and sulphur 80% WP. Among the botanicals, garlic @ 2.5% showed minimum disease incidence. The incidence of viral diseases was not observed in neem based formulation and *Trichoderma viride* treatment which could be due to the fact that neem based formula inhibited the insect vector involved in the spread of disease and *T. viride* with its antibiotics and growth promoting role enhanced the host defense. A positive correlation was also observed between the treatments and the yield parameters of the plants. The details of the disease incidence and plant growth parameters is given in Table 9.

The results of the *in vitro* studies were also in accordance to the *in-vivo* studies and mentioned in Table 9. Among the treatments the best performance was showed by neem based formulation with only 12.00 mm growth of pathogen followed by sulphur 80% WP 13.07 mm of

growth. The least performance was shown by Bordeaux mixture and copper hydroxide 75% WP with maximum pathogen growth of 83.67 mm and 66.0 mm, respectively.

Table 7.8.2.2. Effect of treatments on the yield parameters and disease incidence of large cardamom under field conditions

Treatment details	No. of flowers/ plant	Total number of tillers	Recovery %	No. of seeds / fruit	Disease free tillers	Disease infected tillers	Disease incidence %
Garlic (<i>Allium sativum</i>) 2.5%	6	22	82.1	18.8	15	7	32
Common Mugwort (<i>Artemisia vulgaris</i>) 2.5%	7	15	84.3	13.5	9	6	40
Needle wood (<i>Schima wallichii</i>) 2.5%	5	17	81.9	13.0	11	6	35
Commercial neem based formula (Azadirachtin 1500 ppm)	6	15	80.7	22.6	11	4	2 7
<i>Trichoderma viride</i>	7	20	82.9	20.6	13	7	35
<i>Pseudomonas fluorescens</i>	8	20	87.0	10.1	11	9	45
Copper oxychloride 50% WP	4	17	88.4	16.1	10	7	41
Copper hydroxide 75% WP	4	17	84.6	14.2	9	8	47
Bordeaux Mixture	4	15	72.7	12.3	7	8	53
Sulphur 80% WP	8	15	79.8	20.6	11	4	27
Control	4	20	82.7	11.0	7	13	65
CD (0.05%)	2.33	NS	-	4.90	4.82	3.54	12.7



Spraying of botanicals, bio control agents and organically permitted fungicides



Leaf blight damage



Foorkey Infection



Chirkey infection

Large cardamom field under spray and incidence of major diseases in field

7.9 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

A. Standardization of organic nutrient management package for large cardamom

Among the different organic nutrient's management in the large cardamom, maximum number of mature tillers/bush was recorded with the application of vermicompost @ 10 kg/clump + biofertilizer (3.10 tillers / bush) followed by vermicompost @ 7.5 kg/clump + biofertilizer during 2019. The dry weight of capsules per clump and the productivity of the large cardamom were maximum, i.e., 19.96 g and 412 kg/ha, in the year 2019 when vermicompost was applied @ 10 kg/clump + biofertilizer. The SOC (%) was highest under vermicompost @ 10 kg/clump + biofertilizer (1.28 %) followed by FYM @ 10 kg + VC @ 2.5 kg/clump + Biofertilizer (1.21 %). The application of vermicompost @ 10 kg/clump + biofertilizer as well as other nutrient treatments showed positive response to improved soil SOC (%) as well as NPK content of the soil as compared to control (Table 7.9.1)

Table 7.9.1: Effect organic nutrient management package for large cardamom

Treatments	Mature tillers/ bush	Dry wt. of capsules / clump (g)	Productivity (kg/ha)	SOC (%)	Available N (kg ha ⁻¹)	Available P (kg ha ⁻¹)	Available K (kg ha ⁻¹)
FYM @ 5 kg/clump + BF	3.00	14.6	327	1.10	314	26.5	214
FYM @ 7.5 kg/clump + BF	3.11	15.8	313	1.12	323	26.5	215
FYM @ 10 kg/clump + BF	3.33	16.3	338	1.16	322	26.8	218
FYM @ 5 kg + VC @ 2.5 kg/clump + BF	3.92	16.2	363	1.15	333	26.7	214
FYM @ 7.5 kg + VC @ 2.5 kg/clump + BF	3.98	17.8	383	1.21	340	26.2	217
FYM @ 10 kg + VC @ 2.5 kg/clump + BF	4.14	18.7	399	1.21	344	28.0	214
VC @ 5.0 kg/clump + BF	2.72	17.4	392	1.11	327	26.8	214
VC @ 7.5 kg/clump + BF	3.08	18.94	405	1.16	354	28.0	224
VC @ 10 kg/clump + BF	3.10	19.96	412	1.18	364	26.9	224
Control	1.06	5.38	117	0.97	227	19.1	189
CD (P=0.05)	0.24	0.51	22.3	0.07	10.3	1.69	11.6



Maximum tillers/bush in the treatment VC @ 10 kg/clump + BF



Maximum capsules under VC @ 10 kg/clump + BF



Harvesting of capsule



Sun drying of capsule

Effect organic nutrient management package for large cardamom

B. Response of large cardamom (growth and yield parameters) to soil and foliar application of micronutrients

Micronutrients showed that the available boron under foliar application is much as compared to soil application for Zn, B and Mo. The best soil treatment that increased the vegetative buds of large cardamom significantly was 3.0 kg/ha boron, 1.5 kg/ha zinc and 10.0 kg/ha molybdenum (2.51, 2.40, 2.41 respectively) as compared to control. Critical appraisal of data revealed that application of boron significantly affected the immature, mature tillers and vegetative buds. Among the foliar application of boron treatments, foliar application of Borax @ 0.30% recorded the maximum values of immature tillers per clump (3.81 numbers) and mature tillers per clump (3.54). It might be due to the positive role of boron in meristematic tissue development, whether these were root tips, tips of upper plant parts. (Table 7.9.2).

Table 7.9.2. Effect of soil and foliar application of micronutrients in response of large cardamom (growth and yield parameters)

Treatments		Dose	Available Nutrients (mg kg ⁻¹)	Immature tiller (numbers)	Mature tiller	Vegetative buds (numbers)
Soil application						
T ₁	Boron	1.0 kg/ha	0.153	3.16	3.06	2.39
		2.0 kg/ha	0.164	3.21	3.16	2.43
		3.0 kg/ha	0.168	3.30	3.25	2.51
T ₂	Zinc	1.0 kg/ha	3.280	2.87	2.92	2.36
		1.5 kg/ha	3.450	3.13	3.11	2.46
		2.0 kg/ha	3.680	3.01	2.99	2.40
T ₃	Molybdenum	5.0 kg/ha	0.117	2.73	3.00	2.27
		7.5 kg/ha	0.121	2.81	3.09	2.32
		10.0 kg/ha	0.122	3.05	3.16	2.41
Foliar application						
T ₄	Boron	0.10%	0.174	3.64	3.43	2.75
		0.20%	0.175	3.81	3.54	2.75
		0.30%	0.178	3.75	3.38	2.73
T ₅	Zinc	0.10%	3.550	3.70	3.30	2.65
		0.25%	3.670	3.77	3.35	2.67
		0.50%	3.750	2.85	3.22	2.59
T ₆	Molybdenum	0.05%	0.115	1.99	3.09	2.55
		0.10%	0.116	2.17	3.12	2.63
		0.20%	0.121	1.66	2.10	1.78
T ₇	Control	Control	1.05	0.63	0.615	0.52
	CD (P=0.05)		-	0.50	0.40	0.27



Maximum Immature tillers under the foliar application treatment of boron @ 30%



Maximum vegetative buds under the foliar application treatment of boron @ 30%

C. Organic disease management in large cardamom.

Effect of locally available botanicals, commercially available bio control agents and organically permitted fungicides against blight of large cardamom

Results: Studied the effect of different treatments against various diseases in large cardamom consisting of 11 treatments including botanicals, bio-control agents and organically permitted fungicides. The diseases included chirkey disease caused by Large Cardamom Chirke Virus (*Maclura virus*), Foorkey disease caused by Cardamom Bushy Dwarf virus (*Nano virus*), leaf blight disease complex associated with group of pathogenic fungi including *Colletotrichum spp*, *Pestalotiopsis spp*, *Fusarium spp*, *Pestalotia spp*. Among the treatments, significant difference was observed. The results showed that the least disease incidence of 27% was observed in neem-based compound (Azadirachtin 1500 ppm) and sulphur 80% WP. Among the botanicals, garlic @ 2.5% showed minimum disease incidence. The incidence of viral diseases was not observed in neem based formulation and *Trichoderma viride* treatment which could be due to the fact that neem based formula inhibited the insect vector involved in the spread of disease and *T. viride* with its antibiotics and growth promoting role enhanced the host defense. A positive correlation was also observed between the treatments and the yield parameters of the plants (Table 7.9.3).

The in vitro studies were carried out against the leaf blight pathogen isolated and purified on Potato Dextrose Agar (PDA) media. Among the several pathogens identified in leaf blight complex, *Pestalotiopsis spp*. culture was used to conduct the in vitro assay using dual culture and poison food technique. The results of the in vitro studies were also in accordance to the in-vivo studies and mentioned in Table 7.9.3. Among the treatments the best performance was showed by neem-based formulation with only 12.00 mm growth of pathogen followed by sulphur 80% WP 13.07 mm of growth. The least performance was shown by Bordeaux mixture and copper hydroxide 75% WP with maximum pathogen growth of 83.67 mm and 66.0 mm, respectively (Table 7.9.4).

Treatment	Mean growth of pathogen mycelia (mm)	Percentage recovery over control (PROC)
T1Garlic (<i>Allium sativum</i>) 2.5%	22.4	73.6
T2Common Mugwort (<i>Artemisia vulgaris</i>) 2.5%	25.0	70.5
T3Needlewood (<i>Schiima wallichii</i>) 2.5%	18.6	78.0
T4Commercial neem-based formula (Azadirachtin 1500ppm)	12.0	85.8
T5Trichoderma viride 6.5%	19.6	76.8
T6 ICAR-TV7	12.6	85.0
T7Pseudomonas fluorescens 0.5%	36.3	57.2
T8Copper oxychloride 50% WP	32.3	61.9
T9Copper hydroxide 75% WP	66.0	22.3
T10Bordeaux Mixture	83.6	1.56
T11Sulphur 80% WP	13.0	84.6
T12 Control	85.0	0.00
CD (0.05%)	7.06	-



Spraying of botanicals, bio control agents and organically permitted fungicides



Leaf blight damage



Foorkey Infection



Chirkey infection



Pseudomonas fluorescens 0.5%



Trichoderma viride ICAR-Sikkim



Trichoderma viride Commercial 6.5%



Bordeaux mixture 0.25%



Copper hydroxide 0.25%



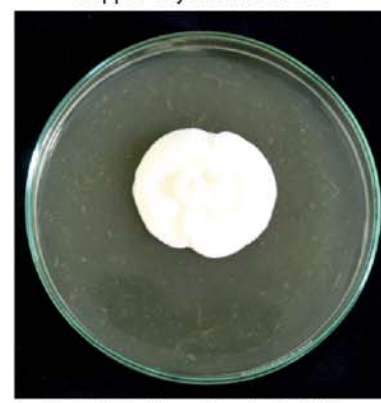
Copper oxychloride 0.25%



Garlic 2.5%



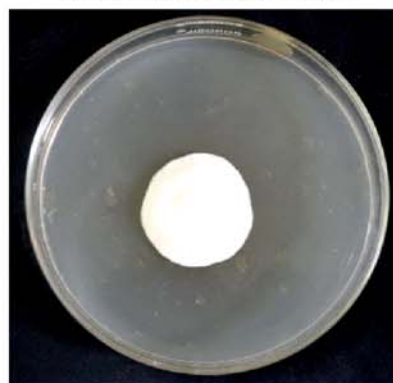
Neem based formulation 0.3%



Artemisia vulgaris 2.5%



Supfex 0.1%



Schima wallichii 2.5 %



CONTROL

Inhibition of pathogen *Pestaliopsis* spp by the antagonists under *in vitro* conditions



Table 7.9. 3: Effect of treatments on the yield parameters and disease incidence of large cardamom under field conditions

Treatment	Treatment details	No. of flowers/plant	Total number of tillers	No. of mature tillers	No. of immature tillers	Fresh weight (g)	Dry weight (g)	Recovery %	No. of seeds/fruit	Disease free tillers	Disease infected tillers	Disease incidence %
T1	Garlic (<i>Allium sativum</i>) 2.5%	6	22	14	8	303	54	82.1	18.8	15	7	32
T2	Common Mug wort (<i>Artemisia vulgaris</i>) 2.5%	7	15	13	2	300	47	84.3	13.5	9	6	40
T3	Needle wood (<i>Schima wallichii</i>) 2.5%	5	17	13	4	260	47	81.9	13.0	11	6	35
T4	Commercial neem-based formula (Azadirachtin 1500 ppm)	6	15	13	2	244	47	80.7	22.6	11	4	27
T5	<i>Trichoderma viride</i> 6.5%	7	20	17	3	310	53	82.9	20.6	13	7	35
T6	<i>Pseudomonas fluorescens</i> 0.50%	8	20	16	4	200	26	87.0	10.1	11	9	45
T7	Copper oxychloride 50% WP 0.25%	4	17	14	3	233	27	88.4	16.1	10	7	41
T8	Copper hydroxide 75% WP 0.25%	4	17	14	3	150	23	84.6	14.2	9	8	47
T9	Bordeaux mixture 0.25%	4	15	12	3	136	37	72.7	12.3	7	8	53
T10	Sulphur 80% WP 0.10%	8	15	13	2	213	43	79.8	20.6	11	4	27
T11	Control	4	20	16	4	133	23	82.7	11.0	7	13	65
	CD (0.05%)	2.33	NS	NS	2.77	111	18.81	-	4.90	4.82	3.54	12.7

D. Organic insect pest management in large cardamom

Result: Insects that cause infestation in Large Cardamom are Leaf caterpillars, Tea Mosquito bug, Shoot fly, Stem borer and Root mealy bug. The present study was conducted to study the effect of biopesticides and organically permitted chemicals on insect pest management in organic large cardamom. All the biopesticide treatments showed very effective results on control of insect pests over control plot. Application of Spinosad 45 SC @ 0.3 ml/l reduced the infestation of insect pests in crop which ranged from 70.39 to 78.88 % over control followed by neem oil (1500 ppm) @ 4 ml/l (59.95 to 73.45 % reduction of infestation over control) and petroleum agrospray @ 2ml/lit (43.94 to 69.44 % reduction of infestation over control).

Table 7.9.4. Effect of Biopesticides on insect of large cardamom

Treatments	Dose	Percent reduction in damage over control				
		Leaf caterpillar damage	Tea Mosquito bug damage (%)	Shoot fly damage (%)	Root mealy bug incidence (%)	Stem borer damage (%)
Neem oil (1500 ppm)	4 ml/l	73.4	67.8	59.9	*	62.7
<i>Beauveria bassiana</i>	7 g/l	41.7	11.0	52.1	*	52.2
<i>Metarhizium anisopliae</i>	5 ml/l	44.5	8.35	41.9	*	41.4
Petroleum oil based agro-spray	2ml/lit	59.2	69.4	43.9	*	44.2
Petroleum oil based horticultural spray	10 ml/l	51.9	63.2	51.7	*	53.5
<i>Bacillus thuringiensis</i>	2 g/l	47.4	11.1	56.3	*	58.2
Spinosad 45 SC	0.3 ml/l	78.8	75.3	71.6	*	70.3
CD (P=0.05)		5.62	4.15	5.46	*	10.3

* Treatment no considered for root mealy bug incidence



Shoot Fly Damage



Tea Mosquito bug damage



7.10 Biochemical characterization & molecular identification of microbial population of different organic manures

Location: Narendrapur

Morphological and Biochemical Characterization as well as validation of organic and natural farming Based organic bio-stimulant – Beejamrit

Aim of this project is to study physico-chemical parameters and plant beneficial microbial diversity of this conventional liquid organic bio-stimulant, *Beejamrit*. The *Beejamrit* was prepared using forest soils North Bengal (Alipurduar district) – Boksa Tiger Reserve Forest and incubated over periods of 0, 24, 48, 72, 96, 120 and 144 hours. Samples from each incubation hours were further analysed to determine its microbial load and physico-chemical properties. This study showed gradual decrease of pH upon more days of incubation where the initial pH in alkaline range tells about the presence of cow urine in it. The nutrient analysis showed that the concentration of organic carbon in *Beejamrit* samples gradually depleted upon days of incubation, clearly suggesting microbial decomposition in the system. A similar and significant decline in the total soluble protein content of *Beejamrit* samples was observed upon days of incubation mostly due to the proteolytic activities of microbes. The concentration of available phosphorus increased significantly upon days of incubation due to mobilization of insoluble phosphorus compounds into its plant available forms by microbial action. However, available potassium profile showed gradual increment after days of decomposition. The concentration of available potash reaches its maximum after 5-days of incubation. This study also showed that the concentration of IAA content of the *Beejamrit* solution archives maximum after 4-days of incubation, which denotes that the *Beejamrit* solution is a rich source of IAA.

The studies on microbial dynamics in the system revealed that total bacterial count evenly increases and reaches highest after 5-days of incubation. The bacterial population starts decreased in number after 5-days. Counting this all, this result suggests that the *Beejamrit* is a poor nutrient medium for microbial growth for longer period. So the *Beejamrit* solution is best up to 3 to 4-days of incubation for seed treatment. This experiment also tells about the gradual increase of population of the N-fixers with days of decomposition & it reaches maximum after 4-days of incubation. This establishes the fact that the *Beejamrit* would provide better support to the seeds if it's applied just after 4-days of decomposition. This study also interprets that the population of PSBs increases upon days of incubation. This result on the population of PSBs beautifully matches up with the availability of phosphorus in the system.

Table 7.10.1. Physico-chemical parameters of Beejamrit, Variation in incubation period

Parameters	0 Hours	24 Hours	48 Hours	72 Hours	96 Hours	120 Hours	144 Hours	168 Hours
pH	8.51± 0.030	8.21± 0.0120	8.08± 0.0145	7.84± 0.0133	7.49± 0.0318	7.29± 0.0186	7.15± 0.0173	7.14± 0.0067
Organic Carbon (%)	3.96± 0.0173	3.81± 0.0346	3.45± 0.0153	2.28± 0.0203	1.90± 0.0426	1.67± 0.0484	1.43± 0.0265	1.05± 0.0176
Available Nitrogen (%)	0.00132± 0.235	0.00231± 0.345	0.00256± 0.876	0.002578± 0.765	0.0003120± 0.786	0.003045± 0.483	0.002854± 0.452	0.002843± 0.9865
Available Phosphorus (%)	0.12± 2.603	0.13± 1.453	0.14± 4.808	0.15± 1.453	0.15± 3.757	0.14± 1.202	0.14± 0.667	0.14± 0.333
Available Potassium (%)	0.21± 4.702	0.19± 1.764	0.19± 1.764	0.21± 3.512	0.22± 1.453	0.23± 1.764	0.21± 1.528	0.20± 0.882

Table 7.10.2. Microbial parameters of *Beejamrit*, Variation in incubation period

Parameters(CFU/ml)	0 Hours	24 Hours	48 Hours	72 Hours	96 Hours	120 Hours	144 Hours	168 Hours
Total bacterial count (10^8)	12.67± 0.67	11.67± 0.33	14.33± 0.88	17.33± 0.33	21.33± 0.67	24.33± 0.33	20.33± 0.88	16.67± 0.88
Total Fungal Count (10^4)	6.67± 0.33	6.33± 0.33	4.33± 0.33	3.00± 0.58	2.33± 0.33	1.67± 0.33	2.00± 0.00	1.00± 0.00
Total Actinomycetes Count (10^5)	23.33± 0.88	25.00± 0.58	21.67± 0.33	18.33± 0.33	16.33± 0.33	11.67± 0.33	10.67± 0.33	6.67± 0.88
Total Free living Nitrogen fixer's count (10^6)	11.00± 0.58	12.00± 0.58	14.67± 0.67	18.67± 0.67	23.00± 1.15	23.00± 0.58	19.67± 0.67	16.33± 0.67
Total Phosphate Solubilizers count (10^5)	12.33± 1.15	17.67± 0.88	22.00± 0.58	26.67± 0.67	31.00± 1.15	36.33± 0.88	30.33± 0.88	24.00± 1.15

Table 7.10.3. Biochemical parameters of *Beejamrit*, Variation in incubation period

Parameters	0 Hours	24 Hours	48 Hours	72 Hours	96 Hours	120 Hours	144 Hours	168 Hours
Total Soluble protein (mg/ml)	3.33± 0.049	3.14± 0.026	2.98± 0.035	2.49± 0.045	2.34± 0.031	2.15± 0.022	2.00± 0.044	1.59± 0.045
Total indolic compounds content (µg/ml)	10.37± 0.019	14.18± 0.369	16.78± 0.350	18.73± 0.350	20.33± 0.058	18.37± 0.591	16.21± 0.057	15.09± 0.142



7.11 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, Coimbatore, Dharwad, Karjat, Modipuram, Pantnagar, Raipur, Ranchi, Umiam and Udaipur

Treatments: The treatments may be differed from centre to centre as per their respective cropping systems based on the overall treatment structure given below

Treatments symbol		Treatment details/Management Practice (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 2019-20 for each center are presented and discussed.

Bajaura

Evaluation of weed management practices under organic vegetable production (black gram–cauliflower- summer squash)

Weed management practices in black gram: Significantly lower fresh weed weight (40.5 g/m²), weed density (24.0 number/ m²) and weed index (-5.4%) of black gram was observed with T₄ (Stale seed bed technique + reduced spacing up to 25% +mulching with wheat straw + one hand pulling at 20DAS) at 40 days after sowing resulted in maximum yield (830 kg/ha), net returns (141530 Rs/ha) and B:C (1.97) followed by T₇:ITK-Hand weeding at 20 DAS *fb* mulching (Table 7.11.1.1) . The weed index (33.4%) was found maximum with treatment T2 (one mechanical weeding at 20 DAS+ one hand weeding at 40 DAS) while minimum (-5.4%) being T4 (stale seed bed technique + reduced spacing up to 25% +mulching with wheat straw + one hand pulling at 20DAS).

Table 7.11.1.1: Evaluation of weed management practices for black gram in *kharif* under organic condition at Bajaura

Weed management practices	Yield (kg/ha)	Fresh weed weight at 40 DAS(g/m ²)	Dry weed weight at 40 DAS(g/m ²)	Weed density (number/m ²)	Weed index (%)	Net returns Rs/ha	B:C ratio
T ₁ : Hand weeding (Two) at 20 and 40 DAS	610	44.8	4.3	28.7	21.7	87287	1.23
T ₂ : One Mechanical weeding at 20 DAS+ one Hand weeding at 40 DAS	520	42.4	4.3	26.0	33.4	69612	1.07
T ₃ : Inter cropping in blackgram with Sunhemp (1:1 row of blackgram and sunhemp at 20cm row spacing) fb mulching with sunhemp biomass to be harvested at knee height stage. + one hand pulling at 40DAS	670	53.5	5.0	41.3	15.0	104365	1.54
T ₄ : Stale seed bed technique (standing water for 3-4weeks) + reduced spacing up to 25% i.e., 22.5 cm in black gram as against 30cm recommended row spacing+ mulching with wheat straw + one hand pulling at 20DAS	830	40.5	4.4	24.0	-5.4	141530	1.97
T ₅ : Mulching with local weed i.e., cannabis and congress grass + hand pulling at 40DAS	710	45.6	4.3	30.0	9.6	118676	1.85
T ₆ : Soil solarisation for 3weeks with 8-25 micron transparent polythene sheet + hand weeding at 20DAS	630	44.3	4.5	32.0	19.7	91943	1.31
T ₇ : ITK-Hand weeding at 20 DAS fb mulching with all weed incorporation obtained from hand weeding	730	42.1	4.4	30.0	6.5	120675	1.76
CD at 5%	029	5.11	NS	4.41	3.23	6550	0.09

Weed management practices in cauliflower: Significantly lower dry weed weight (1.4 g/m²), weed density (12.0 number/ m²) and weed index (26.5%) of cauliflower was observed with T5 (Mulching with local weed + hand pulling at 40DAS) resulted in maximum yield of cauliflower curd (5810 kg/ha), net returns (35,588 Rs/ha) and B:C (0.49) followed by T2: One MW at 20 DAT+ one HW at 40 DAT. The different weed management practices show non-significant effect on weed density and weed index (Table 7.11.1.2).

Table 7.11.1.2: Evaluation of weed management practices for *rabi* cauliflower under organic condition

Weed management practices	Yield (kg/ ha)	Fresh weed weight 40 DAS(g/m ²)	Dry weed weight 40 DAS(g/m ²)	Weed density (number/ m ²)	Weed index (%)	Net returns Rs/ha	B:C
T ₁ Hand weeding (Two) at 20 and 40 DAT	5230	21.6	1.9	22.7	33.8	10875	0.12
T ₂ One Mechanical weeding at 20 DAT+ one Hand weeding at 40 DAT	5460	17.4	1.7	20.0	30.8	18188	0.22
T ₃ Inter rows polyethylene mulching with mulch sheet	5030	12.1	1.4	16.0	36.3	3625	0.04
T ₄ Stale seed bed technique + reduced	5070	23.0	1.9	20.0	35.8	16863	0.22

Weed management practices	Yield (kg/ ha)	Fresh weed weight 40 DAS(g/m ²)	Dry weed weight 40 DAS(g/m ²)	Weed density (number/ m ²)	Weed index (%)	Net returns Rs/ha	B:C
spacing up to 25% + mulching with blackgram crop residues + one hand weed pulling at 20DAT							
T ₅ Mulching with local weed <i>gechinocloa</i> and <i>galinscoga</i> + hand pulling at 20DAT	5810	14.7	1.4	12.0	26.5	35588	0.49
T ₆ Soil solarization + hand weeding at 20 DAT	5380	15.6	1.6	17.3	31.9	6188	0.07
T ₇ ITK- FYM Mulching at 10 DAT	5300	24.3	2.7	18.7	32.9	26025	0.35
CD at 5%	325	5.35	0.35	NS	4.24	6102	0.07

Weed management practices for summer squash: Significantly lower fresh weed weight (18.8 g/m²), dry weed weight (1.8 g/m²) and weed index (24.6%) of summer squash was observed with T₆ (Soil solarization + hand weeding at 20DAT) 40 days after sowing. Maximum yield (15010 kg/ha), net returns (124321 Rs/ha) and B:C (1.96) of summer squash recorded with T₇ (ITK- FYM Mulching at 10 DAT), followed by T₅ mulching with local + hand pulling at 40 DAT in term of yield, net return and B:C ratio (Table 7.11.1.3). The weed index (41.5%) was found maximum with treatment T3 (Inter-cropping in squash with cow pea 1:1 fb mulching with cowpea biomass after 20DOS of cowpea)

Table 7.11.1.3: Evaluation of weed management practices for summer squash under organic condition

Weed management practices	Yield (kg/ ha)	Fresh weed weight 40 DAS(g/m ²)	Dry weed weight 40 DAS(g/m ²)	Weed density (number/ m ²)	Weed index (%)	Net returns Rs/ha	B:C
T1: Hand weeding (Two) at 20 and 40 DAS	6830	23.0	2.2	20.0	28.6	15121	0.22
T ₂ : One Mechanical weeding at 20 DAT+ one Hand weeding at 40 DAT	6720	20.0	2.0	18.7	29.7	9700	0.13
T ₃ : Inter-cropping in squash with cow pea 1:1 fb mulching with cowpea biomass after 20 DOS of cowpea	5590	24.8	2.1	21.3	41.5	7651	0.12
T ₄ : Stale seed bed technique+ reduced spacing+ mulching + one hand weed pulling 20DAT	12060	22.4	2.2	18.7	-26.2	83568	1.24
T ₅ : Mulching with local weed <i>cannabis</i> and <i>congress grass</i> + hand pulling at 40 DAT	12610	26.2	2.3	26.7	-31.9	94291	1.49
T ₆ : Soil solarization + hand weeding at 20DAT	7210	18.8	1.8	22.7	24.6	5357	0.06
T ₇ : ITK- FYM Mulching at 10 DAT	15010	28.7	2.5	25.3	-57.0	124321	1.96
CD at 5%	287	2.33	0.29	4.74	3.73	3576	0.05



Best weed management techniques under organic practice at Bajaura

Bhopal

Evaluation of weed management practices for maize-mustard production system under organic conditions:

Maize: Weed management practice under organic management in Vertisols for maize crop showed that grain yield (2826 kg/ha) was significantly higher with treatment T6- incorporation of cotton seed cake @ 5t/ha at 15 DAS + one hand weeding than all other however, treatment T3, T1, T2, T4 and T7 being on par to each other. T8: ITK treatment on weed control practiced by farmers (mulching with dried leaf of mango @ 5t/ha showed poor performance than rest of the treatments but was statistically on par with control i.e., T9 (Table 7.11.2.1).

Mustard: Mustard grain and total biomass yield were significantly influenced by weed management practices under organic production system. Incorporation of cotton seed cake + one hand weeding (treatment: T6) recorded significantly highest grain yield (1488 kg ha⁻¹) but it was at par with treatment T3: intercropping with chickpea 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), 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 @ 5 t/ha (T8) on par with control (T9). Biological yield of mustard follows the same trend (Table 7.11.2.1).

Table 7.11.2.1: Effect of different weed management practices on grain and biomass yield of maize and mustard under organic production system at Bhopal.

Weed management practice	Maize		Mustard	
	Seed Yield (kg /ha)	Total biomass yield (kg /ha)	Seed yield (kg /ha)	Total biomass yield (kg /ha)
T1 Hand weeding (Two) at 25 and 50 days after sowing	2303	5070	1336	4820
T2 One mechanical weeding at 25 days after sowing + One Hand weeding at 50 days after sowing	2236	4932	1264	4730
T3 Intercropping with Chickpea (1:1)	2533	5304	1391	5017
T4 Stale seed bed + reduced spacing (45 × 20 cm) + mulching with maize straw + one Hand weeding at 40 DAS	2153	4636	1217	4481
T5 Locally available weed mulch (Water hyacinth 4 t/ha dwb) + one hand pulling at 40 DAS	2008	4250	1024	3254
T6 Incorporation of cotton seed cake 15 days before planting/sowing @ 5t/ha + one hand weeding at 40 DAS	2826	5696	1488	5154
T7 Soil solarization with 110 microns polythene mulch during summer + one hand weeding at 40 DAS	2085	4585	1135	4418
T8 ITK treatment on weed control practiced by farmers (mulching with dried leaf of mango @ 5t/ha)	1915	4083	953	2994
T9 Control	1648	3846	920	2960
CD (P=0.05)	181	376	176	318

Weed population (weed dry weight (g / 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 in Kharif and Rabi season under treatment (T1) two hand weeding followed by stale seed bed + reduced spacing (45 × 20 cm) + mulching with mustard straw + one hand weeding at 40 DAS (T4) and soil solarization with 110 microns polythene mulch during summer + one hand weeding at 40 DAS (T7). Treatment T2 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 7.11.2.2).

Weed control efficiency (WCE %)

Adoption of different weed management practices controlled the weed efficiency as evident from the weed control efficiency, which range from 33.8 to 92.4 per cent at 25 DAS, 29.9 to 93.2 per cent at 50 DAS during *kharif* and 35.1 to 94.5 per cent at 25 DAS, 22.4 to 94.7 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. weed control efficiency was highly influenced by different weed control and recorded higher with two hand weeding at 25 and 50 DAS (T1) of 92.4 and 93.2 percent during *kharif* and 94.5 and 94.7 during *rabi* at 25 and 50 DAS respectively and it was at par with T4 (stale seed bed + reduced spacing (45 × 20 cm) + mulching with mustard straw + one Hand weeding at 40 DAS) followed by T7 (soil solarization with 110 microns polythene mulch during summer + one hand weeding at 40 DAS and T2 (One mechanical weeding at 25 days after sowing + One Hand weeding at 50 DAS) (Table 7.11.2.2).

Table 7.11.2.2: Weed control efficiency (WCE %) in *kharif* and *rabi* crops

Treatments	weed dry weight (g / M ²) at 25 DAS		Weed control efficiency (%) at 25 DAS		weed dry weight (g / M ²) at 50 DAS		Weed control efficiency (%) at 50 DAS	
	<i>Kharif</i>	<i>Rabi</i>	<i>Kharif</i>	<i>Rabi</i>	<i>Kharif</i>	<i>Rabi</i>	<i>Kharif</i>	<i>Rabi</i>
T1	36.3	25.5	92.4	94.5	22.7	17.3	93.2	94.7
T2	70.0	59.2	85.3	87.2	49.7	44.3	85.0	86.4
T3	81.0	70.2	82.9	84.9	54.3	48.9	83.6	85.0
T4	45.7	34.9	90.4	92.5	31.0	25.6	90.7	92.2
T5	66.7	55.9	86.0	88.0	48.3	42.9	85.4	86.9
T6	101.3	90.5	78.7	80.5	76.3	70.9	77.0	78.3
T7	54.6	43.8	88.5	90.6	40.5	35.1	87.8	89.2
T8	314.7	301.3	33.8	35.1	232.7	253.3	29.9	22.4
T9	475.0	464.2	0.0	0.0	332.0	326.6	0.0	0.0

Coimbatore

Among the different weed management practices in tomato, mulching with dried mango leaves @ 5 t ha⁻¹ followed by one hand weeding on 45 DAT recorded the highest fruit yield (38180 kg ha⁻¹) of tomato. Highest net returns per hectare of Rs. 453906 ha⁻¹ was also fetched in plots maintained under mulching with dried mango leaves @ 5 t ha⁻¹ followed by one hand weeding on 45 DAT. Cost of cultivation per hectare (Rs. 110535) was lower in foliar spraying of cow urine @ 10% at 4-5 leaf stage of weed practices adopted plots (Table 7.11.3).

Table 7.11.3. Evaluation of weed management practices in tomato under organic production system

Treatments	Tomato		
	Yield (kg/ha)	Cost of cultivation (Rs/ha)	Net returns (Rs/ha)
SSB technique + One HW on 45 DAT	26040	116565	273977
Inter cropping with vegetable cowpea	21130	120635	196266
Inter cropping with vegetable marigold	19890	118765	179652
Mulching with dried mango leaves @ 5 t ha ⁻¹ + one HW on 45 DAT	38180	118845	453906
Foliar spraying of lemongrass leaf extract @ 10% at 4-5 leaf stage of weed + One HW on 45 DAT	15750	116185	120070
Post emergence application of vinegar @ 10% + One HW on 45 DAT	30130	120485	331527
Multi-varietal seed technique and in situ incorporation on 45 DAT	23560	116645	236819
Application of weed compost @ 5 t/ha during last ploughing + One HW on 30 DAT	14050	117325	93477
Foliar spraying of cow urine @ 10% at 4-5 leaf stage of weed	18390	110535	165377
Foliar spraying of non-edible oilcake extract @ 10% at 4-5 leaf stage of weed	11900	112985	65536
Weed free check	40870	142885	470180
Unweeded check	8070	110485	10588

Dharwad

Evaluation of weed management practices in maize under organic production system

Treatments

T1 :	Inter cultivation followed by hand weeding at 20 and 40 DAS
T2 :	Cover cropping with Cowpea (1:1) & mulching at 45 DAS
T3 :	Cover cropping with Sun hemp (1:1) & mulching at 45 DAS
T4 :	Cover cropping with Niger (1:1) & mulching at 45 DAS
T5 :	Cover cropping with Navadhanya (1:1) & mulching at 45 DAS
T6 :	Mulching with Glyricidia @ 5 t/ ha
T7 :	Mulching with Pongamea @ 5 t/ ha
T8 :	Mulching with Maize stover @ 5 t/ha
T9 :	Mulching with Cassia species @ 5 t/ ha
T10 :	Foliar spray of aqueous solution of <i>P. juliflora</i> @ 25% leaf extract at 20 & 40 DAS

Result

The maize grain yield (3318 kg/ha.) was higher in T1: IC followed by HW at 20 to 40 DAS and was on par with T10: foliar spray of aqueous solution of *Prosopis juliflora* @ 25% leaf extract at 20 and 40 days after sowing (3108 Kg/ha.), T3: cover crops with sun hemp and cowpea in 1:1 row along with mulching with maize stover @5t/ha respectively (3077 and 2920 Kg/ha.) but significantly differ by other treatments. Growth parameters of maize such as Plant height (cm), TDMP /plant (g), cob wt. /plant (g), grain wt. plant (g), 100-grains wt.(g) and dry weed wt. (g/sq.mt.) were also influenced significantly and recorded higher also with IC followed by HW at 20 to 40 DAS of 143.1 cm, 68.8 g, 19.90g, 18.10 g, 24.58g and 28. 6g respectively. It was also observed that weed control efficiency in maize crop was also higher with weed management practice T1 (IC followed by HW at 20 to 40 DAS) which is very effective in suppressing the weeds recorded higher weed control efficiency (83%) and followed by T4 (CC with Niger (1:1) & mulching at 45 DAS) of 77% (Table 7.11.4).

Table 7.11.4. Growth parameters of maize and dry weed weight and WCE as influenced by weed management practices under organic farming at Dharwad

Weed management practice	Dryweed wt. (g/ sq.mt.)	Weed control efficiency	Plant height (cm)	TDMP / plant (g)	Cob wt. / plant (g)	Grain wt. plant (g)	100 grain wt.(g)	Grain yield (Kg/ha)
T1 IC followed by HW at 20 to 40 DAS	28.6	83	143.1	68.8	19.90	18.10	24.58	3318
T2 CC with Cowpea (1:1) & mulching at 45 DAS	52.7	69	135.9	64.1	18.55	15.77	24.01	2846
T3 CC with Sun hemp (1:1) & mulching at 45 DAS	52.4	69	141.7	64.2	18.75	16.34	23.99	3077
T4 CC with Niger (1:1) & mulching at 45 DAS	38.6	77	111.6	52.1	14.71	11.38	21.93	2413
T5 CC with Navadhanya (1:1) & mulching at 45 DAS	43.4	74	132.1	55.7	15.51	13.89	22.47	2610
T6 Mulching with Glyricidia @ 5 t/ ha	104.9	53	118.9	52.7	14.26	12.41	22.38	2445
T7 Mulching with Pongamea @ 5 t/ ha	94.4	64	133.3	64.27	17.85	15.69	24.13	2839
T8 Mulching with Maize stover @ 5 t/ha	97.0	58	132.8	63.6	17.76	17.50	23.96	2920
T9 Mulching with Cassia species @ 5 t/ ha	119.5	29	128.9	56.2	17.02	15.14	22.18	2430
T10 Foliar spray of aqueous solution of <i>P. juliflora</i> @ 25% leaf extract at 20 & 40 DAS	96.4	64	136.3	63.8	17.78	15.84	24.08	3108
CD (P=0.05)	22.12		3.55	5.38	2.28	2.42	1.93	592



Karjat

Different weed management practices were evaluated in rice-groundnut system under organic management. Treatments using during *kharif* and *rabi* is given as under. Rice variety Karjat-9 and groundnut variety SB-11 were grown.

Treatments

Treatments	Weed management practice (<i>Kharif</i>)	Weed management practice (<i>Rabi</i>)
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-30 DAT) + 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)

Weed management practices in rice and groundnut

Yield of rice and rabi-hot weather groundnut did not influence by different weed management practices under organic production system. Among the weed management practices in rice and rabi-hot weather 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 yield of rice and groundnut of 3909 and 4419 kg/ha respectively followed by treatment T2 (One mechanical weeding (cono-weeder-30 DAT) + one HW at 50 DAT during *kharif* and One mechanical weeding (Dry land weeder-20 DAS) + one HW at 30 DAS during *rabi*) compare to other weed management practices. Systems equivalent yield and net return recorded significantly higher also with T4 which is closely followed by T2. Benefit cost ratio was higher in T2:One mechanical weeding (cono-weeder-30 DAT) + one HW at 50 DAT (Table 7.11.5.1).

Dry matter of weeds (g m²) of rice of 20.28 g m² recorded maximum in weed management practice T5 i.e., locally available weed mulch (mix weed flora) + one hand pulling at 30 DAT and dry matter of weeds (g m²) of groundnut 12.71 g m² in T1 i.e., Two hand weeding (HW) at 25 and 50 DAS. Weed control efficiency in rice (58.49 % and 82.27%) recorded higher with weed management practice, reduced spacing (up to 25% -15x15 cm) + incorporation of previous crop residue + HW at 30 DAT (T4) at 30 and 50 DAT. Likewise, Treatment T7 found to be most efficient for weed suppressing in ground nut crop of 84.48% (Table 7.11.5.2).

The soil chemical properties measured after completing of cropping cycle did not influence significantly for soil pH, EC organic carbon, available N and K whereas, Available P₂O₅ recorded significant difference. Among the different weed management practices, maximum organic carbon content (1.17%), available N (244.11 Kg ha⁻¹), available P₂O₅ (19.62 Kg ha⁻¹) and available K₂O (396.93 Kg ha⁻¹) were observed under T6 (Incorporation of neem cake 15 days before planting @ 5 t ha⁻¹ + one HW at 40 DAT) which was followed by T3 (Inter cropping (1:1) with pulses – Cowpea var. *K. sadabahar*). (Table 7.11.5.3).

Table 7.11.5.1: Productivity and economics of rice as influenced by weed management practices under organic production system at Karjat

Treatments	Rice yield (kg/ha)		Ground nut yield (kg/ha)		system 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	3636	4090	1393	1641	128.74	236240	89005	1.60
T ₂	3777	4246	1333	1599	127.39	233760	95125	1.69
T ₃	3073	3475	805	963	88.08	161632	25974	1.19
T ₄	3909	4419	1412	1705	133.71	245356	95451	1.64
T ₅	2788	3154	800	948	83.75	153688	-1421	0.99
T ₆	3609	4082	1364	1580	126.72	232539	85054	1.58
T ₇	3497	3955	1246	1511	118.66	217743	67208	1.45
T ₈	3212	3634	952	1148	98.26	180303	35018	1.24
C.D. at 5%	NS	NS	NS	NS	47.45	87070	87070	0.59

Table 7.11.5.2: Effect of weed management practices on dry matter production of weeds and WCE (%) of rice-groundnut crops

Tr. Symbol	Dry matter of weeds (gm ²)				Weed control efficiency			
	Rice		Groundnut		Rice		Groundnut	
	30 DAT	50 DAT	25 DAS	50 DAS	30 DAT	50 DAT	25 DAS	50 DAS
T ₁	12.96	11.35	12.71	6.28	51.40	72.38	59.26	82.08
T ₂	12.28	9.63	9.06	9.41	53.50	75.66	68.82	76.12
T ₃	12.42	8.36	7.08	9.66	53.07	78.08	74.01	75.65
T ₄	10.67	6.16	8.39	10.17	58.49	82.27	70.58	74.68
T ₅	20.28	16.36	9.39	12.71	28.71	62.83	67.96	69.84
T ₆	13.39	11.03	10.27	11.65	50.06	72.99	65.65	71.86
T ₇	9.29	9.68	3.08	5.37	62.77	75.56	84.48	83.81
T ₈	11.28	9.69	8.75	10.56	56.60	75.54	69.63	73.93
Unweeded control	31.12	51.43	48.19	72.57	—	—	—	—

Table 7.11.5.3: 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	6.72	0.31	1.09	223.21	17.55	370.94
T ₂	6.75	0.30	1.11	229.06	17.81	374.53
T ₃	6.64	0.32	1.13	240.77	18.84	392.90
T ₄	6.63	0.29	1.12	231.57	18.58	385.73
T ₅	6.76	0.30	1.13	232.41	19.10	386.62
T ₆	6.81	0.31	1.17	244.11	19.62	396.93
T ₇	6.74	0.29	1.05	217.78	17.81	367.36
T ₈	6.75	0.32	1.00	214.85	16.78	347.65
C. D. at 5 %	NS	NS	NS	NS	NS	NS

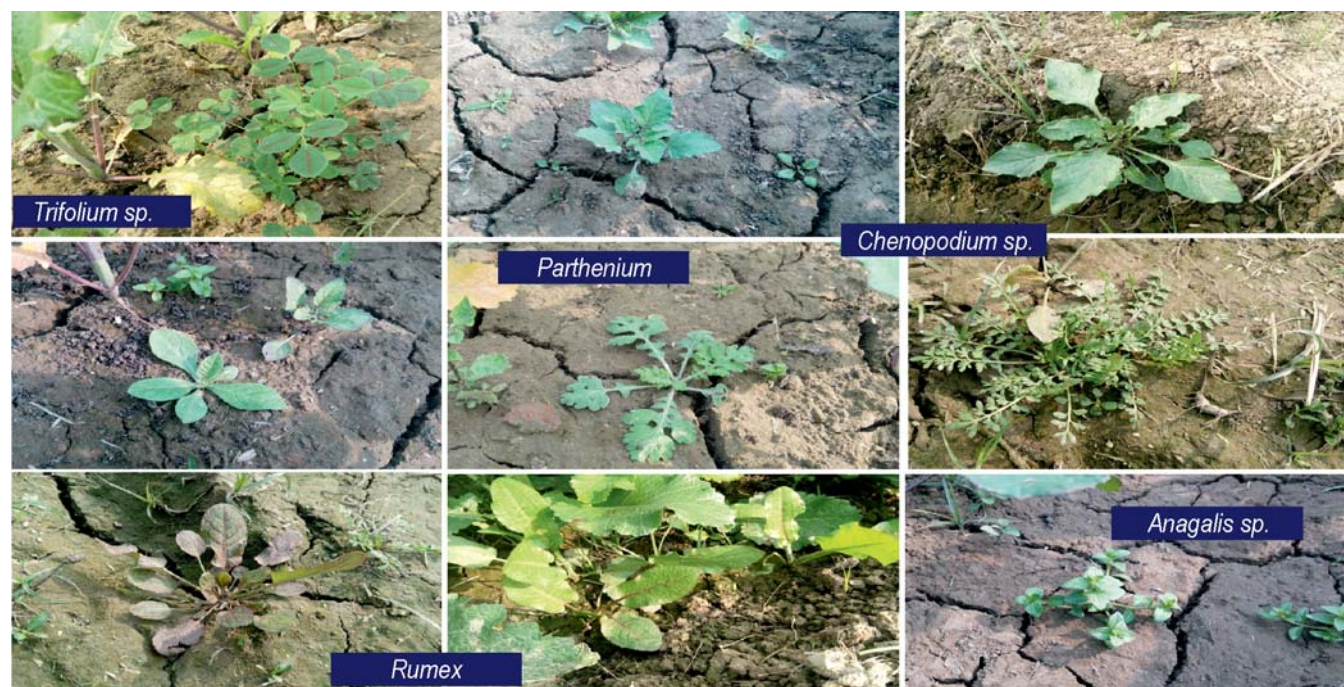
Modipuram

Evaluation of weed management practices maize-mustard cropping system under organic production systems

Maize yield and economics: Among the different weed management practices, highest cob yield (7936 kg/ha) of maize was recorded with management practice i.e. incorporation of mustard seed meal 15 days before sowing @ 5t/ha + one hand weeding at 40 DAS (T6) followed by intercropping with green gram (1:1) (T3). Application of mustard oilcake increased seed yield about 2 times as compared to hand weeding (T1). Highest cost of cultivation and gross return was found under incorporation of mustard seed meal 15 days before sowing @ 5t/ha + one hand weeding at 40 DAS (T6) however, net return was highest under intercropping with green gram (1:1 additive series) treatment T3 (Table 7.11.6.1).

Table 7.11.6.1: Effect of different weed management practices on yield and economics of maize under organic farming.

Weed management practice	Cob yield (kg/ha)	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net return Rs./ha)	B:C ratio
T1 Hand weeding at 25 and 50 DAS	4159	25480	48527	23047	1.90
T2 One mechanical weeding at 25 days after sowing+ One Hand weeding at 50 DAS	4421	23480	51813	28333	2.21
T3 Intercropping with Green gram (1:1)	5766	23580	63395	39815	2.69
T4 Stale seed bed + reduced spacing (45×20 cm) + mulching with mustard straw + one Hand weeding at 40 DAS	4760	28660	56000	27340	1.95
T5 Locally available weed mulch (Water hyacinth 4 t/ha dwb) + one hand pulling at 40 DAS	3308	24480	38013	13533	1.55
T6 Incorporation of mustard seed meal 15 days before sowing @ 5t/ha + one hand weeding at 40 DAS	7936	122880	85493	-37387	0.70
T7 Soil solarization with 25 µ polythene mulch during summer + one hand weeding at 40 DAS	4059	42680	52720	10040	1.24
T8 ITK for weed control (mulching with eucalyptus leaves @ 5t/ha dwb) and one hand weeding at 40 DAS	4107	24480	47600	23120	1.94
CD (p=0.05)	680.8	-	-	-	-



Major Weed species found in mustard at Modipuram field

Table 7.11.6.2: Weed density, weed control efficiency, productivity and economics of mustard under different weed management

Weed management practice	Total weed density (M ²)		Weed control efficiency at 20 DAS (%)	No. of branches/plant	No. of siliqua/plant	Mustard equivalent yield (kg/ha)	Stover yield (kg/ha)	Cost of cultivation (Rs./ha)	Net return (Rs./ha)	B:C ratio
	20 DAS	40 DAS								
T1 Hand weeding at 25 and 50 DAS	15.8 (248)	9.1 (84)	-	5.2	134	1474	4598	19880	57484	3.9
T2 One mechanical weeding at 25 days after sowing + One Hand weeding at 50 DAS	16.1 (259)	8.9 (79)	-4.32	5.4	142	1542	4677	17880	63096	4.5
T3 Intercropping with Chickpea (1:1)	15.2 (231)	14.0 (197)	6.8	4.6	123	2830	4082	22380	126194	6.6
T4 Stale seed bed + reduced spacing (30×10 cm) + mulching with maize straw + one Hand weeding at 40 DAS	12.0 (143)	13.6 (185)	41.7	4.3	141	1262	4643	24060	42181	2.8
T5 Locally available weed mulch (Water hyacinth 4 t/ha dwb) + one hand pulling at 40 DAS	14.1 (199)	14.7 (217)	18.4	4.7	144	1843	4545	18880	77895	5.1
T6 Incorporation of mustard seed meal 15 days before sowing @ 5t/ha + one hand weeding at 40 DAS	17.8 (319)	17.1 (296)	-28.5	5.7	307	3527	8943	117280	67877	1.6
T7 Soil solarization with 8-25 microns polythene mulch during summer (only in kharif) + one hand weeding at 40 DAS	10.9 (120)	11.0 (122)	51.3	5.4	168	1535	5269	37080	43532	2.2
T8 ITK for weed control (mulching with eucalyptus leaves @ 5t/ha dwb) and one hand weeding at 40 DAS	14.7 (215)	14.5 (212)	12.8	5.2	201	1535	4315	18880	61725	4.3
CD (P=0.05)	1.49	1.33	-	0.51	14.3					



Weed density, weed control efficiency, yield and economics of mustard: Among the different weed management practices, lowest weed density but highest weed control efficiency at 20 DAS was found under soil solarization with 8-25 microns polythene mulch during summer (only in *kharif*) + one hand weeding at 40 DAS with T7 however, highest weed density was recorded in incorporation of mustard seed meal 15 days before sowing @ 5t/ha + one hand weeding at 40 DAS with treatment T6. Similarly, Yield contributing characters and yield, such as no. of branches and siliqua/plant, mustard equivalent and stover yield was recorded highest under management practice T6 i.e. incorporation of mustard seed meal 15 days before sowing @ 5t/ha + one hand weeding at 40 DAS. Seed yield of mustard was 139.3% higher under mustard oil cake applied treatment as compared to two HW at 25 and 50 DAS. Highest net returns and B:C ratio was obtained with weed management practice intercropping with chickpea 1:1 followed by application of water hyacinth mulch @ 4t/ha + HW at 40 DAS (Table 7.11.6.2).

Pant Nagar

Weed management practices were evaluated in rice-wheat system under organic production.

Yield and yield attributes of rice as influenced by different weed management practices: Significantly higher plant height (106 cm) was recorded with management practice T5 i.e. *Sesbania* + 2 MW over all other treatments which was on par with T3: DSR + Soybean + 1MW (30 -35 DAT). Effective tillers/m² (284) and 1000-grains weight (24.2g) was found to be higher under T3: DSR + Soybean + 1MW (30 -35 DAT) followed by T5: *Sesbania* + 2 MW (one way) which was at par with T4: Stale bed + 25% reduce spacing and T1: 2HW (20 & 40 DAT), respectively. Grain and straw yield of rice as influenced by of weed management practices differ significantly. The maximum, grain and straw yield (3673 and 4249 kg/ha) was recorded under T5: *Sesbania* + 2 MW (one way) which was on par with T3: DSR + Soybean + 1MW (30 -35 DAT) and the lowest of management practice being with treatment T8: Eucalyptus oil spray @ 5% which recorded 2339 kg/ha of grain yield. Harvest index was not significantly differed and found in range from 0.42 to 0.47. Economic analysis of cropping system managed under varying weed management practices revealed that highest net return (Rs. 79,702/ ha) and B: C ratio (2.27) was recorded in T5 (*Sesbania* + 2 MW) (Table 7.11.7.1).

Table 7.11.7.1: Yield attributes, yield and economics of rice (var. Pusa-1121) as influenced by different weed management practices under organic production system at Pantnagar

Weed management practice	Plant height (cm)	Effective tillers/ m ²	1000-grains wt. (g)	Grain yield (Kg/ha)	Straw yield (Kg/ha)	Harvest Index	Cost of cultivation (Rs./ha)	Net Return (Rs./ha)	B:C Ratio
T1: 2HW (20 & 40 DAT)	81	220	23.9	2945	3599	0.45	36639	55406	1.51
T2: 1 MW & 1HW (20 & 40 DAT)	82	228	21.2	3030	4219	0.42	35343	59354	1.68
T3: DSR + Soybean + 1MW (30 -35 DAT)	86	284	24.2	3371	3766	0.47	36605	68728	1.88
T4: Stale bed + 25 % reduce spacing	81	224	24.1	2727	3288	0.45	30159	54384	1.76
T5: <i>Sesbania</i> + 2 MW (one way)	106	280	24.1	3673	4249	0.46	35071	79702	2.27
T6: Neem-cake @5 t/ha + 1 HW	85	192	21.5	2645	3286	0.45	36659	45993	1.25
T7: Soil solarization + 1 HW	83	229	23.0	3152	3576	0.47	45243	53242	1.18
T8: Eucalyptus oil spray @ 5%	81	173	24.0	2339	2908	0.45	27179	45927	1.69
CD(P=0.05)	6.8	30.4	0.6	305.7	NS	NS	-	-	-

Different weed species and dry weight of weed in rice: Weed count (number/m²) and dry weight (g) in rice for different species such as *Echinochloa colona*, *Eleusine indica*, *Molugo stricta*, *Cyperus iria*, *Cyperus rotundus* significantly influenced by different weed management practices (Table 7.11.7.2). Minimum count of *E. colona* (1.0 m⁻²) was observed in T4: Stale bed + 25 % reduced spacing while at 40 DAT it was minimum with T7: Soil Sol. + 1 HW of 3.0 no./m². Although weed count of *Eleusine indica* (4.0 m⁻²) was lowest in T4: Stale bed + 25 % red. spacing at 20 DAT but at 40 DAT it was minimum with T1: 2HW (20 & 40 DAT) (7 nos./m²). Weed count of *M. stricta* at 20 DAT observed minimum (0.0 m⁻²) with management practice T2 (1 MW & 1HW at 20 & 40 DAT) while at 40 DAT it recorded minimum (5.0 m⁻²) with management practice T7: Soil Sol. + 1 HW. *Cyperus iria* found to be minimum 5 m⁻² with T4: Stale bed + 25 % red. Spacing) at 20 DAT and

at 40 DAT it was 3 m⁻² in T7: Soil Sol. + 1 HW. *C. rotundus* weed count (9.0 m⁻²) was recorded minimum in weed management practices T5 (*Sesbania* + 2 MW) followed by T6 (NC @5 t/ha + 1 HW). Other weed species at 20 DAT was also found to be lowest with management Practice T4: Stale bed + 25 % red. Spacing while at 40 DAT it was lowest with management practice T7: Soil Solarization + 1 hand weeding. Dry weight of weeds was significantly influenced by different weed management practices. Minimum dry weight (26.2 g/m²) of weed at 20 DAT recorded in weed management practice T5: *Sesbania* + 2 MW (one way) followed by T6 (NC @5 t/ha + 1 HW; 28.1 gm⁻²) while at 40 days after transplanting treatment T6 recorded lowest weed dry weight of 24.9 gm⁻².

Table 7.11.7.2: Weed count (number/m²) and dry weight (g/m²) in rice at 40 DAS as influenced by different weed management practices under organic production system.

Weed management practice	<i>Echinochloa colona</i>		<i>Eleusine indica</i>		<i>Molugo stricta</i>		<i>Cyperus iria</i>		<i>Cyperus rotundus</i>		Others weed spp.		Weed dry weight (g)	
	20 DAT	40 DAT	20 DAT	40 DAT	20 DAT	40 DAT	20 DAT	40 DAT	20 DAT	40 DAT	20 DAT	40 DAT	20 DAT	40 DAT
T1: 2HW (20 & 40 DAT)	11	27	8	7	11	7	47	29	28	21	47	37	32.7	25.1
T2: 1 MW & 1HW (20 & 40 DAT)	23	23	15	19	0.0	23	21	43	41	29	48	24	33.3	26.8
T3: DSR + Soybean + 1MW (30 -35 DAT)	25	32	19	31	9.0	33	24	27	32	21	23	36	39.3	38.1
T4: Stale bed + 25 % reduce spacing	1.0	21	4.0	27	11	29	5	24	29	23	8	24	36.0	30.5
T5: <i>Sesbania</i> + 2 MW (one way)	25	19	27	17	12	13	7	20	9	12	36	19	26.2	26.7
T6: Neem-cake @5 t/ha + 1 HW	35	13	23	13	11	15	20	16	12	13	33	15	28.0	24.9
T7: Soil solarization + 1 HW	13	3	15	8	10	5	9	3	45	9	20	4	31.6	28.3
T8: Eucalyptus oil spray @ 5%	9	5	7.0	9	15	20	12	12	39	21	17	11	29.4	27.6
CD (P=0.05)	13.1	13.8	12.0	15.4	NS	15.4	4.5	15.2	16.8	NS	17.3	20.8	4.3	4.4

Yield and yield attributes of wheat as influenced by different weed management practices: Among the different weed management practices, maximum plant height (68.8 cm) was recorded in T1: 2HW (30 & 50 DAS). Spike /m² (339) was recorded higher in weed management practice (Stale bed + 25 % red. Spacing+ mulching+ 1 HP (30-45 DAS) i.e. T4 and closely followed by treatment T5 (338 m²). Test weight i.e.1000-grains weight (43.4g) was observed under T7 (1 manual weeding + 1 hand weeding) and statistically at par with T1: 2HW (30 & 50 DAS), T2: 1 MW & 1HW (30 & 50 DAS), T3: Wheat + Kas. methi + 1MW (30 -35 DAS), T4 (Stale bed + 25% reduce spacing) and T8: Eucalyptus oil spray@ 5%. Grain yield of wheat did influence significantly by different weed management practices. Maximum grain yield (3475 kg/ha) was recorded in T1: 2HW (30 & 50 DAS) while minimum grain yield (2962 kg/ha) was observed under T 8 (Eucalyptus oil spray@ 5%) and the variation between the highest and lowest being of 17.3%. Economics of different weed management practices revealed that maximum net return and B:C ratio was recorded in management practice T4: Stale bed + 25% reduce spacing+ mulching+ 1 HP(30-45 DAS) of Rs. 45, 179/ha and 1.30 respectively (Table 7.11.7.3).

**Table 7.11.7.3: Growth, yield attributes and yield of wheat (Var. UP 2565) as influenced by different weed management practices under organic production system**

Weed management practice	Plant height (cm)	Spikes/ m ²	1000-grains wt. (g)	Grain yield (Kg/ha)	Straw yield (Kg/ha)	Harvest Index	COC (Rs./ha)	Net Return (Rs./ha)	B:C Ratio
T1: 2HW (30 & 50 DAS)	68.8	285	43.1	3475	4655	0.43	50308	33301	0.66
T2: 1 MW & 1HW (30 & 50 DAS)	62.1	276	42.3	3105	3544	0.47	47068	27630	0.59
T3: Wheat + Kas. methi + 1MW (30-35 DAS)	65.5	259	42.8	3290	3723	0.47	41588	37569	0.90
T4: Stale bed + 25 % red. Spacing+ mulching+ 1 HP (30-45 DAS)	61.5	339	43.2	3336	4026	0.45	35093	45179	1.30
T5: Bio fuming mustard (30 DAS) + 1 MW	66.1	338	41.5	3472	4188	0.46	40588	42940	1.06
T6: NC @5 t/ha + 1 HW	68.5	269	41.3	3392	3706	0.48	38965	42655	1.09
T7: 1 MW + 1 HW	65.7	283	43.4	3318	3973	0.46	34733	45106	1.30
T8: Eucalyptus oil spray@ 5%	61.4	260	42.1	2962	3644	0.45	31105	40169	1.29
Cd (P=0.05)	4.1	35.5	1.12	319.2	NS	NS	-	-	-

Weed count and dry weight in wheat: Weed count (number/m²) at 50 days after sowing in wheat was not significantly influenced by different weed management practices for weed species such as, *Medicago denticulata*, *Phalaris minor*, *Chenopodium album*, *Plavangum Polygonum*, *Comopus*. *Phalaris minor* recorded minimum (60 nos./m²) with T8: Eucalyptus oil spray@ 5% followed by T7: 1 MW + 1 HW. Although, weeds/m² of *M.denticulata* were not observed with the treatment combination T4 (Stale bed + 25 % reduced spacing+ mulching+ 1 HP at 30-45 DAS), T6 (NC @5 t/ha + 1 HW) and T7 (1 MW + 1 HW), respectively. But other practice was recorded in low number ranging from 1 to 4. *Chenopodium album* were not recorded with treatment combinations T1, T2, T3, T7. and T8, respectively. Minimum weeds/m² of *P. polygonum* were not seen with treatment T5 (Biofuming mustard at 30 DAS + 1 MW). However, weeds/m² of *Comopus* spp. were not found minimum with treatment T3 and T8, respectively. Dry weight of weeds (g/m²) as influenced by different weed management practices at 50 DAS was non-significant and found to be minimum of 4.72 g/m² with T8: Eucalyptus oil spray@ 5% at 50 DAS in wheat crop (Table 7.11.7.4).

Table 7.11.7.4: Weed density (number/m²) in wheat at 50 DAS as influenced by different weed management practices under organic production system

Weed management practice	Phalaris minor	Medicago denticulata	Melilotus spp.	C. album	Plavangum Polygonum	Comopus	Weed dry weight (g/m ²)
T1: 2HW (30 & 50 DAS)	83	1	27	0	8	1	5.62
T2: 1 MW & 1HW (30 & 50 DAS)	73	3	12	0	8	3	6.72
T3: Wheat + Kas. methi + 1MW (30-35 DAS)	87	1	16	0	8	0	7.44
T4: Stale bed + 25 % red. Spacing+ mulching+ 1 HP (30-45 DAS)	91	0	5	3	7	9	4.91
T5: Bio fuming mustard (30 DAS) + 1 MW	88	4	4	1	0	9	6.93
T6: NC @5 t/ha + 1 HW	84	0	12	1	3	9	6.66
T7: 1 MW + 1 HW	69	0	8	0	15	11	5.34
T8: Eucalyptus oil spray@ 5%	60	1	13	0	8	0	4.72
CD (P=0.05)	NS	NS	12.5	NS	NS	NS	NS

Raipur

Evaluation of weed management practices in sweet corn – tomato cropping system under organic production

Treatments: Sweet corn (*khariif*)–Tomato (*Rabi*): Sweet corn variety Sugar-75 and Tomato variety Laxmi was used

Treatment symbol	Weed management Practices
T ₁	T1: Hand weeding at 20 and 40 DAS
T ₂	T2: One mechanical weeding at 20 + one hand weeding at 40DAS
T ₃	T3: Intercropping with black gram (1:1)
T ₄	T4: Stale seed bed + reduced spacing (upto 25%) + mulching with paddy straw + hand weeding at 20 DAS
T ₅	T5: Locally available weed mulch (<i>Lantana camera</i>) + one hand pulling at 20 DAS
T ₆	T6: Incorporation of neem cake 15 days before sowing, 5 tonnes/ ha + hand weeding at 20 DAS
T ₇	T7: Soil solarization with 25μ polythene mulch during summer + one hand weeding at 20 DAS
T ₈	T8: Mulching with waste polythene bags (ITK-practices)
T ₉	T9: Weedy check

Weed density, dry weight and weed control efficiency (Table 7.11.9.1 & 2): Weed flora of the experimental site was dominated with *Alternanthera sessilis*, *Cyperus iria*, *Echinochloa colona* and *Parthenium hysterphorus*. Some other weeds were also found in very less quantity and categorized as other weeds. At initial stage of 20 DAS *Cyperus iria* were in highest density (22%) followed by *Alternanthera sessilis* (20%), while at 40DAS *Echinochloa colona* density was highest (26%) followed by *Cyperus iria*. However, at 60 DAS and at harvest *Cyperus iria* density was more as compared to others. Weed management through stale seed bed + reduced spacing (up to 25%) + mulching with paddy straw mulch + hand weeding at 20 DAS significantly reduced the weed density of *Alternanthera sessilis*, *Cyperus iria*, *Echinochloa colona*, *Parthenium hysterphorus* & other weeds and resulted in the lowest total weed density and weed dry weight over the other weed management practices at 20, 40, 60 DAS, as compared to hand weeding twice, which was statistically at par with mulching waste polythene bags at initial stages of 20 and 40 DAS, whereas hand weeding twice and mechanical weeding gave encouraging results towards weed density and weed dry weight at 60 DAS. The weed control efficiency was higher in stale seed bed + reduced spacing (up to 25%) + mulching with paddy straw mulch + hand weeding at 20 DAS (87.75 to 95.73% during the entire growth period) followed by mulching with waste polythene bags (ITK – practice).



7.11.8.1: Weed density at 20, 40 and 60 DAS as influenced by weed management practices in organically grown sweet corn at Raipur

Management practices	Echinochloa colona			Alternanthera sessilis			Parthenium hysterophorus			Cyperus iria			Others			Total		
	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS
Hand weeding at 20 and 40 DAS	2.92 (8.03)	1.78 (2.67)	1.61 (2.10)	3.13 (9.33)	2.04 (3.67)	1.52 (2.17)	2.67 (6.67)	1.95 (3.33)	1.49 (1.73)	3.18 (9.67)	2.48 (5.67)	2.20 (4.37)	2.79 (7.29)	2.16 (4.19)	1.78 (2.67)	6.44 (40.99)	4.47 (19.53)	3.67 (13.04)
One mechanical weeding at 20 + one hand weeding at 40DAS	2.57 (6.11)	2.04 (3.67)	1.88 (3.07)	3.02 (8.67)	2.34 (5.00)	1.50 (2.27)	2.61 (6.33)	1.87 (3.00)	1.60 (2.07)	3.53 (12.00)	2.61 (6.33)	1.88 (3.07)	2.82 (7.43)	2.17 (4.22)	1.49 (1.73)	6.41 (40.54)	4.76 (22.22)	3.56 (12.21)
Intercropping with black gram(1:1)	1.98 (3.43)	3.76 (13.67)	3.94 (15.07)	3.08 (9.00)	3.34 (10.67)	3.43 (11.33)	2.67 (6.67)	3.13 (9.33)	3.54 (12.10)	2.97 (8.33)	3.76 (13.67)	3.80 (14.000)	2.85 (7.63)	3.66 (12.90)	5.12 (25.80)	5.96 (35.06)	7.79 (60.24)	8.87 (78.30)
Stale seed bed + reduced spacing (upto 25%) + mulching with paddy straw + hand weeding at 20 DAS	1.59 (2.03)	1.52 (1.83)	1.68 (2.33)	2.19 (4.33)	1.08 (0.67)	1.22 (1.00)	1.63 (2.17)	1.35 (1.33)	1.47 (1.67)	1.78 (2.67)	1.87 (3.00)	2.06 (3.77)	2.14 (4.07)	1.73 (2.50)	1.82 (2.83)	3.95 (15.11)	3.13 (9.33)	3.47 (11.60)
Locally available weed mulch (<i>Lantana camera</i>) + one hand pulling at 20 DAS	2.48 (5.67)	2.48 (5.67)	2.70 (6.80)	2.91 (8.00)	2.58 (6.17)	2.72 (7.00)	2.61 (6.33)	2.27 (4.67)	2.32 (4.90)	2.91 (8.00)	2.79 (7.33)	2.87 (7.77)	2.76 (7.13)	2.23 (4.50)	3.11 (9.23)	5.97 (35.13)	5.37 (28.34)	6.01 (35.70)
Incorporation of neem cake 15 days before sowing, 5 tonnes ha ⁻¹ hand weeding at 20 DAS	2.80 (7.33)	2.19 (4.33)	2.48 (5.70)	3.08 (9.00)	2.41 (5.33)	2.64 (6.67)	2.73 (7.00)	2.19 (4.33)	2.31 (4.87)	3.18 (9.67)	2.76 (7.13)	2.85 (7.67)	2.86 (7.73)	2.29 (4.75)	3.04 (8.77)	6.42 (40.73)	5.13 (25.87)	5.84 (33.68)
Soil solarization with 25µ polythene mulch during summer + one hand weeding at 20 DAS	1.87 (3.00)	1.95 (3.33)	2.00 (3.50)	2.48 (5.67)	1.95 (3.33)	2.22 (4.67)	1.95 (3.33)	1.78 (2.67)	1.89 (3.10)	2.73 (7.00)	2.20 (4.33)	2.34 (5.00)	2.68 (6.67)	2.27 (4.69)	2.54 (6.00)	5.12 (25.67)	4.34 (18.35)	4.77 (22.27)
Mulching with waste polythene bags (ITK-practices)	1.60 (2.07)	1.78 (2.67)	1.80 (2.77)	1.95 (3.33)	1.96 (3.37)	2.06 (3.77)	1.68 (2.33)	1.87 (3.00)	2.04 (3.67)	2.14 (4.10)	2.20 (4.33)	2.27 (4.67)	2.35 (5.00)	2.36 (5.08)	2.48 (5.67)	4.16 (16.83)	4.38 (18.75)	4.58 (20.55)
Weedy check	2.61 (6.33)	4.14 (16.67)	4.37 (18.67)	3.18 (9.67)	3.82 (14.13)	4.33 (16.23)	3.02 (8.67)	3.39 (11.00)	3.89 (14.67)	3.62 (12.67)	4.02 (15.73)	4.60 (20.67)	2.86 (7.69)	5.29 (27.50)	6.77 (45.37)	6.82 (46.03)	9.24 (85.03)	10.77 (115.64)
CD (P=0.05)	0.60	0.46	0.61	0.53	0.43	0.58	0.58	0.67	0.44	0.46	0.37	0.49	0.38	0.57	0.67	0.27	0.54	1.13

Data subjected to transformation and figures in parenthesis are original weed count

Table 7.11.8.2: Effect of different weed management practices on total weed dry weight and weed control efficiency in sweet corn under organic production system

	Weed dry weight, g m ⁻²			Weed control efficiency		
	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS
Hand weeding at 20 and 40 DAS	5.42	3.8	3.67	4.61	79.72	89.60
One mechanical weeding at 20 + one hand weeding at 40DAS	5.26	3.97	3.78	10.21	77.83	88.94
Intercropping with black gram (1:1)	4.45	6.16	9.64	36.30	45.68	25.86
Stale seed bed + reduced spacing (upto 25%) + mulching with paddy straw + hand weeding at 20 DAS	2.05	1.83	2.41	87.75	95.83	95.73
Locally available weed mulch (<i>Lantana camera</i>) + one hand pulling at 20 DAS	4.45	3.77	4.91	36.30	80.06	81.05
Incorporation of neem cake 15 days before sowing, 5 tonnes ha ⁻¹ + hand weeding at 20 DAS	4.45	3.54	4.56	36.33	82.56	83.71
Soil solarization with 25µ polythene mulch during summer + one hand weeding at 20 DAS	3.53	3.23	4.07	60.47	85.58	86.58
Mulching with waste polythene bags (ITK-practices)	2.68	3.30	3.85	77.96	84.92	88.51
Weedy check	5.73	8.33	11.19	4.61	79.72	89.60
CD (P=0.05)	0.24	0.45	0.72			

Effect of weed management practices on yield attributes, yield and net return of sweet corn (Table 7.11.8.3):

Yield attributing characters and yield of sweet corn was affected significantly due to weed management practices. Among weed management practices, growth parameters such as plant height, cob length, cob weight, no. of rows/cob and No. of grains/cob recorded higher with weed management practice T4: Stale seed bed + reduced spacing (up to 25%) + mulching with paddy straw + hand weeding at 20 DAS of 181.9 cm, 17.1 cm, 164.4 g, 15.5 g and 489.0g respectively. The next best performing practice for weed management was T8: Mulching with waste polythene bags (ITK-practices). Similarly, significantly higher green cob yield (7630 kg/ha) were also recorded under T4: Stale seed bed + reduced spacing (up to 25%) + mulching with paddy straw + hand weeding at 20 DAS followed by T8: Mulching with waste polythene bags (ITK-practices) which gave 7450 kg/ha of green cob yield. All these weed management practices produced at par green cob yield of sweet corn. The lowest green cob yield ha⁻¹ (1260 kg ha⁻¹) was recorded under weedy check (T9). Adoption of Mulching with waste polythene bags (ITK-practices) generated highest net returns (Rs. 85,948/ha and maximum B: C ratio was 2.33 under hand weeding at 20 & 40 DAS.

Table: 7.11.8.3: Effect of different weed management practices on growth and yield of sweet corn under organic production system

Weed management practices	Plant height (cm)	Cob length (cm)	Cob weight (g)	No. of rows/cob	No. of grains/cob	Green Cob yield (kg/ha)	Net return (Rs/ha)	B:C ratio
T1: Hand weeding at 20 and 40 DAS	174.3	16.5	157.2	15.4	477.3	7330	85589	2.33
T2: One mechanical weeding at 20 + one hand weeding at 40DAS	167.7	13.8	145.3	14.3	425.6	6370	68417	2.10
T3: Intercropping with black gram(1:1)	127.4	10.5	92.5	12.1	313.6	4970	42659	1.72
T4: Stale seed bed + reduced spacing (upto 25%) + mulching with paddy straw + hand weeding at 20 DAS	181.9	17.1	164.4	15.5	489.0	7630	84960	2.19



Weed management practices	Plant height (cm)	Cob length (cm)	Cob weight (g)	No. of rows/ cob	No. of grains/ cob	Green Cob yield (kg/ha)	Net return (Rs/ha)	B:C ratio
T5: Locally available weed mulch (<i>Lantana camera</i>) + one hand pulling at 20 DAS	161.4	12.7	112.7	13.2	380.5	5860	57825	1.93
T6: Incorporation of neem cake 15 days before sowing, 5 tonnes ha ⁻¹ + hand weeding at 20 DAS	168.0	13.1	138.4	13.3	391.6	5880	-1739	0.99
T7: Soil solarization with 25µ polythene mulch during summer + one hand weeding at 20 DAS	173.5	16.1	154.4	15.8	449.1	6940	73107	2.06
T8: Mulching with waste polythene bags (ITK-practices)	176.8	16.7	160.6	15.4	483.7	7450	85948	2.29
T9: Weedy check	110.2	7.3	73.5	11.6	212.7	1260	-30355	0.46
CD (P=0.05)	8.52	1.01	10.45	0.75	43.38	105	-	-

Effect of weed management practices on growth and yield of tomato (Table 7.11.8.4)

Effect of different weed management practices on growth and yield of tomato under organic production system showed significant effect. The maximum plant height (106.83 cm) was observed under Mulching with waste polythene bags (ITK-practices) which was on par with Incorporation of neem cake 15 days before sowing, 5 tonnes ha⁻¹ + hand weeding at 20 DAS but significantly higher than other. Significantly higher number of fruits plant⁻¹ and fruit weight (65.82 and 46.33 g respectively) was achieved also with management practice Mulching with waste polythene bags (ITK-practices). The lowest number of fruits/plant and fruit weight plant⁻¹ was produced under weedy check. Among the different management practices, Stale seed bed + reduced spacing (upto 25%) + mulching with paddy straw + hand weeding at 20 DAS resulted in significantly higher fruit yield of tomato 49470 kg/ha. The lowest fruit yield was obtained under weedy check (8840 kg/ha).

Economics of tomato as influenced by weed management practices showed that maximum net return was achieved under Stale seed bed + reduced spacing (upto 25%) + mulching with paddy straw + hand weeding at 20 DAS (Rs 4,23,899) with highest B: C ratio (6.75). Mulching with waste polythene bags (ITK-practices) was the next best treatment and gave net return of Rs 3,41,992/ha but the B: C ratio was low as 5.87.

Table 7.11.8.4 Effect of different weed management practices on growth and yield of tomato under organic production system

Weed management practices	Plant height (cm)	No. of fruits/ plant	Fruit weight (g)	Fruit yield (kg/ha)	Cost of cultivation (Rs ha ⁻¹)	Net return (Rs ha ⁻¹)	B:C ratio
T1: Hand weeding at 20 and 40 DAS	90.81	62.06	41.33	38270	76987	305690	4.99
T2: One mechanical weeding at 20 + one hand weeding at 40DAS	88.33	58.09	39.00	32020	65003	255230	4.79
T3: Intercropping with black gram(1:1)	77.33	46.98	35.33	12260	62867	59740	1.95
T4: Stale seed bed + reduced spacing (upto 25%) + mulching with paddy straw + hand weeding at 20 DAS	93.67	58.12	42.00	49470	70824	423899	6.75
T5: Locally available weed mulch (<i>Lantana camera</i>) + one hand pulling at 20 DAS	94.18	47.2	25.00	15100	65867	85130	2.28
T6: Incorporation of neem cake 15 days before sowing, 5 tonnes/ha + hand weeding at 20 DAS	95.43	49.95	27.00	21100	125410	85630	1.68
T7: Soil solarization with 25µ polythene mulch during summer + one hand weeding at 20 DAS	86.82	47.83	29.00	19810	67693	130430	2.91
T8: Mulching with waste polythene bags (ITK-practices)	106.83	65.82	46.33	41060	68565	341992	5.87
T9: Weedy check	76.30	33.7	18.67	8840	62853	25520	1.43
CD (P=0.05)	6.79	8.65	4.53	202	-	-	-

Weed dry weight and weed control efficiency as influenced by weed management practices in tomato (Table 7.11.8.5): Weed dry weight in organically grown tomato crop was affected significantly due to weed management practices. Significantly lower weed dry weight was recorded under Mulching with waste polythene bags (ITK-practices) at both the crop stages of 40 and 60 DAT. Similar trend was observed with weed control efficiency which was maximum in Mulching with waste polythene bags (ITK-practices) (100%) followed by Stale seed bed + reduced spacing (upto 25%) + mulching with paddy straw + hand weeding at 20 DAS (81.42 and 80.48 % at 40 and 60 DAT respectively).

Table 7.11.8.5: Effect of different weed management practices on total weed dry weight and weed control efficiency in tomato under organic production system

Weed management practices	Total weed dry weight (gm ⁻²)		Weed control efficiency (%)	
	40 DAT	60 DAT	40 DAT	60 DAT
T1: Hand weeding at 20 and 40 DAS	4.61(20.79)	4.66(21.3)	72.29	82.57
T2: One mechanical weeding at 20 + one hand weeding at 40 DAS	4.95(24.06)	5.02(24.80)	67.94	79.71
T3: Intercropping with black gram(1:1)	7.19(51.22)	9.23(84.73)	31.74	30.68
T4: Stale seed bed + reduced spacing (upto 25%) + mulching with paddy straw + hand weeding at 20 DAS	3.8(13.94)	4.93(23.86)	81.42	80.48
T5: Locally available weed mulch (<i>Lantana camera</i>) + one hand pulling at 20 DAS	5.05(25.06)	7.97(63.06)	66.62	48.41
T6: Incorporation of neem cake 15 days before sowing, 5 tonnes ha ⁻¹ + hand weeding at 20 DAS	4.84(22.98)	7.04(49.19)	69.38	59.76
T7: Soil solarization with 25µ polythene mulch during summer + one hand weeding at 20 DAS	4.7(21.66)	4.63(21)	71.14	82.82
T8: Mulching with waste polythene bags (ITK-practices)	3.24(10)	3.75(13.6)	86.67	88.87
T9: Weedy check	8.69(75.04)	11.07(122.23)	-	-
CD (P=0.05)	4.15	2.63	-	-

Ranchi

Evaluation of weed management practices in rice- wheat system under organic production system

Treatments

Treatments Symbols	Rice (Direct seeded), variety Birsamati	Wheat (K-9107)
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	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
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

Yield and yield attributing characters of rice crop under different weed management practices in rice wheat cropping system

Yield and yield attributing character of rice like Effective tillers/m², filled grain/panicle and 1000 grain wt. were significantly higher under hand weeding (two) at 25 and 50 DAS (T1) (271, 81 and 20.82g) followed by intercropping with *dhaincha* (broadcasting @50 kg/ha) (T3) and stale seed bed + 25% higher seed rate + mulching with wheat straw + one hand weeding at 25 DAS (T4). Maximum straw yield of rice (4543 kg/ha) was obtained with Incorporation with *Dhaincha* (broadcasting @50 kg/ha) (T3) which was significantly superior over all the weed management practices.

Table 7.11.9.1: Yield and yield attributing characters of rice crop under different weed management practices

Weed management practices	Effective tillers/m ²	Panicle length (cm)	Filled grain/panicle	1000-grains wt. (g)	Rice straw yield (kg/ha)
T1-Hand weeding (Two) at 25 and 50 DAS	271	15.6	81	20.82	4435
T2- One mechanical weeding at 25 DAS + One Hand weeding at 50 DAS	265	16.2	74	20.07	4238
T3-Incorporation with <i>Dhaincha</i> (broadcasting @50 kg/ha)	268	17.3	79	20.74	4543
T4-Stale seed bed + 25% higher seed rate+ mulching with wheat straw + one hand weeding at 25DAS	245	15.0	73	20.51	3455
T5-Locally available weed mulch + one hand pulling at 25 DAS	200	14.7	62	19.93	3052
T6-Incorporation of Karanj cake 15 days before planting/sowing @ 5t/ha + one hand weeding at 25 DAS	206	16.8	65	20.36	3050
T7-Soil solarization with 8–25-micron polythene mulch during summer + one hand weeding + 25 DAS	242	15.5	69	20.55	3555
T8-ITK treatment mulching with Karanj leaves etc	138	14.3	58	19.76	2033
T9-Weedy check	122	13.6	53	19.31	1575
CD (P=0.05 %)	7.67	9.47	7.98	6.31	89.4

Yield and yield attributing characters of wheat crop under different weed management practices in rice wheat cropping system.

Wheat (7.11.9.2): Yield and yield attributing characters of wheat significantly affected by weed management practices. Maximum number of spike/m² (283) was obtained in stale seed bed + 25% higher seed rate+ mulching with wheat straw + one hand weeding at 25DAS (T4) which was significantly superior over rest of the weed management practices except hand weeding (Two) at 25 and 50 DAS (275 /m²) (T1) and one mechanical weeding at 25 DAS + one hand weeding at 50 DAS (273 /m²) (T2). Maximum spike length, grains /spike, 1000-grains wt. recorded highest in hand weeding (Two) at 25 and 50 DAS (T1) which was significantly superior over rest of the weed management practices except one mechanical weeding at 25 DAS + one Hand weeding at 50 DAS (T2).

Table 7.11.9.2: Yield and yield attributing characters of wheat crop under different weed management

Weed management practices	No. of spike/m ²	Spike length (cm)	No. of grains/spike	1000-grains wt. (g)	Wheat yield (kg/ha)
T1-Hand weeding (Two) at 25 and 50 DAS	276	8.55	34.93	44.38	3745
T2- One mechanical weeding at 25 DAS + One Hand weeding at 50 DAS	275	7.95	33.46	43.32	3507
T3-Incorporation with <i>Dhaincha</i> (broadcasting @50 kg/ha)	245	6.65	29.75	42.98	2989
T4-Stale seed bed + 25% higher seed rate+ mulching with wheat straw + one hand weeding at 25DAS	283	6.65	30.90	42.62	3455
T5-Locally available weed mulch + one hand pulling at 25 DAS	204	6.29	28.68	42.82	2931

Weed management practices	No. of spike/ m ²	Spike length (cm)	No. of grains/ spike	1000-grains wt. (g)	Wheat yield (kg/ha)
T6-Incorporation of Karanj cake 15 days before planting/ sowing @ 5t/ha + one hand weeding at 25 DAS	200	6.09	27.88	42.28	2633
T7-Soil solarization with 8–25-micron polythene mulch during summer + one hand weeding + 25 DAS	249	6.82	30.21	43.15	3012
T8-ITK treatment mulching with Karanj leaves etc	145	5.32	25.01	42.17	2344
T9-Weedy check	127	5.05	22.48	41.68	2022
CD (P=0.05 %)	7.09	8.97	8.75	4.19	75.4

Dry matter accumulation of weeds in both the season *kharif* and *rabi* at 20 days to 40 days as influenced by weed management practices increased with advancement of crop age. Significantly minimum dry weight of weeds per unit area among different weed management practices in rice and wheat was recorded in T1: Hand weeding (Two) at 25 and 50 DAS followed by T2- One mechanical weeding at 25 DAS + One Hand weeding at 50 DAS.

Table 7.11.9.3: Dry matter accumulation of weeds (g/m²) in rice-wheat cropping system under different weed management practices.

Weed management practices	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
T1-Hand weeding (Two) at 25 and 50 DAS	19.33	26.75	8.93	17.10
T2- One mechanical weeding at 25 DAS + One Hand weeding at 50 DAS	24.47	31.29	11.02	26.03
T3-Incorporation with Dhaincha (broadcasting @50 kg/ha)	21.93	30.72	15.09	29.13
T4-Stale seed bed + 25% higher seed rate+ mulching with wheat straw + one hand weeding at 25DAS	26.73	33.61	14.15	23.22
T5-Locally available weed mulch + one hand pulling at 25 DAS	32.94	38.31	15.98	30.20
T6-Incorporation of Karanj cake 15 days before planting/sowing @ 5t/ha + one hand weeding at 25 DAS	29.71	37.15	16.87	31.39
T7-Soil solarization with 8–25-micron polythene mulch during summer + one hand weeding + 25 DAS	27.82	34.55	13.67	27.05
T8-ITK treatment mulching with Karanj leaves etc	35.36	40.96	22.03	34.09
T9-Weedy check	39.92	45.80	24.28	38.35
CD (P=0.05 %)	3.61	3.31	2.34	3.80

Soil nutrient status in rice-wheat cropping system under different weed management practices (Table 7.11.9.4): There was improvement in soil pH, OC, available N and P in all weed management practices from its initial values but in case of available K, the values in all weed management practices from its initial values found to be lower. However, weedy check plot recorded the least buildup in soil nutrient status i.e., soil pH, and OC.



Table 7.11.9.4: Soil nutrient status under different weed management practices in rice-wheat cropping system at the end of cropping cycle.

Weed management practices	pH	Organ carbon (%)	Available N(kg/ha)	Available P(kg/ha)	Available K(kg/ha)
Hand weeding (Two) at 25 and 50 DAS	6.11	0.64	236.70	28.45	123.45
One mechanical weeding at 25 DAS+ One Hand weeding at 50 DAS	6.00	0.62	243.83	31.41	124.12
Intercropping with Dhaincha (broadcasting @50 kg/ha) / Intercropping of wheat + lentil intercropping	5.96	0.60	247.89	33.48	131.35
Stale seed bed + 25% higher seed rate + mulching with wheat straw + one Hand weeding at 25 DAS	5.98	0.61	246.89	32.82	127.41
Locally available weed mulch + one hand pulling at 25 DAS	5.96	0.60	247.66	33.18	130.33
Incorporation of karanj cake 15 days before planting/sowing @ 5t/ha + one hand weeding at 25 DAS	5.89	0.57	253.60	34.58	137.25
Soil solarization with 8-25 microns polythene mulch during summer + one hand weeding +25 DAS	5.92	0.59	252.93	34.03	136.42
ITK treatment mulching with Karanj leaves etc.	5.87	0.56	257.15	35.59	146.64
Weedy check	5.84	0.53	261.00	36.75	148.68
CD (P=0.05)	0.29	0.05	8.00	2.13	2.97

Table 7.11.9.5: System productivity, net return and B: C ratio of rice-wheat cropping system under different weed management practices

Rice (Direct seeded)	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
T1-Hand weeding (Two) at 25 and 50 DAS	5415	40866	1.07	26954	0.88	75480	2.47
T2- One mechanical weeding at 25 DAS + One Hand weeding at 50 DAS	4883	37869	1.12	23388	0.81	66107	2.28
T3-Incorporation with Dhaincha (broadcasting @50 kg/ha) in kharif/ intercropping with lentil (@40kg/ha)	4661	45450	1.54	18425	0.72	66201	2.48
T4-Stale seed bed + 25% higher seed rate + mulching with wheat straw + one hand weeding at 25DAS	4357	27243	0.80	21154	0.74	52963	1.83
T5-Locally available weed mulch + one hand pulling at 25 DAS	3411	13929	0.43	13909	0.53	33082	1.21
T6-Incorporation of Karanj cake 15 days before planting/sowing @ 5t/ha + one hand weeding at 25 DAS	3350	-(60576)	-(0.55)	-21424	-0.36	-30300	-0.52
T7-Soil solarization with 8–25-micron polythene mulch during summer + one hand weeding + 25 DAS	4183	23777	0.67	18038	0.62	48613	1.69
T8-ITK treatment mulching with Karanj leaves etc.	2462	1441	0.05	6387	0.24	7828	0.29
T9-Weedy check	1937	-(1224)	-(0.05)	-857	-0.03	-1004	-0.04
CD (P=0.05)	42.4	5565.44	0.15	3396.84	0.13	6364.33	0.19

System productivity and profitability (Table 7.11.9.5): System productivity of rice weed system influenced by different weed management practices. Among management practices, hand weeding (two) at 25 and 50 DAS (T1) recorded maximum system productivity (5415 kg/ha) in term of rice equivalent which was statistically at par with one mechanical weeding at 25 DAS + one Hand weeding (T2) at 50 DAS (4883 kg/ha) but significantly differ from other. Treatment T1 (Hand weeding (Two) at 25 and 50 DAS) also recorded significantly highest net returns (75480 Rs/ha) which was superior to rest of the treatments among the weed management practices. B: C ratio (2.48) was recorded highest in T3 Incorporation with Dhaincha (broadcasting @50 kg/ha) in kharif/ intercropping with lentil (@40kg/ha) and treatment T1: Hand weeding (Two) at 25 and 50 DAS. The lowest net return and B: C ratio was obtained in treatment T9.

Umiam (Table 7.12.10.1)

Among different weed management practices in maize, intercropping with soybean followed by soil solarization + one hand weeding recorded relatively higher maize grain yield of maize (4930 kg/ha) as compared to other weed control treatments. As the maximum temperature of the experiment area (Umiam centre) does not go beyond 32-33 degrees in general, soil solarization could not give desired results as expected. Maize intercropping with soybean also recorded the highest net returns (38150 Rs/ha) due to higher maize yield owing sparing of fixed N from atmosphere from associated soybean, maize equivalent yield and less weed problem. Incorporation of neem cake @ 5t/ha + one hand weeding recorded negative income (-Rs. 61,000/ha) due to high market price of neem cake (Rs. 20/kg).

Table 7.11.10.1: Weed management practices under organic production system at Umiam

Weed management practices	Yield (kg/ha)	Cost of cultivation (Rs/ha)	Net returns (Rs/ha)
T1. Hand weeding (Twice)	4280	4280	27700
T2. One mechanical weeding + one hand weeding	3990	34600	25250
T3. Intercropping with soybean	4930	35800	38150
T4. Stale seed bed + reduced spacing (upto 25%) + mulching with previous crop residues + one hand weeding	4750	40970	30280
T5. Locally available weed mulch + one hand pulling	4370	38500	27050
T6. Incorporation of neem cake @ 5t/ha + one hand weeding	4580	129700	-61000
T7. Soil solarization + one hand weeding	4110	43200	18450
T8. ITK treatment on weed control practiced by farmers	3680	35050	20150
CD ($p=0.05$)	-	-	-

Udaipur

Weed flora and Weed density (Table 7.11.11.1 & 2): The major broadleaf weeds in the experimental fields were *Digera arvenris* (kalinjra), *Trianthema partulacastrum* (patharchata), *Physalis minima* (Popati) and *Commehina bengalensis* (bokna). The grassy weeds were *Echinochloa colona* (jungle rice), *Dinebra retroflexa* (viper grass) and *Setaria glauca* (Foxtail). Weed density recorded at 30 & 60 DAS of sweet corn was significantly influenced by organic weed management practices.. 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 (5 t/ha), sesbania as smothering crop with hand weeding or pre-emergence application of herbicide with straw mulch (5 t/ha), summer ploughing and stale seed bed with one hand weeding at 20 DAS..

Yield attributes yield and economics (Table 7.11.11.3): Growth and yield attributes of sweet corn was significantly affected by organic weed management practices. Among various organic weed management treatments, maximum number of cobs per plant (1.45) and cob weight per plant (192.58 g) 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 cob yield (8790 kg/ha) and fodder yield (17660 kg/ha) of sweet corn were recorded with crop sown with treatment of soil solarization with plastic mulch, which was at par with stale seed bed preparation + plastic mulch and summer ploughing + plastic mulch. Among organic weed management practices, highest net return (Rs. 10,8825/Rs) was



recorded with Soil solarization + plastic mulch at sowing. B:C ratio (2.65) was highest recorded in Pendimethalin 1000 ml /atrazine500g fb straw mulching (5 t/ha) at 20 DAS.

Table 7.11.11.1: Effect of organic weed management practices on weed density at 30 DAS of kharif sweet corn at Udaipur

Treatment	Weed density (No./m ²)								
	<i>Echinochloa colona</i>	<i>Digera arvensis</i>	<i>Triantema portulacas-trum</i>	<i>Commelina bengha-lensis</i>	<i>Physilis minima</i>	<i>Setaria gluca</i>	<i>Dinebra retroflexa</i>	<i>Chloris barbata</i>	<i>Dactylec-tunum aegypticum</i>
Summer ploughing + 1 hand weeding at 20 DAS	2.98 (8.40)	1.93 (3.21)	2.54 (5.98)	1.97 (3.38)	1.78 (2.67)	1.80 (2.76)	1.26 (1.09)	1.73 (2.50)	1.68 (2.32)
Summer ploughing + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS	1.98 (3.44)	1.75 (2.57)	2.05 (3.74)	1.38 (1.42)	1.94 (3.28)	1.58 (1.99)	1.46 (1.64)	1.30 (1.18)	1.63 (2.15)
Summer ploughing + plastic mulch at sowing	0.74 (0.05)	0.79 (0.14)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.81 (0.55)	0.73 (0.54)	0.82 (0.64)	0.71 (0.00)
Stale seed bed preparation + 1 Hand Weeding at 20DAS	2.45 (5.51)	1.95 (3.29)	2.39 (5.24)	2.27 (4.68)	1.87 (2.99)	1.50 (1.74)	1.13 (1.28)	1.30 (1.34)	1.50 (1.74)
Stale seed bed preparation + straw mulch (5 t/ha) at 20 DAS +1 hand weeding at 40 DAS	3.09 (9.09)	1.76 (2.59)	1.91 (3.14)	1.51 (1.77)	2.04 (3.67)	1.55 (1.90)	0.58 (1.04)	1.63 (2.16)	1.32 (1.24)
Stale seed bed preparation + plastic mulch at sowing	0.72 (0.01)	0.02 (0.72)	0.09 (0.26)	0.85 (0.09)	0.71 (0.00)	0.81 (0.55)	0.72 (0.40)	0.71 (1.00)	1.61 (2.11)
Soil solarization + 1 hand weeding	2.13 (4.05)	1.84 (2.88)	2.16 (4.16)	2.57 (6.12)	2.27 (4.67)	1.75 (2.57)	1.60 (2.06)	1.83 (2.87)	1.50 (1.74)
Soil solarization + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS	2.26 (4.70)	1.58 (2.01)	1.90 (3.13)	1.74 (2.63)	2.31 (4.83)	1.50 (1.75)	1.41 (1.50)	2.09 (3.85)	1.44 (1.59)
Soil solarization + plastic mulch at sowing	0.71 (0.00)	0.71 (0.00)	0.73 (0.03)	0.97 (0.06)	0.82 (0.20)	2.21 (3.84)	0.84 (0.21)	0.77 (0.33)	1.01 (0.55)
Sesbania as smothering crop in between rows and used same Sesbaina as mulch after 30 days + 1 HW at 40 DAS	3.03 (8.70)	2.19 (4.30)	2.33 (4.95)	2.28 (4.75)	1.93 (3.22)	1.61 (2.09)	1.02 (0.55)	1.57 (1.97)	1.70 (2.40)
Pendimethalin 1000 ml / atrazine500g fb straw mulching (5 t/ha) at 20 DAS	1.41 (1.54)	1.22 (1.00)	1.58 (2.00)	1.46 (1.73)	2.35 (5.00)	1.03 (0.56)	1.03 (0.55)	1.63 (2.17)	1.23 (1.00)
Weedy check	5.47 (29.42)	2.84 (7.57)	3.49 (11.71)	3.75 (13.55)	2.29 (5.07)	2.21 (4.37)	2.03 (3.62)	2.35 (5.04)	1.92 (3.20)
CD (P= 0.05%)	0.32	0.19	5.70	0.34	0.13	0.013	0.06	0.49	3.11

Data subjected to $\sqrt{x + 0.5}$ transformation and figures in parenthesis are original weed count per sq.m

Table 7.11.11.2: Effect of organic weed management practices on weed density at 60 DAS of *kharif* sweet corn

Treatment	Weed density (No./m ²)								
	<i>Echinochloa colona</i>	<i>Digera arvensis</i>	<i>Triantema portulacastrum</i>	<i>Commelina benghalensis</i>	<i>Physalis minima</i>	<i>Setaria glauca</i>	<i>Dinebra retroflexa</i>	<i>Chloris barbata</i>	<i>Dactylectunum aegypticum</i>
Summer ploughing + 1 hand weeding at 20 DAS	2.90 (7.92)	2.12 (3.99)	2.01 (3.55)	1.79 (2.72)	1.35 (1.34)	1.53 (1.85)	1.11 (0.74)	1.28 (1.15)	1.27 (1.12)
Summer ploughing + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS	2.22 (4.47)	1.07 (0.65)	1.51 (1.77)	1.53 (1.83)	1.07 (0.64)	1.14 (0.80)	1.08 (0.67)	0.91 (0.33)	1.06 (0.63)
Summer ploughing + plastic mulch at sowing	1.12 (0.77)	0.94 (0.38)	0.82 (0.17)	0.86 (0.28)	0.89 (0.31)	0.81 (0.16)	0.71 (0.00)	0.79 (0.13)	0.79 (0.12)
Stale seed bed preparation + 1 Hand Weeding at 20DAS	3.15 (9.42)	1.70 (2.38)	2.45 (5.49)	2.54 (5.94)	1.82 (2.83)	1.59 (2.03)	1.35 (1.32)	1.24 (1.04)	1.41 (1.48)
Stale seed bed preparation + straw mulch (5 t/ha) at 20 DAS +1 hand weeding at 40 DAS	1.96 (3.35)	1.10 (0.71)	1.49 (1.72)	1.48 (1.68)	1.14 (0.80)	1.16 (0.84)	0.77 (0.10)	1.08 (0.66)	0.95 (0.40)
Stale seed bed preparation + plastic mulch at sowing	0.90 (0.34)	0.76 (0.07)	0.84 (0.21)	0.71 (0.00)	0.86 (0.28)	0.83 (0.23)	0.88 (0.27)	0.71 (0.00)	0.77 (0.09)
Soil solarization + 1 hand weeding	2.70 (6.79)	1.82 (2.82)	2.28 (4.72)	2.57 (6.13)	1.78 (2.69)	1.94 (3.26)	1.77 (2.64)	1.20 (0.94)	1.45 (1.61)
Soil solarization + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS	1.70 (2.47)	1.26 (1.08)	1.78 (2.68)	2.06 (3.80)	1.72 (2.46)	1.42 (1.52)	1.34 (1.30)	0.94 (0.39)	1.22 (1.00)
Soil solarization + plastic mulch at sowing	0.85 (0.23)	0.93 (0.36)	0.88 (0.33)	0.76 (0.09)	0.82 (0.19)	0.79 (0.15)	0.80 (0.17)	0.84 (0.21)	0.71 (0.00)
<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	3.23 (9.93)	2.38 (5.17)	2.68 (6.68)	2.83 (7.52)	2.02 (3.60)	2.13 (4.06)	1.15 (0.83)	1.59 (2.03)	1.76 (2.59)
Pendimethalin 1000 ml / atrazine 500g fb straw mulching (5 t/ha) at 20 DAS	2.10 (3.91)	1.82 (2.82)	1.39 (1.43)	1.80 (2.75)	1.23 (1.02)	0.97 (0.45)	0.97 (0.45)	0.95 (0.40)	1.04 (0.59)
Weedy check	6.16 (37.52)	2.75 (7.06)	4.08 (16.15)	3.83 (14.23)	2.27 (4.64)	2.66 (6.55)	2.45 (5.51)	2.14 (4.10)	2.00 (3.51)
CD (P= 0.05%)	0.26	0.10	0.16	0.25	0.08	0.15	0.27	0.08	0.08

Data subjected to $\sqrt{x + 0.5}$ transformation and figures in parenthesis are original weed count per sq.m

Table 7.11.11.3: Effect of organic weed management practices on yield attributes, yield and net return of sweet corn

Treatments	No. of cobs/ plant	Cob weight/ plant(g)	Cob length (cm)	Green Cob yield (kg/ha)	Green Fodder yield (kg/ha)	Net return (Rs/ha)	B:C ratio
Summer ploughing + 1 hand weeding at 20 DAS	1.19	151.46	12.89	5220	10300	64250	2.17
Summer ploughing + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS	1.32	155.97	13.60	6670	1343	84835	2.40
Summer ploughing + plastic mulch at sowing	1.41	173.49	14.33	8250	16760	104279	2.34
Stale seed bed preparation + 1 Hand Weeding at 20DAS	1.22	149.27	13.41	4850	9600	57547	1.95
Stale seed bed preparation + straw mulch (5 t/ha) at 20 DAS +1 hand weeding at 40 DAS	1.32	164.75	14.06	6230	12360	77225	2.22
Stale seed bed preparation + plastic mulch at sowing	1.42	184.91	14.07	8300	16910	105201	2.35
Soil solarization + 1 hand weeding	1.22	152.98	14.27	6240	12430	76898	2.17
Soil solarization + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS	1.29	156.44	14.27	6570	13030	73361	1.64
Soil solarization + plastic mulch at sowing	1.45	192.58	14.17	8790	17660	108825	2.20
<i>Sesbania</i> as smothering crop in between rows and used same <i>Sesbania</i> as mulch after 30 days + 1 HW at 40 DAS	1.16	156.13	13.46	4730	9370	58529	2.21
Pendimethalin 1000 ml /atrazine500g fb straw mulching (5 t/ha) at 20 DAS	1.41	161.80	14.35	6890	13820	90094	2.65
Weedy check	1.14	101.83	10.52	2750	5560	26858	1.18
CD (P= 0.05%)	0.16	15.20	1.33	148	296	26631	0.72

Weed flora and weed density in fennel (Table 7.11.11.4)

The major broadleaf weeds in the experimental fields were *Chenopodium album*, *Chenopodium murale*, *Fumaria parviflora*, *Convolvulus arvensis*, *Melilotus alba* and *Malwa parviflora*. The grassy weed and sedges were *Phalaris minor* and *Cyperus rotundus*. Weed density in fennel at 60 DAS was significantly influenced by organic weed management practices. Weed density was recorded significantly lower in plastic mulch either with soil solarization and sowing after stale seed bed preparation. 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 (5 t/ha), *sesbania* as smothering crop with hand weeding or pre-emergence application of herbicide with straw mulch (5 t/ha), summer ploughing and stale seed bed with one hand weeding at 20 DAS (Table 7.12.12.4).

Yield attributes and yield of fennel (Table 7.11.11.5)

Growth and yield attributes of fennel were significantly influenced by organic weed management practices. Maximum height of plants of the crop were recorded when weeds were managed by soil solarization with plastic mulch at sowing (181.02 cm). Among various organic weed management treatments, maximum number of branches per plant (15.03) and number of umbels per plant (21.03) were recorded with soil solarization with plastic mulch as compared to other treatments. 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 seed yield (1393 kg/ha) of fennel was recorded with crop sown with treatment of soil solarization with plastic mulch, which was at par with plastic mulch with summer ploughing and stale seed bed. 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. Among organic weed management practices, highest net return (Rs. 62,588/ha) and B: C (1.62) was recorded in stale seed bed with plastic mulch.

Table 7.11.11.4: 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>Melilotus alba</i>	<i>Malva parviflora</i>
Summer ploughing + 1 hand weeding at 20 DAS	3.75 (13.54)	3.12 (9.23)	3.34 (10.64)	1.51 (1.77)	1.54 (1.88)	2.07 (3.77)	1.26 (1.09)
Summer ploughing + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS	2.98 (8.38)	2.18 (4.25)	3.09 (9.05)	1.00 (0.50)	0.94 (0.39)	1.10 (0.71)	1.19 (0.91)
Summer ploughing + plastic mulch at sowing	2.00 (3.50)	1.19 (0.91)	0.71 (0.00)	0.71 (0.00)	0.73 (0.03)	0.78 (0.11)	1.04 (0.57)
Stale seed bed preparation + 1 Hand Weeding at 20DAS	4.02 (15.66)	2.69 (6.73)	4.15 (16.73)	1.58 (1.99)	2.05 (3.69)	2.26 (4.61)	1.22 (1.00)
Stale seed bed preparation + straw mulch (5 t/ha) at 20 DAS +1 hand weeding at 40 DAS	2.98 (8.39)	2.03 (3.63)	3.29 (10.32)	1.02 (0.54)	1.07 (0.65)	1.18 (0.90)	0.90 (0.32)
Stale seed bed preparation + plastic mulch at sowing	0.71 (0.00)	1.53 (1.84)	0.71 (0.00)	0.71 (0.00)	0.78 (0.11)	0.96 (0.41)	1.24 (1.03)
Soil solarization + 1 hand weeding	2.11 (3.95)	2.45 (5.50)	4.13 (16.56)	1.57 (1.97)	2.08 (3.83)	2.56 (6.06)	1.58 (2.01)
Soil solarization + straw mulch (5 t/ha) at 20 DAS+ 1 hand weeding at 40 DAS	2.15 (4.13)	2.31 (4.83)	2.75 (7.08)	1.25 (1.07)	1.60 (2.05)	1.50 (1.74)	1.16 (0.84)
Soil solarization + plastic mulch at sowing	0.71 (0.00)	1.62 (2.12)	0.71 (0.00)	0.71 (0.00)	1.18 (0.89)	1.77 (2.63)	0.82 (0.17)
<i>Sesbania</i> as smothering crop in between rows and used same <i>Sesbania</i> as mulch after 30 days + 1 HW at 40 DAS	2.46 (5.54)	2.55 (6.01)	2.87 (7.74)	1.30 (1.19)	1.89 (3.09)	2.31 (4.84)	0.89 (0.30)
Pendimethalin 1000 ml fb straw mulching (5 t/ha) at 20 DAS	2.31 (4.85)	3.47 (11.57)	2.91 (7.95)	1.15 (0.83)	1.62 (2.14)	1.19 (0.91)	0.99 (0.47)
Weedy check	5.92 (34.51)	4.49 (19.70)	4.06 (16.00)	1.74 (2.54)	2.70 (6.81)	3.65 (12.86)	1.93 (3.23)
CD (P= 0.05%)	9.44	8.50	9.68	10.21	10.19	10.59	9.47

Data subjected to transformation and figures in parenthesis are original weed count per sq.m

Table 7.11.11.5: Effect of organic weed management practices on growth & yield attributes of fennel

Treatments	Plant height at harvest (cm)	No. of branches / plant	No. of umbels per plant
Summer ploughing + 1 hand weeding at 20 DAS	105.10	5.28	9.33
Summer ploughing + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS	142.14	11.03	17.94
Summer ploughing + plastic mulch at sowing	161.29	13.83	20.09
Stale seed bed preparation + 1 Hand Weeding at 20DAS	123.14	10.27	17.39
Stale seed bed preparation + straw mulch (5 t/ha) at 20 DAS +1 hand weeding at 40 DAS	146.00	11.65	18.53
Stale seed bed preparation + plastic mulch at sowing	162.63	14.00	20.05
Soil solarization + 1 hand weeding	111.79	11.26	18.23
Soil solarization + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS	137.49	11.78	18.84
Soil solarization + plastic mulch at sowing	181.02	15.03	21.03
Sesbania as smothering crop in between rows and used same Sesbainia as mulch after 30 days + 1 HW at 40 DAS	107.46	9.68	17.52
Pendimethalin 1000 ml /atrazine500g fb straw mulching (5 t/ha) at 20 DAS	144.23	9.90	17.69
Weedy check	82.72	4.58	12.53
CD (P= 0.05%)	15.07	1.34	1.39

per sq.m



Soil solarization + plastic mulch at sowing



Sesbania as green manuring 30 DAS + 1 HW at 40 DAS



Stale seed bed + 1 HW at 40 DAS



Summer ploughing + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS



Stale seed bed + plastic mulch at sowing in Sweet corn



Fennel crop

Effect of organic weed management practices in sweet corn and fennel at Udaipur

Table 7.11.11.6: Effect of organic weed management practices on yield and economics of fennel

Treatments	Plant height at harvest (cm)	No. of branches/plant	No. of umbels per plant	Seed yield (kg/ha)	Straw yield (kg/ha)	Biological yield (kg/ha)	Harvest index	Net Returns (Rs/ha)	B/C Ratio
Summer ploughing + 1 hand weeding at 20 DAS	105.10	5.28	9.33	784	2171	2955	26.52	35681	1.51
Summer ploughing + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS	142.14	11.03	17.94	875	2379	3254	26.90	36602	1.24
Summer ploughing + plastic mulch at sowing	161.29	13.83	20.09	1310	2859	4169	31.42	58847	1.53
Stale seed bed preparation + 1 Hand Weeding at 20DAS	123.14	10.27	17.39	771	2153	2924	26.35	34705	1.47
Stale seed bed preparation + straw mulch (5 t/ha) at 20 DAS +1 hand weeding at 40 DAS	146.00	11.65	18.53	916	2313	3229	28.38	40058	1.39
Stale seed bed preparation + plastic mulch at sowing	162.63	14.00	20.05	1362	2976	4338	31.41	62588	1.62
Soil solarization + 1 hand weeding	111.79	11.26	18.23	824	2657	3481	23.67	33583	1.14
Soil solarization + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS	137.49	11.78	18.84	986	2144	3130	31.51	34604	0.89
Soil solarization + plastic mulch at sowing	181.02	15.03	21.03	1393	3168	4561	30.56	60284	1.38
Sesbania as smothering crop in between rows and used same Sesbainia as mulch after 30 days + 1 HW at 40 DAS	107.46	9.68	17.52	648	3124	3773	17.17	31087	1.51
Pendimethalin 1000 ml fb straw mulching (5 t/ha) at 20 DAS	144.23	9.90	17.69	954	2778	3732	25.58	44375	1.59
Weedy check	82.72	4.58	12.53	406	1113	1519	26.77	13927	0.83
CD (P= 0.05%)	15.07	1.34	1.39	139	233	273	3.40	9713	0.21



7.12: Evaluation of concoctions of Natural Farming in Basmati Rice-Wheat cropping system

Objectives

- To study the natural farming practices on productivity and economics of basmati rice-wheat cropping 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) and Kurukshetra (Haryana)

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:	AINP-OF developed package
T3:	Gurukul package (Beejamrit, jeevamrit and Ghanjeevamrit) 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 2019-20 for each center are presented and discussed

Ludhiana

For basmati rice, the experimental field was green manured with sunnhemp crop (irrespective of treatments). The Gurukul products i.e., Ghanjeevamrit, Beejamrit, Jeevamrit, cow urine and biopesticides (*Brahmastra*, *Neemastra*) were prepared at research farm of the School of Organic Farming using urine and dung of desi cow procured from Gurukul, Kurukshetra, Haryana. Urine and dung of hybrid cow was used for preparing NF concoctions in treatment NF (hybrid cow). The NF concoctions of NF (desi cow) were enriched with recommended consortium bio-fertilizers to obtain the improved NF concoctions (NF-Improved). In integrated crop management (ICM), 50 per cent N to wheat was applied through FYM and 50 per cent through chemical fertilizer ($\frac{1}{2}$ N and full P at sowing fb LCC based application of urea) whereas in

INM + pesticide free treatment, no synthetic pesticides were used. Basmati rice variety Punjab Basmati 5 and Wheat variety Unnat PBW 343 was undertaken.

Growth and yield of basmati rice as affected by various concoctions (Table 7.12.1.1)

Significant variation among the different concoctions of natural farming was observed. Though number of grains/panicle (25.4) was highest in integrated nutrient management + pesticide free treatment but other major parameters such as plant height, effective tillers, panicle length, 1000-grains weight, grain and straw yield found to be higher with integrated crop management (50:50) of 98.4, 343.5, 26.5, 58.2, 3440 and 7820 respectively. Grain yield under integrated crop management (50:50) and NPOF package was increased by 24.6 and 16.3% respectively over complete natural farming concoctions. The lowest grain yield was observed with control treatment and it was statistically at par with all-natural farming treatments.

Table 7.12.1.1: Growth and yield attributing characters of basmati rice as affected by various concoctions of natural farming practices

Treatments	Plant height (cm)	Effective length tillers/m ²	Panicle panicle (cm)	Grains /panicle	1000 - grains weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
NPOF Package	95.3	337.6	24.1	23.2	53.6	3210	7630
Gurukul package (ZBNF)	93.8	331.8	23.1	21.5	51.0	2760	7010
Locally prepared (ZBNF)	95.9	331.2	23.1	22.6	50.1	2750	6890
Improved products (ZBNF)	93.0	331.0	23.0	21.1	50.4	2760	6920
Integrated crop management (50:50)	98.4	343.5	26.5	24.6	58.2	3440	7820
Integrated nutrient management + pesticide free	97.6	340.8	26.2	25.4	57.2	3350	7700
Control (Unfertilized)	92.6	330.5	20.6	20.5	46.0	2730	6730
CD (P=0.05)	4.0	16.8	3.3	NS	8.4	300	760

Performance of wheat as influenced by various concoction of natural farming (Table 7.12.1.2)

Significant variation for yield and attributing characters among the concoctions of natural farming input was observed, but the results of INM + pesticide free and ICM 50:50 treatment were at par. Among concoctions of natural farming input, integrated nutrient management (pesticide free) resulted in higher plant height (96.8 cm), number of effective tillers/m² (372.4), spike length (11.3), number of grains per spike (41.7). The highest thousand-grain weight (41.8 and 41.7 g) was also observed in INM + pesticide free and ICM 50:50 respectively.

Table 7.12.1.2: Growth and yield attributing characters of wheat as affected by various concoctions of natural farming practices

Treatments	Plant height (cm)	Effective length tillers/m ²	Spike length (cm)	Grains per spike	1000 grains weight (g)	Grain yield (q/ha)	Straw yield (q/ha)
NPOF Package	92.3	284.3	40.4	10.0	40.8	2880	4880
Gurukul package (ZBNF)	84.7	233.0	38.1	9.6	40.0	2090	3750
Locally prepared (ZBNF)	86.2	240.2	38.8	9.9	40.5	2230	4130
Improved products (ZBNF)	85.1	236.1	38.3	9.7	40.2	2170	4010
Integrated crop management (50:50)	96.5	365.4	41.5	11.1	41.7	4190	6480
Integrated nutrient management + Pesticide free	96.8	372.4	41.7	11.3	41.8	4270	6650
Control (Unfertilized)	81.7	214.2	37.4	9.4	39.4	1950	3740
CD (P=0.05)	5.6	14.4	3.0	1.1	NS	620	550



Maximum grain yield of wheat (4270 kg/ha) was obtained under INM + pesticide free, which was statistically at par with integrated crop management (4190 kg/ha) and significantly higher than complete natural farming input management practices by 104 and 99.5% respectively whereas NPOF package also found to be higher by 37.8%. Straw yield was the highest in INM + pesticide free (6650 kg/ha) which was statistically at par with ICM 50:50 but significantly higher than all the other nutrient management practices.

Economics of rice wheat system under various zero budget natural farming practices (Table 7.12.1.3)

In basmati rice, highest gross returns of Rs 1,08,340/ha was obtained with NPOF Package practice followed by ZBNF (Gurukul and Improved) which gave Rs. 93150/ha however, highest net returns (Rs 78050 per ha) were observed in NPOF package followed by control plot due to comparable yield, low cost of cultivation and premium price of organic produce. In case of wheat, highest gross (Rs 82,200 and 80,660/ha respectively) was obtained in INM + pesticide free closely followed by ICM 50:50 and highest net return (Rs 54,830/ha) was obtained in ICM 50:50 followed by INM + pesticide free which was due to higher grain yields and low cost of cultivation under these treatments. Minimum net returns (Rs 20820 per ha) were observed in Gurukul package (ZBNF) treatment, which was due to very high cost of cultivation in this treatment. Rice-wheat cropping system as whole recorded highest gross return under NPOF package of Rs. 1,77,640/ha closely followed by integrated nutrient management + pesticide free of Rs. 1,73,540/ha and INM + pesticide free of Rs.1,72,650/h owing to low cost of cultivation and high economic yield of rice and wheat with the same practice.

Table 7.12.1.3: Economics of basmati rice-wheat system (in Rs 000/ha) under various zero budget natural farming practices

Treatments	Basmati rice			Wheat			System		
	Gross returns	Cost of cultivation	Net returns	Gross returns	Cost of cultivation	Net returns	Gross returns	Cost of cultivation	Net returns
NPOF Package	108.34	30.29	78.05	69.30	47.85	21.45	177.64	78.14	99.5
Gurukul package (ZBNF)	93.15	31.24	61.91	50.29	29.47	20.82	143.44	60.71	82.73
Locally prepared (ZBNF)	92.81	31.24	61.57	53.66	29.47	24.19	146.47	60.71	85.76
Improved products (ZBNF)	93.15	32.04	61.11	52.22	29.87	22.35	145.37	61.91	83.46
Integrated crop management	92.88 (50:50)	31.39	61.50	80.66	25.83	54.83	173.54	57.22	116.33
Integrated nutrient management + Pesticide free	90.45	30.29	60.17	82.20	32.00	50.20	172.65	62.29	110.37
Control (Unfertilized)	92.14	26.59	65.55	46.92	23.96	22.96	139.06	50.55	88.51

*25 per cent price premium on NPOF, ZBNF treatments and control

Effect of various concoctions of farming practices on soil health (Table 7.12.1.4)

Among various concoctions of natural farming input practices, lowest EC was recorded in NPOF and Gurukul (ZBNF) whereas maximum EC found to be in local ZBNF. The maximum value of soil organic carbon was recorded in integrated crop management (50:50) and NPOF treatments (0.57, each) and it was minimum under the control. The soil available nitrogen was highest in NPOF package and was followed by integrated crop management (50:50) and Improved (ZBNF). The soil available phosphorous was highest in NPOF package and was lowest in control. The soil available potassium was highest in NPOF and was lowest in control. The soil EC was highest in Local (ZBNF) and was lowest in Improved.

Table 7.12.1.4: Effect of zero budget farming practices on soil chemical properties (0-15cm) in basmati rice-wheat system at the end of one cropping cycle

Treatment	EC (mmhos/cm)	OC (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
NPOF Package	0.28	0.561	114.2	99.8	316.5
Gurukul (ZBNF)	0.28	0.525	98.5	94.2	313.2
Local (ZBNF)	0.34	0.528	101.5	93.7	313.9
Improved (ZBNF)	0.29	0.522	112.8	94.8	314.2
ICM 50:50	0.30	0.530	113.0	95.2	314.0
INM+ Pesticide free	0.32	0.528	107.9	95.6	314.4
Control	0.28	0.521	90.5	91.8	282.1

Modipuram

Growth and yield of basmati rice as affected by natural farming concoctions (Table 7.12.2.1)

Growth parameters of basmati rice significantly affected due to the various concoctions of natural farming practices. Basmati rice attain the maximum plant height with integrated crop management (50% organic + 50% inorganic) followed by organic farming package (NPOF.) Moreover, maximum number of tillers per meter row length were also recorded under integrated crop management (50% organic + 50% inorganic) (63.6) followed by NPOF (57.5). Number of effective tillers was reduced by 23.3.0% and 16.4% under Gurukul package (ZBNF) compared to ICM and NPOF package, respectively. Similarly, SPAD meter reading was found highest under ICM followed by organic farming package.

Highest productivity of basmati rice was recorded under integrated crop management (50% organic + 50% inorganic) followed by organic farming package. Yield gap between ICM and organic farming package was reduced during third year in comparison to first and second year of experimentation. Moreover, yield gap between ICM and ZBNF treatments was further increased as compared to first and second year of experimentation. On the mean yield basis, grain yield of basmati rice was reduced by 14.6%, 64.8%, 66.8%, 49.8% and 70.5% under organic farming package, Gurukul package (Product supplied by Gurukul), Locally prepared Gurukul products, Location specific improved products and control as compared to integrated crop management (50% organic + 50% inorganic), respectively. Cost of cultivation was recorded highest under organic farming package. However, net return was received maximum under ICM followed by organic farming package.

Table 7.12.2.1: Growth and yield attributes of basmati rice as affected by different nutrient management practices of natural farming

Treatments	SPAD meter reading		Plant height at harvest (cm)	No. of tillers at harvest (m/r/l)	Rice grain yield (kg/ha)	COC (Rs./ha)	Gross Return (Rs./ha)	Net Return (Rs./ha)	B:C ratio
	30 DAT	60 DAT							
Control	35.6	30.4	86.4	50.0	1026	37,830	32631 (26988)	-5199 (-10842)	0.86 (0.71)
NPOF package	39.7	32.5	97.2	57.5	2973	57,330	90546 (74194)	33216 (16864)	1.58 (1.29)
Gurukul package (Product supplied by Gurukul)	35.9	29.7	85.9	49.4	1224	42,765	38534 (31802)	-4231 (-10963)	0.90 (0.74)
Locally prepared Gurukul products	38.1	30.0	86.5	46.4	1156	42,765	36675 (30317)	-6090 (-12448)	0.86 (0.71)
Location specific improved products	38.3	31.4	88.1	47.4	1747	43,165	55119 (45510)	11954 (2345)	1.28 (1.05)
Integrated crop management (50% organic + 50% inorganic)	42.6	39.5	101.8	63.6	3482	49,286	87630	38344	1.78
CD (P=0.05)	1.92	1.17	3.69	6.13	217.5	-	-	-	-

Value in parenthesis indicates returns without premium price

**Growth attributes and yield of wheat as affected by natural farming concoctions** (Table 7.12.2.2 & 3)

Plant height of wheat was found highest under integrated crop management (94.7 cm) followed by organic farming package (83.4 cm) and least under locally prepared Gurukul products. Similarly, number of tillers/meter row length at harvest in wheat were recorded highest under ICM followed by organic farming package. Number of tillers was reduced by 35.2% and 28.4% under Gurukul package (product supplied by Gurukul) at harvest as compared to ICM and organic farming package, respectively. Number of grains/spikes (60.5) was found highest under ICM followed by organic farming package (49.8). Number of grains/spike was found 56.5% lower under ZBNF treatment as compared to ICM.

Grain yield of wheat was recorded highest under ICM 50:50 (4150 kg/ha) followed by NPOF (3010 Kg/ha). On an average, grain yield of wheat was reduced by 27.5%, 72.5%, 72.8%, 67.3% and 73.4% under organic farming package, Gurukul package (Product supplied by Gurukul), Locally prepared Gurukul products and Location specific improved products as compared to ICM, respectively. Yield gap between ICM and organic farming package was reduced from 53.5% during first year to 44.2% during second year and 27.5% during third year of experimentation. Cost of cultivation was highest under organic farming package. However, net return was highest under ICM followed by organic farming package. Higher cost of cultivation was recorded in NPOF package followed by Integrated crop management (50% organic + 50% inorganic). Integrated crop management (50% organic + 50% inorganic) treatment gave highest gross return net return and benefit cost ration followed by NPOF.

Table 7.12.2.2: Growth and yield parameters of wheat as affected by different nutrient management practices

Treatments	SPAD reading at 60 DAT	Plant height (cm) at harvest	No. of tillers at Harvest (mrl)	Spike weight (g)	No. of grains/spike	Wheat grain yield (kg/ha)
Control	29.9	65.5	44.3	1.61	24.5	1103
NPOF	33.6	83.4	56.3	2.03	49.8	3010
Gurukul package (Product supplied by Gurukul)	30.4	64.1	40.3	1.64	26.3	1142
Locally prepared Gurukul products	30.6	64.0	37.4	1.82	26.5	1130
Location specific improved products	31.5	69.9	39.7	1.88	33.0	1357
Integrated crop management (50% organic + 50% inorganic)	39.8	94.7	62.2	2.11	60.5	4150
CD (P=0.05)	1.16	4.29	7.01	0.33	3.02	230.9

Table 7.12.2.3: Productivity and economics of wheat systems as affected by different nutrient management practices

Treatments	Cost of cultivation (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C ratio
Control	24400	35873 (30636)	11473 (6236)	1.47 (1.26)
NPOF	43900	90040 (75743)	46140 (31843)	2.05 (1.73)
Gurukul package (Product supplied by Gurukul)	29335	36939 (31516)	7604 (2181)	1.26 (1.07)
Locally prepared Gurukul products	29335	35520 (30153)	6185 (818)	1.21 (1.03)
Location specific improved products	29735	43283 (36837)	13548 (7102)	1.46 (1.24)
Integrated crop management (50% organic + 50% inorganic)	35856	106313	70457	2.96

Value in parenthesis indicates returns without premium price

Soil biological properties (Table 7.12.2.4)

Among the different management practices, highest population of bacteria, fungi and actinomycetes and Glomalin content were found highest under organic farming practices. Organic farming practices also resulted in the highest activity of different soil enzymes namely dehydrogenase, phosphatase, urease and α -glucosidase which are crucial for soil nutrient mineralization. Population of bacteria, fungi and actinomycetes was found higher under ZBNF treatments as compared to control.

Table 7.12.2.4: Biological properties of soil as affected by different nutrient management practices

Treatments	Population of different microbial groups			Glomalin content (mg/kg dry soil)	Enzyme activities in soil			
	Bacteria (CFU/g dry soil)	Fungi (CFU/g dry soil)	Actinomycetes (CFU/g dry soil)		Dehydrogenase (μg TPF/g dry soil/h)	Phosphatase (μg pNP/g dry soil/h)	β -glucosidase (μg pNP/g dry soil/h)	Urease (mg urea/g soil/h)
Control	0.98×10^7	3.66×10^4	1.83×10^6	341	14.41 ± 1.41	35.02 ± 3.79	14.56 ± 1.42	5.90 ± 0.76
NPOF	1.33×10^7	5.81×10^4	2.83×10^6	546	25.24 ± 1.78	56.04 ± 5.09	16.88 ± 1.09	10.90 ± 0.98
Gurukul package (Product supplied by Gurukul)	1.23×10^7	3.82×10^4	2.40×10^6	413	13.77 ± 2.42	42.71 ± 4.78	14.08 ± 1.79	10.06 ± 1.21
Locally prepared Gurukul products	1.06×10^7	4.70×10^4	2.13×10^6	456	14.20 ± 1.79	42.95 ± 5.35	14.75 ± 0.95	9.16 ± 0.89
Location specific improved products	1.02×10^7	4.67×10^4	2.05×10^6	373	19.51 ± 2.59	44.12 ± 3.65	14.61 ± 2.07	9.66 ± 1.07
Integrated crop management (50% organic + 50% inorganic)	1.02×10^7	5.32×10^4	2.02×10^6	431	20.77 ± 2.71	53.89 ± 4.49	16.15 ± 0.49	10.02 ± 1.12



Overview of wheat under natural farming experiment at Modipuram

**Pant Nagar****Performance of basmati rice as influenced by various concoctions of natural farming input** (Table 7.12.3.1)

Rice variety Pant basmati-1 was taken in the experiment. Highest plant height (124 cm) was recorded under NPOF package followed by integrated treatment (122 cm) compared to all other practices. Minimum plant height was recorded in Gurukul package Centre (95.0 cm). Effective tillers/m² was found significantly higher in integrated system (263) followed by NPOF Package (259) and lowest under the Control practice (166). Grain weight/panicle ranged from 0.98 to 1.74 g and integrated system showed significantly higher grain weight/panicle (1.74 g) which was followed by NPOF Package (1.59 g) while test weight i.e. 1000-grains-weight (25.5 g) recorded highest with NPOF package followed by ICM and minimum test weight was recorded under Gurukul package Centre (22.0 g).

Among the management practice of natural farming, significantly higher grain yield (4020 kg/ha) and straw yield (5711 Kg/ha) of rice was recorded with integrated crop management followed by NPOF package (3775 and 5521 Kg/ha, respectively). Highest per cent increase in grain yield was recorded under ICM system (221 %) as compared to the control, 6.4% as compared to NPOF package. Economics of different management practice of natural farming revealed that highest net return of Rs. 80258 /ha and B:C ratio (2.31) was observed with NPOF package followed by ICM and minimum net returns (Rs. 11139/ha) with B: C ratio (0.40) was found under Control with minimum cost of cultivation.

Table 7.12.3.1: Growth and yield attributes of rice as influenced by different natural farming concoctions

Treatments	Plant height (cm)	Effective tillers/ m ²	Grain wt./ panicle(g)	1000-grains weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index	Cost of cultivation (Rs./ha)	Net returns (Rs./ha)	B:C ratio
Control	104	166	0.98	23.8	1251	1951	0.39	27965	11139	0.40
AI-NPOF Package	124	259	1.59	25.5	3775	5521	0.41	37694	80258	2.13
Gurukul package (from Kurukshetra)	105	179	1.02	22.7	1456	2264	0.39	30398	15116	0.50
Gurukul package" Locally prepared	95	183	0.98	22.5	1395	2092	0.40	30995	12596	0.41
Gurukul package" Improved	100	177	0.99	22.0	1487	2235	0.40	31419	15057	0.48
Integrated Crop Management	122	263	1.74	24.8	4020	5711	0.41	38701	61814	1.60
CD(P=0.05)	11.2	19.6	0.24	2.2	295.0	539.3	NS	-	-	-

Nutrient uptake (nitrogen, phosphorus and potassium) was significantly influenced under different treatment combinations. Significantly higher uptake of nitrogen (85.5 kg/ha), phosphorus (31.8 kg/ha) and potassium (89.7 kg/ha) by the crop was found to be with integrated system, and lowest uptake was recorded with Control (26.0, 8.8 and 28.7 kg/ha, for N, P and K, respectively (Table 7.12.3.2).

Table 7.12.3.2: Nutrient (N, P and K) Uptake by rice as influenced by different zero budget management practices.

Treatments	N uptake(kg/ha)	P uptake (kg/ha)	K uptake (kg/ha)
Control	26.0	8.8	28.7
NPOF Package	76.6	31.1	85.1
Gurukul Package	32.1	10.9	33.9
Gurukul Package Centre	30.2	10.3	32.3
Gurukul Package Centre Improved	32.8	11.8	34.7
Integrated	85.5	31.8	89.7
CD(P=0.05)	8.0	4.6	9.5



Basmati rice grain yields under zero budget management practices



Performance of Basmati rice under zero budget management practices

**Performance of wheat as influenced by various concoctions of natural farming input** (Table 7.12.3.3)

Wheat variety UP 2565 was taken in the experiment. Tallest plant was observed under NPOF Package (88.3 cm) which was statistically at par with integrated system (86.3cm), whereas maximum spikes/m² of wheat was observed under integrated system (298) and minimum spikes/m² was found under the Control (187). Test weight (1000-grains weight) of wheat was found in range between 39.7 g to 43.4g, and highest being with NPOF practice i.e. 43.4 g which was significantly higher over Gurukul packages but on par with ICM.

Among different zero budget management practices in wheat, maximum grain yield of 4709 kg/ha, straw yield (5628 kg/ha) and harvest index (0.46) were recorded in integrated crop management.

Economic analysis of different treatments showed that net return (Rs. 42951/ha and B:C ratio (1.34) was recorded with integrated system with and lowest net return being with control (Rs. 25684/ha) while minimum B: C ratio was recorded under NPOF Package (0.96)

Table 7.13.3.3: Growth and yield attributes of wheat (UP 2565) as influenced by different natural farming concoctions

Reatments	Plant height (cm)	Spikes/ m ²	Grain wt./spike (g)	1000-grains weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index	Cost of cultivation (Rs./ha)	Net returns (Rs./ha)	B:C ratio
Control	72.3	187	1.21	41.1	1910	2244	0.46	20274	25684	1.27
AI-NPOF Package	88.3	256	1.47	43.4	3431	3924	0.47	33190	31740	0.96
Gurukul package (from Kurukshetra)	71.0	222	1.18	39.7	2394	2886	0.45	24003	27713	1.15
Gurukul package" Locally prepared	72.3	233	1.14	39.7	2449	2910	0.46	24600	28444	1.16
Gurukul package" Improved	74.0	224	1.13	41.1	2518	2811	0.47	25024	26751	1.07
Integrated Crop Management (50% organic+:50% inorganic)	86.3	298	1.41	42.9	4709	5628	0.46	32143	42951	1.34
CD (P=0.05)	7.72	24.1	0.19	2.47	281.7	659.7	NS	-	-	-

Organic carbon, available N, P and K were greatly influenced by different zero budget management practices and maximum organic carbon (0.82 %), available N (169 kg/ha), P (27.0 kg/ha) and K (237 kg/ha) were recorded in NPOF package system followed by Integrated system (i.e. 0.79 kg/ha, 167 kg/ha, 24.0 kg/ha and 230 kg/ha respectively). Significant differences were observed in nitrogen, phosphorus and potassium uptakes of wheat. However highest uptakes of nitrogen, phosphorus and potassium were recorded under integrated system (i.e. 81.9 kg/ha, 20.2 kg/ha and 60.9 kg/ha), respectively. While minimum uptake was noted with the control (34.2 kg/ha, 8.50 kg/ha and 30.3 kg/ha for N, P and K, respectively (Table 7.12.3.4)

Table 7.12.3.4: Organic carbon, Available and Uptake N, P and K by different of wheat (UP 2565) as influenced by different natural farming concoctions

Treatments	Organic carbon (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)	Total N Uptake (kg/ha)	Total P Uptake (kg/ha)	Total K Uptake (kg/ha)
Control	0.75	155	21.2	221	34.2	8.5	30.3
AI-NPOF Package	0.82	169	27.0	237	60.0	14.7	46.6
Gurukul package (from Kurukshetra)	0.68	161	23.9	225	43.2	10.6	36.6
Gurukul package" Locally prepared	0.70	163	25.9	228	45.5	11.1	37.3
Gurukul package" Improved	0.72	161	22.2	225	46.0	10.0	35.8
Integrated Crop Management (50% organic+:50% inorganic)	0.79	167	24.0	230	81.9	20.2	60.9
CD(P=0.05)	0.10	NS	NS	4.6	34.2	8.5	30.3



Performance of wheat under zero budget management practice



7.13 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 for disseminating organic production technology in cluster approach. Mynsain village is located in Umsning Tehsil of Ri-Bhoi district in Meghalaya. The sensitization meeting with the villagers including village head (Headman), member of the SHGs, Department of agriculture (Gram Sabath) was organized, subsequently a group of farmers visited the ICAR, Umiam, to get first hand exposure to various technologies to be demonstrated under the programme. The improved seeds like maize, groundnut, french bean and some 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 cluster approach under the NPOF Project. These newly adopted villages are neighbors of Mynsain village. The component of the Model village would be as follows-

Soil Fertility status

Results: The available N, P, SOC (kg/ha) and pH of the soil at lowland and upland conditions recorded are presented in the table below:

Particulars		Av N	Av P	SOC	pH
Lowland	0-15	214.2±2	9.5±5.1	1.62±0.61	4.96 ±0.66
	15-30	188.3±2	12.1±5.4	1.33±0.56	4.89±0.66
Upland	0-15	208.4±3	23.1±2.5	1.45±3.42	4.86±0.64
	15-30	171.1±2	9.4±2.2	1.05±0.54	5.01±0.65

Progress mode during 2019-20

A. 'Jalkund' Low- cost rainwater harvesting structure

Meghalaya is basically an agricultural state and about 80% of the population depends entirely on agriculture for their livelihood. The state is blessed with abundant rainfall during monsoon season but due to lack of irrigation facilities and inappropriate water harvesting infrastructures, it faces major challenges of available water resource during the off monsoon periods and cultivation during the dry months is generally limited. The bulk of agriculture in the State is rain fed and only 18.5% of the cultivated area is irrigated resulting in mono-cropping and low cropping intensity. The trend on cultivation will change for the better once water is provided during the lean period and will subsequently contribute to socio-economic upliftment of the farmers. Thus, there is potential to increase agricultural productivity through both increasing the area under surface water irrigation and improving water management in rain fed farming systems. Keeping this in view, low cost 'jalkund' technology was introduced in the adopted villages with the main goal of securing water supply during the lean period in order to provide critical irrigation to high value winter crops to minimize crop failure during dry months, supply drinking water and domestic water for animals and people respectively and enhance crop diversification.

The rain water is stored directly in the *jalkunds* during the rainy season and is later utilized to provide protective irrigation to crops for successful cultivation during dry periods. Also the stored water is utilized for rearing of livestock, piggery and poultry. Farmers grow tomato, capsicum, cucurbits, cabbage, cauliflower, bottle gourd and pumpkin all along the periphery of the *Jalkund* to increase farm income as a whole. The stored water also helps the farmers of this village to raise crops for the whole year. The names of farmers, village and their geographical location of the demonstration sites have been provided in the Table below. A total of six (6) numbers *Jalkunds* having 30,000 liters capacity each was distributed to the farmers during the year 2019-20.

Fig: Diverting of water into the *jalkund*Fig: Farmer releasing fingerlings in *jalkund*

B. Vermicomposting as a feasible technology for farm households

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. Six (6) numbers each of such beds of the size 12'x'4' x 2' were distributed to the three (3) villages during the year 2019-20 for vermicomposting, which can produce about 1200kgs to 1500kgs of vermicompost.



Fig: Vermicompost demonstration



Fig: Vermicompost tank

C. Land Development and modification

1. Raised and Sunken beds

Farmers in the three villages conventionally cultivate crops like vegetables (tomato, cabbage, cauliflower, carrot, etc.), ginger, turmeric etc., in *buns* (raised bed of 1 m width, 8–10 m long and 30–50 cm height) especially in uplands. These crops are normally raised on the temporary *buns* (raised beds) while the sunken area (area between the two raised beds) is usually left unutilized. Some farmers also grow vegetables in lowland fields by forming buns after kharif rice but the sunken area is left unutilized. After the vegetables are harvested, the buns are broken down and leveled for rice cultivation. As a result, farmers incur repeated expenditure every year for making fresh buns. Therefore, the introduction of land configuration through RSB technology was initiated in farmers' fields to address the advantages of this technology in providing an alternative approach for promotion of crop diversification, increasing productivity and enhancing income. Field demonstrations were conducted in five (%) farmers field to give farmers a clear idea to construct the raised and sunken beds.



Fig. Raised and sunken beds in farmer's field

The intervention of raised and sunken bed system has proven to be immensely beneficial for the farmers as the system has resulted in enhanced crop production and productivity of rice during *kharif* due to prolonged submergence of water in sunken beds and effective rainwater harvesting for the lean period. Also, the technology has also provided effective utilization of land by reducing tillage of the cultivated area thus saving labour, farmer's energy, conservation of moisture and improving soil health. The system also generated additional income for the farmers as well as boosting employment generation as two or more crops were raised in a year as compared to their traditional practice of monocropping.

D. Integrated Organic Farming System (IOFS) Model

The organic farming technology standardized by ICAR Umiam under Network Project On Organic Farming has been disseminated to three villages viz., Mynsain, Pynthor and Umden Umbathiang and demonstrated to 330 households covering an area of about 300 ha. In addition to the existing IOFS models, 2 more beneficiaries were selected during the year 2019-20, for developing the IOFS model. The IOFS model promotes crop diversification thereby improving the farmers' livelihood and providing food security round the year along with enhancement of soil fertility and generating employment for the farmers. Furthermore, outputs of one enterprise component are used as inputs for other related enterprises wherever feasible. Thereby, very little amount of nutrient is required to be met from external sources which can be reduced substantially with the recycling of pond silt, intercropping with legume, use of bio-fertilizers in crop production. Currently, twelve 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 structures (*Jalkund*) etc. in the system.

Table: List of some farmers for IOFS model

Farmers name	Farming Components	Water source	Area (ha)	Net return/ha/ year (Rs)
Jril Makdoh	Maize + Vegetables + Ginger + Dairy + Poultry + Pisciculture + Mushroom	Jalkund	0.27	46,695
Lahun Lapang	Fruit Trees (Pineapple, Assam lemon, Pomelo) + Vegetables + Piggery + Poultry	Jalkund	0.20	24,500
Judy Wahlang	Rice + Vegetables + Poultry + Pisciculture + Bamboo	Pond	0.32	29,500
Pynsanlang Rynghang	Maize + Vegetables + Ginger + Poultry + Apiculture	Jalkund	0.18	18,750
Lamphrang Rympei	Rice + Vegetables + Turmeric + Piggery + Poultry + Pisciculture	Pond	0.29	35,670
Ban War	Fruit Trees (Pineapple, Assam lemon, Banana) + Piggery + Vegetables	Jalkund	0.35	41,590
Skola Kurbah	Maize + Soybean + Vegetables + Turmeric + Piggery + Poultry + Apiculture	Jalkund	0.21	31,100



Fig : Mushroom unit & Honey Bee Hive

E. Secondary agriculture

Secondary agricultural activities like mushroom cultivation, apiary etc. helps in generating of extra income during the lockdown apart from their everyday consumption.



Fig : Mushroom unit & Honey Bee Hive



"Input distribution cum field demonstration programme on promotion of organic farming under Tribal Sub Plan (TSP)"



Fig: Organic outlet



Fig: Vegetables sold at the outlet

PUBLICATIONS/HUMAN RESOURCE DEVELOPMENT AND WORKSHOPS/ MEETINGS



8.1 Publications

8.1.1 Research Papers

Bhopal

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8.1.2 Popular article/folders/ Palmphletp

Bhopal

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Coimbatore

- Ganesan, K., Sanbagavalli, S and Somasundaram, E. (2020). Botanicals in organic farming. Agri Business, January 2020 issue. Sri Muththan Printers, Madurai.p.32-36.
- Ganesan, K and Somasundaram, E (2020). Eco friendly pesticides for the management of insect pests in organic rice. Souvenir cum abstract on International Seminar on Tran's boundary Pest Management (ISTPM 2020) during 4-5th March, 2020 at TNAU, Coimbatore, TNAU, offset Printers, Pp.336-337.
- Ganesan, K and Somasundaram, E (2020). Management of palm civet in coconut, Souvenir cum abstract on International Seminar on Tran's boundary Pest Management (ISTPM 2020) during 4-5th March, 2020 at TNAU, Coimbatore, TNAU offset Printers, Pp.371-372.
- Somasundaram, E., Udhaya nandhini, D., and N. Ravisankar (2020) Metabolomic analysis, functional group identification and complete characterization of Panchagavya (organic foliar nutrition) (Prepared for submission to IJAS after University approval)
- Somasundaram, E., Ganesan, Ravisankar, N and A. S. Panwar (2020). Integrated organic farming system approach to sustain productivity, income and employment of marginal farm holdings of Southern India (Prepared for submission to IJAS after University approval)
- Udhaya nandhini, D., Somasundaram, E and N. Ravisankar (2020) Identification of organic functional groups and proximate analysis of crop residues for sustainable organic farming (Prepared for submission to IJAS after University approval)
- TNAU Newsletter on One day training programme on organic agriculture
- Mandate of Department of Sustainable Organic Agriculture
- Objectives of PGS
- Panchagavya preparation
- Vermicompost article.

Ludhiana

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- Walia, S.S., Kaur T. and Aulakh, C.S. 2019. Rice residue management: An environment friendly approach. *Progressive Farming* 55 (11): 9-12
- Walia, S.S., Kaur T. and Aulakh, C.S. 2019. Jhone di rehind-khuhnd di sambhal vatavarn hiteshi hai. *Changi Kheti* 55 (11): 6-7



Raipur

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- डॉ. वैषाली शर्मा ,कृतिका डोंगरे एवं डॉ. एस.एस. पोर्ते (2019) फसल उत्पादन में सूक्ष्म पोषक तत्वों का उपयोग सूक्ष्म लेकिन आवश्यक । पृ.क.13 छत्तीसगढ़ कृषि वानिकी, जुलाई 2019
- कृतिका डोंगरे , डॉ. डी.एस. ठाकुर एवं एस.एस.पोर्ते (2019) किसान भाई धान फसल की खेत में खरपतवार का प्रबंधन कब और कैसे करें पृ.क.14 छत्तीसगढ़ कृषि वानिकी, जुलाई 2019
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- कृतिका डोंगरे , डॉ. डी.एस. ठाकुर एवं एस.एस.पोर्ते (2019) किसान भाई ,जिमीकन्द का अचार वैज्ञानिक तकनीकि से बनाकर अधिक लाभ कैसे पाए पृ.क.17. छत्तीसगढ़ कृषि वानिकी ,जुलाई 2019
- डॉ.एस.एस. पोर्ते,डॉ.कोमल सिंह केराम एवं कृतिका डोंगरे (2019) किसान भाई धान के खेत में हरी खाद का प्रयोग कब और कैसे करें । पृ.क.28.छत्तीसगढ़ कृषि वानिकी ,जुलाई 2019
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Ajmer

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- G. Lal, N.K. Meena, R.D. Meena, N. Choudhary, M.K. Choudhary and Neha Shekhawat. 2019. Performance of coriander varieties under organic production system. Published by Dr. Gopal Lal, Director & PI, AI-NPOF, ICAR-NRCSS, Ajmer.
- G. Lal, N.K. Meena, R.D. Meena, N. Choudhary, M.K. Choudhary and Neha Shekhawat. 2019. Best Performing varieties of green gram under organic production system. Published by Dr. Gopal Lal, Director & PI, AI-NPOF, ICAR-NRCSS, Ajmer.
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- G. Lal, A.S. Panwar, N. Ravisankar, N. Choudhary, Neha Shekhawat and M.K. Choudhary. 2019. Different products of organically produced cumin. Published by Gopal Lal, Director & PI, AI-NPOF, ICAR-NRCSS, Ajmer.
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- Lal, G., Shekhawat Neha, Choudhary, M.K., Choudhary, G.R. and Chaudhary, N. 2020. Jal-Jeera: Jeere ka sayhatmand sasyother prabandhan. *Masala surbhi*, (1): 62-64.
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- Meena, R.D., Lal, G., Meena, N.K., Chaudhary, N. and Tripathi, G.K (2019). Ecofriendly management of diseases in fennel (in Hindi). In: *Masala Surabhi* (Hindi Rajbhasa Patrika), July- December, 2019, Published by Director, ICAR-NRCSS, Ajmer. pp 46-49.

S K Nagar

- A. H. Chaudhary, R. M. Patel and R. R. Patel (2019). Impacts of Sprinkler Irrigation System on Groundnut Production in Deesa Taluka of Banaskantha District. Compendium, SEEG-2019, Gujarat, pp: 268.
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- Dr. K. M. Patel, Dr. L. J. Desai, Dr. K. N. Patel, Dr. S. A. Patel and Dr. H. L. Chaudhari (2019). Jaivik Khataronu Sajivkhetima Mahatva. Book Chapter (ISBN NO., 978-93-5382-551-5), Pp. 45-55.
- Dr. L. J. Desai, Dr. K. M. Patel, Dr. S. A. Patel, Dr. H. L. Chaudhari and Dr. K. N. Patel (2019). Sendriya Khetima Lila Padvashnu Mahatva. Book Chapter (ISBN NO., 978-93-5382-551-5), Pp. 40-44.
- Dr. L. J. Desai, Dr. K. N. Patel, P. K. Patel, V. K. Patel and H. L. Chaudhary (2020). Azolla: Sankalit Kheti Padhhati nu Ghatak, Published by: Chief Agronomist, IFS, SDAU, Sardarkrushinagar. University Publication No. 3:4:981/2020. Pp. 1-8.
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Udaipur

- Arvind Verma, Roshan Choudhary and Gangaram Mali (2019). Rabi ki Faslo main Kharpatwar prabjanan, Rajastahn Kheti Pratap, pp 11-13.
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- B.S.S. Siddhartha Naik, Sharvan Kumar Yadav, Shanti Kumar Sharma, Roshan Choudhary, Ravindra Kumar Jain and Rekha Vyas (2019). Panchagavya: A Better Way to Enhance the Income of Farmer, डी ओ आर, एमपीयूएटी, 2019/05.
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- Roshan Choudhary, Arvind Verma, S. K. Sharma, R. S. Choudhary & Rajesh Chaudhari (2019). Swasthiya prahari aum gunvattapurn Jayad Moong ki fasal- Samnivit kharpartwar prabhandan, Krishi Bharati, PP.6-9.
- Sharvan Kumar Yadav, B.S.S. Siddhartha Naik, Shanti Kumar Sharma, Roshan Choudhary, Ravindra Kumar Jain and Rekha Vyas (2019). NADEP Compost Technology: Preparation of Large Amount of Compost by Using Less Amount of Cowdung, डी ओ आर, एमपीयूएटी, 2019/06.
- Shanti Kumar Sharma, B.S.S. Siddhartha Naik, Dr Sharvan Kumar Yadav, Dr Ravindra Kumar Jain, Dr Roshan Choudhary, and Dr Rekha Vyas (2019). Jeevamrut and Beejamrut: The Great Part and Parcel of Soil and Seed, डी ओ आर, एमपीयूएटी, 2019/06.

8.1.3 Books/ Book Chapter/ Bulletins/Mannual

Bhopal

- Singh, A.B., B. L. Lakaria, B. P. Meena, S. Ramana, J. K. Thakur, P. S. Rajput, M. C. Manna, A. K. Tripathi and A. K. Patra (2020). Jaivi kkhethi me same kit poushaktatao prabandhan. Mridas wasthya Aalok.32-45.
- Singh, A. B., B. L. Lakaria, B. P. Meena, S. Ramana, J. K. Thakur, P. S. Rajput, M. C. Manna, A. K. Tripathi and A. K. Patra (2020). Jaivik kheti me Phasalut padan ki gunvatta ka mulyankan.Mrida Swasth Aalok. 56-62.

Coimbatore

- Developed organic farming technologies for the Rice, Maize and Cotton crops to the Crop Production Guide 2019.
- Hilly organic vegetables crop production guide was prepared and submitted to Director of Research and Dean (Horti), TNAU, Coimbatore.

Jabalpur

- Dr. P.B. Sharma (2020). Practical manual on Rainfed Agriculture and Watershed Management, JNKVV publication under publication.
- Dr. P.B. Sharma, M.L. Kewat and Neelam Bisen (2020). Practical Manual on Water Management, JNKVV publication under publication.
- Dr. Vinita Parte and Dr. Rajendra Prasad Sahu (2020). A practical manual on crop production technology-I (Kharif Crops), JNKVV publication pp. 44.
- Dr. Rajendra Prasad Sahu (2020). Cost of cultivation under organic production system chapter in Manual on organic farming, JNKVV publication under publication.

Ludhiana

- Aulakh, C.S. and Walia, S.S. 2019. Jevik Kheti. Punjab Agricultural University, Ludhiana. pp 64.

Udaipur

- Devendra Jain, Ram Hari Meena, Arunabh Joshi, Gajanand Jat, Ali Asger Bhojiya and Surya Chauhan (2019). Manual on Biofertilizer Research (Laboratory to commercial Production), Apex publication House, Udaipur, ISBN (10) 81-301-00874.
- Dr. S. K. Sharma, Dr. Latika Vyas, Dr. Vishaka, Dr. Roshan Choudhary, Dr. Arvind Verma, Dr. R. N. Bunkar, Dr. Hari Singh, Dr. P. S. Dudi & Er. Manjeet Singh (2019). Cultivating Emotional intelligence among Students for Achieving Success, under IDP, NAHEP, RCA, MPUAT, Udaipur, MPUAT /DR/ 01/50.
- Dr. S K Sharma, Dr Roshan Choudhary, Dr Gajanand Jat, Dr R.S. Choudhary etc. (2020). Organic Farming: Introduction, Input Production, Protocol, Input Quality and Techniques under RKVY, DoR, MPUAT, 02/2020/115.
- Dr. S K Sharma et al. (2020). कृषि मौसम सम्बन्धि जानकारी, under ICAR-SCSP, MPUAT, Udaipur, MPUAT/DR/SCSP/01/30.
- Dr. S K Sharma et al. (2020). कृषि मौसम की जानकारी के लिए आवश्यक वैज्ञानिक पहल, under ICAR-SCSP, MPUAT, Udaipur, MPUAT/DR/SCSP/02/50.
- Jagdish Choudhary, S.K. Sharma, S. S. Lakhawat, D. P. S. Dudi, Gajanand Jat and Urmila (2020). लवणीय एवं क्षारीय मृदा में फसलोत्पादन हेतु नवीन तकनीक, DOR, MPUAT, Udaipur, pg. 45.
- R S Choudhary, S K Sharma, Arunabh Joshi and Roshan Choudhary (2019) Krishi me Udhmita-Navachar evm Bhavi Stat Krishi Rannitiya, under IDP, NAHEP, RCA, MPUAT, Udaipur, pag. 35.
- Srivastava, M., Vyas, R and Sharma. S. K. 2020. Gender Sensitization: Prospects, Challenges and Strategies.IDP, NAHEP, Social & Environmental Safeguards, ICAR New Delhi, CCAS, MPUAT, Udaipur.



- S.K. Sharma, Roshan Choudhary, GajananadJat, R. S. Choudhary, Amit Triwedi, B.G. Chhipa, Hemant Swami, R. K. Jain and S. K. Yadav (2019) Bulletin: Knowledge and skill development in organic farming, IDP, NAHEP MPUAT, Udaipur.
- Vyas, R and Sharma. S. K. 2019. Krishi Udhymita: KoshalaivmAjivika Vikas, MPUAT, Udaipur pp 136.
- Vyas, R and Sharma. S. K. 2020. Technologies and Innovations in Agriculture, MPUAT, Udaipur. pp 248.

8.1.4. Paper presented in International/National Seminar /Conferences/ Symposium/ Workshop.

Bhopal

- Dr AB Singh, Dr AshaSahu and Dr R H Wanjari (2019). Global Organic Convention on Natural Resource Management for Sustainable Agriculture, Soil Health and Quality food, Hotel Le Meridian Nagpur, September, 15-17, 2019.
- Dr AB Singh (2019). 14th Annual Group Meeting of AI-NPOF, ICAR-Central Island Agricultural Research Institute, Port Blair, November, 12-14, 2019.
- Dr AB Singh (2019). National Seminar on Developments in Soil Science-2019, BHU, Varanasi, November, 15-18, 2019.
- Dr AB Singh (2019). KisanSangosthi, KVK Betul, November, 28-29, 2019.
- Dr AB Singh (2019). One day Workshop on Bio-waste Resource Management for Sustainable Agriculture, ICAR-IISS, Bhopal, December, 10, 2019.
- Dr AB Singh (2019). Workshop on Rabi crops, ICAR-CIAE, November, 7, 2019.
- Dr AB Singh (2019). Two days Training Cum Workshop, KVK Badwani, February, 24-25, 2020.

Jabalpur

- Attended Farmer's-scientist discussion/interaction (DES hall) on dated 16-10-2019.
- A review meeting attended to discuss the administrative, technical and financial issues related to AICRP-IFS and NPOF centres operated at JNKVV, Jabalpur.
- Meeting by Hon'ble VC on ZBNF at ELP 'Organic Farming' JNKVV on dated 9-10-2019
- Meeting for ZBNF by Hon'ble VC (DRS hall) of all heads, Deans, Directors on dated 4-11-2019
- Workshop on teaching improvement (Agronomy), held at Biofertilizer Lab podium 8 & 9 August 2019.
- ZBNF model visited at Kurutshetra, Hariyana on dated 20-23, October 2019

Ludhiana

- AICRP-IFS and AINPOF review meeting by DDG (NRM)-ICAR, Modipuram, 26 May, 2020.
- Annual Project Review meeting of Biotech-KISAN project, 'Establishment of Biotech-KISAN hub at PAU Ludhiana, DBT, New Delhi, 29 April 2020.
- Brain storming on Technologies for promotion of organic and natural farming practices in Islands, Port Blair, A&N Islands, 14 Nov., 2019
- Interactive video conference on, "Changing dimensions of Agri marketing in post COVID-19", PHDCCI, Chandigarh, 14 May, 2020.
- Webinar on 'NeGD LMS Workshop for Agricultural Universities in ICAR' under Digital India Programme, Govt of India, ICAR, New Delhi.



- Workshop on “Awareness for Environment protection” PAU, Punjab Pollution Control Board, Department of Science, Technology and Environment, Govt. of Punjab, Feb., 2020.

Pantnagar

- D.K.Singh, Shilpi Gupta, S.K.Yadav, Gangadhar Nanda and Yogesh Sharma. 2018. Economic Sustainability of small and marginal farmers through Organics. In: XXI Binneal National Symposium of Indian Society of Agronomy organized by MPUAT, Udaipur, Rajasthan during 24-26 October. pp 533-534.
- D.K.Singh, Shilpi Gupta, Yogesh Sharma, Dipti Bisariya, and Gangadhar Nanda. 2018. Organic farming: A probable way towards second green revolution in low productive areas of India. In: Proceedings of National Agronomy Congress on Redesigning Agronomy for Nature Conservation and Economic empowerment organized by College of Agriculture, G.B. Pant University of Agriculture and Technology, Pantnagar during 20-22 February. pp 216-219.

Ajmer

- Lal, G., Lal, S., Shekhawat, and Neha Choudhary, M.K. 2019. Value addition in cumin for higher profitability and entrepreneurship development. In: Souvenir of 3rd Global meet on science and technology for ensuring food and nutritional security (GMST-2019), organised by Hi Tech Horticultural Society during 01-03, December, 2019 at ICARNRCSS, Ajmer. Pp.184.
- Lal, G., Meena, N.K., Chaudhary, N., Choudhary, M.K. and Shekhawat, Neha. 2019. Performance of coriander (*Coriandrum sativum* L.) varieties under organic production system. In: Souvenir of 3rd Global meet on science and technology for ensuring food and nutritional security (GMST-2019), organised by Hi Tech Horticultural Society during 0103, December, 2019 at ICAR-NRCSS, Ajmer.Pp.182.
- Meena, N. K., Lal, G., Kant, K. and Meena, R. S. 2019. Pollination management in seed spices. In Souvenir of State Level Seminar on Clean and Safe Production of Seed Spices for Enhancing Farmers' Income, jointly organized by ICAR-NRC on Seed Spices, Ajmer and DASD, Calicut held at ICAR-NRCSS, Ajmer during 27-28 March, 2019, pp 91-95.
- Meena, R. S., Lal, G. and Meena, N. K. 2019. Quality seed production of seed spices. In Souvenir of State Level Seminar on Clean and Safe Production of Seed Spices for Enhancing Farmers' Income, jointly organized by ICAR-NRC on Seed Spices, Ajmer and DASD, Calicut held at ICAR-NRCSS, Ajmer during 27-28 March, 2019, pp 22-26.

S K Nagar

- ZREAC and Agresco meeting were attended

Uaipur

- Dr. Roshan Choudhary, Assistant Professor, Participation & Oral presentation in International Conference on 27th Asian-Pacific Weed Science Society Conference on topic “Three Tier Management Practices for effective Organic Weed Management in Sweet Corn held at Riverside Majestic Hotel, Kuching, Sarawak, Malaysia from 3-6 September, 2019.
- Dr. Roshan Choudhary participated in International Conference on 27th Asian-Pacific Weed Science Society Conference on Weed Science for Sustainable Agriculture and Environment at Riverside Majestic Hotel, Kuching, and Sarawak, Malaysia from 3-6 September, 2019.
- Dr. Roshan Choudhary Participated in in Agronomist meet and student contest at CCSHAU, Hisar from 30-31 January, 2020 organized by Haryana Agronomist Association (Agronomy), CCSHAU, Hisar & International Weed Science Society's.
- Dr. Roshan Choudhary participated in ISWS Biennial Conference on “Weed management for enhancing farmers' income and food security” being organized at ICAR- Central Coastal Agricultural Research, Institute, Goa (India) from 5-7 February 2020.
- Dr. Roshan Choudhary attended in five days Faculty Development Programme (Online Short Term) on Teaching tools to Knockdown the lockdown organized by College of Agriculture, Balaghat Jawaharlal Nehru Krishi Vishwa Vidyalaya from 16 to 20 May, 2020.



- Dr. S.K. Sharma, Dr. Roshan Choudhary, Devendra Jain, Hemant Swami and Dr. Gajanand Jat Participated in National webinar on Scope and Scenario of Agriculture after COVID-19 organized by MPUAT, Udaipur on 29 May, 2020.
- Dr. Roshan Choudhary, participated in the World food safety day commemorative webinar on Pandemics and Hunger Mainstreaming Millets for addressing Food and Nutritional Security on 08 June, 2020 organized by Department of Plant Sciences, School of life Sciences, university of Hyderabad, Telangana, India.
- Dr. S.K. Sharma, Dr. Roshan Choudhary, Devendra Jain and Dr. Gajanand Jat participated in National webinar on Agriculture and Food security beyond COVID-19 organized by Rajasthan College of Agriculture, MPUAT, Udaipur on 22 June, 2020.
- Dr. S.K. Sharma, Dr. Roshan Choudhary and Dr. Gajanand Jat Participated in two days National workshop on National Workshop on Research Methodology: Concepts & Applications organized by Directorate of student's welfare, MPUAT, Udaipur from 26-27 June, 2020.
- Dr. S.K. Sharma, Dr. Roshan Choudhary and Dr. Gajanand Jat Participated in Organic Mahotsav during 29th November to 1st December, 2019 organized by Organic Farming Association of India (OFAI) & Banyan Roots at Shilap Gram, Udaipur (Raj.)
- Roshan Choudhary, Arvind Verma, S.K. Sharma and R.S. Choudhary Three tier management practices for effective organic weed management in sweet corn In 27th Asian-Pacific Weed Science Society Conference on "Weed science for sustainable agriculture and environment" at Sarwak, Malaysia. 3-6 September, 2019.
- R. S. Choudhary, Roshan Choudhary, S. K. Sharma and P. B. Singh Sustainability soil health through organic farming International Conference on "Innovative and Current Advances in Agriculture and Allied Sciences (ICAAAS-2020)" held at Bangkok, Thailand from 27 January – 01 February, 2020.
- Roshan Choudhary, S. K. Sharma, Rajesh Chaudhari, R. S. Choudhary, Arvind Verma, Gajanand Jat, B. G. Chhipa and S. K. Yadav Reorientation of Local Food System for Better Wellbeing and Quality Resources: A need of Post COVID-19 National webinar on Scope and Scenario of Agriculture after COVID-19 at MPUAT, Udaipur on 29th May, 2020.

8.1.5. AWARDS

Udaipur

- Best Thesis Award under Organic farming Dr. Sharvan Kumar Yadav received during International Conference on "Innovative and Current Advances in Agriculture and Allied Sciences (ICAAAS-2020)" held at Bangkok, Thailand from 27 January – 01 February, 2020.
- Best Article Award For article id 31451 entitled "Options and Way Forward for Reducing the Menace of Parthenium" to Roshan Choudhary, R. S. Choudhary, S. K. Sharma and Arvind Verma published in Agriculture & Food: eNewsletter
- Best Article Award For article id 31144 entitled "Agricultural Productivity and Challenges in Sustaining Resource Base" to R. S. Choudhary, Roshan Choudhary, S. K. Sharma and Omika Choudhary published in Agriculture & Food: e-Newsletter.
- Young Scientist Travel Grant Award Dr. Roshan Choudhary received by Indian Society of Weed Science, ICAR-Directorate of Weed Research (ICARDWR), Jabalpur For attending a conference in the subject of weed science for the year 2019-20 to attend International conference on weed Science for Sustainable Agriculture and Environment at Kuching, Sarawak, Malaysia during 36 September 2019.
- Reviewer Excellence Award Dr. Roshan Choudhary received by Indian Journal of Agriculture Research, In recognition of significant and outstanding contribution to the Journal and reviewing the article. Article Title: - Weed dynamics and productivity of direct wet seeded rice under different weed management practices, 2020.
- Woman Scientist Award Dr. Roshan Choudhary received for outstanding contribution in the field of Agronomy during International Conference on "Innovative and Current Advances in Agriculture and Allied Sciences (ICAAAS-2020)" held at Bangkok, Thailand from 27 January – 01 February, 2020.

8.1.6. Lecturers

Jabalpur

- Dhan/pigeonpea/SRI/SPI/Rabi season field preparation/water management/organic farming/organic manures Utpadan Teknik in ATMA Pathshala in different villages (Bheeta, Kudan, Nichi) of, Jabalpur in July, Sept., Oct., November 2019.
- Field visit on Integrated Farming Systems in Refresher Training on New Production Techniques for Agriculture Development under RKVY, DES, JNKVV (17-19, Feb 2020).
- Training on Natural Resource Management organized by COAE, Jabalpur on 20-22 Jan 2020. Integrated Farming System; Principles and advantages with field visit, management of major rabi crops.
- Training on Integrated Nutrient Management for sustainable soil health organized by KVK, Jabalpur w.e.f. 29 Jan to 7 Feb 2020. Water management in wheat, Field visit to IFS.
- Vocational Training on Organic Farming organized by RCOF, Jabalpur, Field visit to IFS.
- Training lecture on Integrated Farming Systems in Refresher Training on New Production Techniques for Agriculture Development under RKVY, DES, JNKVV (24-26 Feb 2020).
- Field visit on Integrated Farming Systems of Professors, Scientists and scholars of Archetacture, Institute Bhopal (Feb 2020).
- Lectures in Business Planning and Development MANAGE programme at JNKVV, Jabalpur during the year.
- Training lecture on Organic farming and field visit in Certification course organized by Regional centre for Organic Farming, Jabalpur.
- Training lectures (05) on Organic farming, vermiculture and their species, feeding materials, composting methods, structure, pest & predators, collection and storage field visit of trainees of skill development training on 'vermicompost producer' organized at KVK, Jabalpur dated 10, Feb 2020 to 10, March 2020.
- Year round Fodder/azolla production, bhusa making plan for Instructional Dairy Unit, JNKVV, Jabalpur.

Ludhiana

- Major problems in organic agriculture: Experience transmission. In: Winter school on Ecological perspectives in Arthropod pest management for sustainable crop production. Deptt of Entomology, PAU Ludhiana, 19.11.19 - 9.12.19.
- Natural farming research in PAU Ludhiana. In: 2nd meeting (Online) of Committee on empirically validating the results of SPNF model. ICAR Committee 20 June, 2020.
- Natural farming: Prospects and constrains. In: 10th Regional Advisory Group deliberations on farm and rural sector organized by NABARD at Chandigarh, 4 Feb., 2020.
- Role of organic farming for enhancing soil health and food quality. In: CAFT on Assessing soil plant atmosphere continuum (SPAC) for enhanced input use efficiency. Deptt of Soil Science, PAU Ludhiana, 1-21, 14 Oct., 2019.
- Organic farming for producing safe food. In: Training programme on "Food safety and nutritional security" organized by PAMETI, PAU campus, Ludhiana
- Organic Farming: Concept and Principles. In: Training programme on "Organic and Integrated farming for sustainable development in livestock sector" organized by PAMETI, PAU campus, Ludhiana, 21 January, 2019.
- Organic farming: Research experiences and prospects in India. In: National webinar on "Approaches towards development of rural and agriculture sector in the present scenario". 8-9.5.2020. Organised by JNKVV College of Agriculture Tikamgarh, JNKVV Jabalpur (MP)
- Organic food: Challenges and opportunities in post COVID-19 scenario. In: Interactive video conference on, 'Changing dimensions of Agri marketing in post COVID-19 by PHDCCI, Chandigarh, 14 May, 2020.



- Prospects and constraints of organic farming in high input agricultural areas. In: National Webinar on Organic Farming-2020. Organized by College of Agriculture Balaghat, JNKVV Jabalpur, MP. 16-20 June, 2020

Ajmer

- Meena, N.K., Lal, G., Kant, K. and Meena, R.S. 2019. Pollination management in seed spices. In: State Level Seminar on "Clean and Safe Production of Seed Spices for Enhancing Farmers' Income" Jointly organized by ICAR-NRC on Seed Spices, Ajmer and DASD, Calicut held at ICAR-NRCSS, Ajmer during 27-28 March, 2019.
- Lal, G., Choudhary, N., Lal, S. And Verma, A.K. 2019. "Organic seed spices: challenges and opportunities" In: State Level Seminar on "Clean and Safe Production of Seed Spices for Enhancing Farmers' Income" Jointly organized by ICAR-NRC on Seed Spices, Ajmer and DASD, Calicut held at ICAR-NRCSS, Ajmer during 27-28 March, 2019.
- Lal, G. And Verma, A.K. 2019. "Value Chain in Seed Spices" in technical session VI –B (Production Technology-Conventional Horticulture). In: 8th Indian Horticulture Congress Shaping Future of Indian Horticulture at IGKV, Raipur, Chattishgarh, 17-21st, January, 2019 organized by Horticulture Society of India, New Delhi.
- Lal, G., Meena S.S. and Lal, S. 2019. "Seed Spices as Medicine in Wellness Industry" In: National Seminar cum Interactive Workshop on "Noni and Medicinal Plants in Human Wellness during, 23 - 24 March, 2019.
- Lal, G., Choudhary, N., Lal, S. And Verma, A.K. 2019. "Organic seed spices: challenges and opportunities" In: State Level Seminar on "Clean and Safe Production of Seed Spices for Enhancing Farmers' Income" Jointly organized by ICAR-NRC on Seed Spices, Ajmer and DASD, Calicut held at ICAR-NRCSS, Ajmer during 27-28 March, 2019.
- Lal, G., Verma, A.K. and Choudhary, M.K. 2019. "Climate resilient technologies for seed spices" technical session VII- Sustainable intensification & Diversifications (Arid Horticulture, Aquaculture, Protected Agriculture) Production Technology-Conventional Horticulture). In: 13th International conference on development of drylands: Converting Dryland Areas from Grey into Green during 11-14 February, 2019. Pp. 157-161.
- Lal, G., Meena, R.S. and Lal, S. 2019. "Biodiversity of seed Spices: Status and opportunities under changing climatic scenario". In: 13th International conference on development of drylands: Converting Dryland Areas from Grey into Green during 11-14 February, 2019. Pp. 45-47.

Udaipur

- Application, IASRI, Pusa, New Delhi. Dr. Roshan Choudhary, Dr. S.K. Sharma and Dr. R.S. Choudhary NADEP Compost Method of Preparation and Uses, CAFT on Org. Farming, 1-21 June, 2019
- Chhipa, B. G., Sharma, S.K., Choudhary, R. and Yadav, S. K. 2019. Practices for Cultivation of Guava. In: Productivity, Economics and Environmental Performance in Organic Agriculture ICAR, New Delhi Division of Computer Application, IASRI, Pusa, New Delhi.
- Choudhary, R., Sharma, S. K. and Dudhwal, K. 2019. Vermicomposting in Organic Farming. In: Productivity, Economics and Environmental Performance in Organic Agriculture ICAR, New Delhi Division of Computer Application, IASRI, Pusa, New Delhi.
- Choudhary, R., Sharma, S. K. and Dudhwal, K. 2019. Use of NADEP Compost in Organic Farming. In: Productivity, Economics and Environmental Performance in Organic Agriculture ICAR, New Delhi Division of Computer Application, IASRI, Pusa, New Delhi.
- Choudhary, R and Sharma, S. K. 2019. Use of Plastic Mulch to Enhance Productivity and Profitability in Agriculture. In: Productivity, Economics and Environmental Performance in Organic Agriculture ICAR, New Delhi Division of Computer Application, IASRI, Pusa, New Delhi.
- Sharma, S. K., Choudhary, R. and Chhipa, B. G. 2019. Organic Food and Impact on Human Health. In: Productivity, Economics and Environmental Performance in Organic Agriculture ICAR, New Delhi Division of Computer Application, IASRI, Pusa, New Delhi.
- Sharma, S. K., Choudhary, R. Jain, D and Praveen. 2019. Use of Panchagavya in Organic Farming. In: Productivity, Economics and Environmental Performance in Organic Agriculture ICAR, New Delhi Division of Computer Application, IASRI, Pusa, New Delhi.

- Sharma, S. K., Choudhary, R., Chhipa, B. G., Praveen and Yadav, S. K. 2019. Role of Organic Agriculture to Adapt and Mitigate Effect of Climate Change. In: Productivity, Economics and Environmental Performance in Organic Agriculture ICAR, New Delhi Division of Computer Application, IASRI, Pusa, New Delhi.
- Sharma, S. K. and Choudhary, R. 2019. Use of PROM in Organic Agriculture. In: Productivity, Economics and Environmental Performance in Organic Agriculture ICAR, New Delhi Division of Computer Application, IASRI, Pusa, New Delhi.
- Sharma, S. K., Choudhary, R., Yadav, S. K. and Jain, R.K. 2019. Organic Certification: Concept and Management Aspects. In: Productivity, Economics and Environmental Performance in Organic Agriculture ICAR, New Delhi Division of Computer Application, IASRI, Pusa, New Delhi.
- Sharma, S. K., Choudhary, R. and Chhipa, B. G. 2019. Organic Agriculture and Participatory Guarantee Systems: Present Status & Way Forward. In: Productivity, Economics and Environmental Performance in Organic Agriculture ICAR, New Delhi Division of Computer Application, IASRI, Pusa, New Delhi.
- Sharma, S. K., Choudhary, R., Gajanand, Chhipa, B. G. and Jain, R. K. 2019. Public Standards and Legislation in Organic Agriculture. In: Productivity, Economics and Environmental Performance in Organic Agriculture ICAR, New Delhi Division of Computer Application, IASRI, Pusa, New Delhi.
- Sharma, S. K. and Choudhary, R. 2019. Policies in Organic Agriculture. In: Productivity, Economics and Environmental Performance in Organic Agriculture ICAR, New Delhi Division of Computer Application, IASRI, Pusa, New Delhi.
- Sharma, S. K., Choudhary, R., Jain, R. K., Yadav, S. K. and Praveen. 2019. World Organic Food Market, Challenges & Outlook. In: Productivity, Economics and Environmental Performance in Organic Agriculture ICAR, New Delhi Division of Computer Application, IASRI, Pusa, New Delhi.
- Sharma, S. K., Choudhary, R. and Chhipa, B. G. 2019. Organic Agriculture: History, Concept and Principles. In: Productivity, Economics and Environmental Performance in Organic Agriculture ICAR, New Delhi Division of Computer

8.1.7. Details of M.Sc. and Ph.D degree awarded based on the project work

Jabalpur

M. Sc. Students guided s

Name of student	Title of thesis
Ms. Iram Naj	Response of soybean to irrigation and nitrogen management for higher growth and yield
Ms Priya Kochle	Efficacy of post emergence herbicides for weed control in transplanted rice
Bankerlang Khengwir	Effect of weed control treatments on growth and yield of transplanted rice
Shyamali Upadhyay	Evaluation of nicosulfuron (SL-950) 6% OD in maize crop against weeds
Mahendra Anjana	Productivity and grain quality parameters of different varieties of rice
Girdhari Nargave	Influence of varying environment on rice varieties under upland condition
Pinki Mehra	Evaluation of Productivity and grain quality parameters of different rice varieties
Pratap Jamre	Bio-efficacy of herbicide mixtures against mixed weed flora and seed yield of soybean [Glycine max (L.) Merrill.]
Shritama Bhunia	Irrigation and Sulphur management in linseed
Richa Singh	Evaluation of Productivity and grain quality parameters of different wheat varieties
Rahul Verma	Diversification of Rabi crops for higher productivity and economics in Central India
Jitendra Sisodiya	Wheat + mustard intercropping



Ph. D Students Guided

Name of student	Title of thesis
Vijay Kumar	Diversification and intensification of rice based cropping system for higher productivity and economics in Central India
Ms. Aparna Sharma	Evaluation of Productivity and grain quality parameters of different rice varieties
U.S. Dhakad	Response of Quinoa to weed and nutrient management
Manas Mohan Setha	Productivity of Wheat + mustard intercropping under varying levels of irrigation and row proportions
Ms. Anamika Jain Badkul	Response of linseed to varying irrigation levels and nutrient management
Puspendra Singh Yadav	Response of Berseem to weed management practices under varying environment

Raipur

S. No.	Name	M. Sc. (Ag)		Ph. D	
		Chairman	Member	Chairman	Member
1	Dr. M.C. Bhambri, Chief Agronomist	2	3	3	3
2	Dr. Sunil Kumar, Sr. scientist (Agronomy)	2	6	2	2
3	Dr. S.S. Porte, Sr. scientist (Soil science)	3	12	-	5

S K Nagar

SN	Particulars	Awarded Degree	Responsibilities
1	Guide one Student of Agronomy	Ph.D. (Agronomy)	Act as Minor Advisor
2	Guide one Student of Agronomy	M.Sc (Agronomy)	Act as Minor Advisor
3	Guide one Student of MBA (Agri- business Management)	MBA (ABM)	Act as Minor Advisor
4	Guide two Student of M.Sc. (Agricultural Economics)	M.Sc. (Agril. Economics)	Act as Major Advisor

8.2.1. Human Resource Development

Bhopal

- Farmers/ Extension workers/ Students visited the Institute.

S. No.	Department	Number of participants	Period
1.	Project Director ATMA, Raisen, Madhya Pradesh	20 Input Dealers	28/09/2019
2	Project Director ATMA, Sehore, Madhya Pradesh	25 Input Dealers	28/09/2019

S. No.	Department	Number of participants	Period
3	Office of Deputy Director Agriculture Evam Project Director ATMA, Dausa, Rajasthan	50 Progressive farmers	14/12/2019
4	BSSS College Bhopal	50 students	02/12/2019
5	ICAR-IISS Bhopal under SCSP Programme	50 SC farmers	06/11/2019
6	ICAR-IISS Bhopal under SCSP Programme	50 SC farmers	06/12/2019
7	ICAR-IISS Bhopal under SCSP Programme	50 SC farmers	18/12/2019
8	Agriculture Officer, Sub Division Betul, Madhya Pradesh under MukhyamantriKhetiTeerthYojana	27 Progressive farmers	31/12/2019
9	Office of Project Director ATMA, Farmer Welfare Evam Agriculture Development, Distt. Shivpuri, Madhya Pradesh	60 Progressive farmers	31/12/2019

World Soil Day Celebration

The ICAR- Indian Institute of Soil Science, Bhopal (Madhya Pradesh, India) celebrated 'Soil health awareness week' with great fervour and enthusiasm in the premises of the Institute, school and villages. The Institute organized a one-week long 'Soil Health Awareness' programme during 1st -7th December 2019.

Agriculture Education Day

The Institute organized the soil health awareness programme for about 100 school children of Sardar Patel Govt School, Bhopal. The scientist briefed key points on importance of Agriculture Education Day', agriculture science Soil Science, importance of soil health and its management for achieving higher crop productivity and soil sustenance. In addition to this, a quiz competition was organized on the theme 'Soil health and agriculture education day. A session on 'Scientists-student-interaction' was also conducted in which students participated enthusiastically and satisfied their queries related to soil health.



Agriculture Education Day organized at Sardar Patel Govt Secondary School, Bhopal

An exposure visit-cum-expert session on 'Soil health for sustaining soil productivity' was organized for B.Sc students of The Bhopal School of Social Sciences (BSSS), Bhopal at ICAR-IISS on 2nd December 2019. The faculty presented their views on 'soil health its impact on human health'. The faculty and students participated in the interaction session. A field visit to vermicomposting pit as well as organic farming field demonstrations was arranged in the Institute premises for the field exposure. Dr Ashok K Patra, Director, ICAR-IISS, Bhopal elaborated several issues and the importance of Agriculture Education Day, soil health in context to crop production, food security and human health in particular.



B.Sc Student from BSSS participated in the session on 'Soil health for sustaining soil productivity'

World Soil Day

A massive campaign for preserving "SOIL – Our Mother Earth", was organised on the occasion of World Soil Day on 5th December, 2019. A march-past was organized from the Institute premises to the city of Bhopal. The Scientist and other staff outfitted in the T Shirts bearing a slogan 'Stop Soil Erosion, Save our Future' given by Food and Agriculture Organization (FAO). A march past was organised in the city of Bhopal to create awareness amongst the citizen for the importance of soil for the survival of the plants, animals and human beings.



The 'World Soil Day' organised at the Institute premises and also in Bhopal city (5th December 2019)

On the same day, a farmer-scientist interaction meet was organized at village Parawalia Sadak (Dist Bhopal, M.P.) where, the renowned Soil Scientist Prof. N. N. Goswami (Ex-Vice Chancellor, CSAUAT, Kanpur, New Delhi) was present along with Prof. D.K. Das (New Delhi), Prof. H.K. Senapati (Bhubaneswar), Dr. J.C. Tarafdar (Jodhpur). On this occasion, Prof. N.N. Goswami emphasized the role of soil for the survival of the mankind and requested to start up a national movement for awareness amongst villagers to protect a precious natural resource (i.e. soil) for the future generation. He reiterated that an application of imbalanced and unscientific use of agro-chemicals resulted in degradation of soil health and occurrence of multi nutrient deficiencies in soil. Indian soils are deficient in sulphur 28%, zinc 36% and boron 23%, as per the recent study by the Indian Institute of Soil Science. This needs urgent attention to propagate balanced application of fertilizers and manures. On this occasion, soil health cards were distributed to the farmers. During the events, scientists, officials, students and about 300 farmers from nearby villages participated in this awareness program. Dr. Ashok K. Patra, Director of the Institute welcomed all experts and participants and called for wholehearted action for the cause of conserving soil and water for the prosperity of the nation.

Training Programme

A training programme on soil health management under SCSP at ICAR-IISS was organized on 6th December, 2019 under the 'Soil Health Awareness Week' with the aim to create awareness about the importance of soil health and its prime significance for sustaining crop productivity. Training was imparted to about 50 SC farmers from different villages. Dr. Ashok K. Patra, Director, ICAR-IISS Bhopal emphasized the balance nutrient management for improvement of soil health to enhance soil productivity. He also mentioned the role of organic input for improving soil and crop quality for sustaining food and nutritional quality for the future generation. In this training programme scientist of this institute delivered lectures on different topics related the soil health and crop productivity namely best agriculture management practices, organic farming, composting technologies, soil quality, agro-techniques etc. On this occasion, field visits to the field experiments and composting unit at IISS, Bhopal were also organized for the farmers.



A Training on soil health management at ICAR-IISS (6th December, 2019)

Training-cum-farmer-Scientist interactive meet was organized at Khamkheda village (Dist Bhopal) on 7/12/2019 under the umbrella of "Soil Health Awareness Week". About 100 farmers from Khamkheda as well as nearby villages participated in this training cum interactive meet with a focus on soil health. A series of discussions were conducted by scientists/experts from ICAR- Indian Institute of Soil Science, Bhopal, ICAR- Central Institute on Agriculture Engineering, Bhopal and State department of agriculture. Some farmers pointed out the problems related to agriculture which were adequately addressed by the experts. On this occasion, soil health cards were distributed to the farmers. Experts elaborated parameters mentioned on soil health cards including critical ranges and suggested the nutrient application strategies. The remedial measures were suggested based on the symptoms of plant samples brought in by a farmer.



Training-cum-Farmer-Scientist interaction organised at Khamkheda village (Dist Bhopal) on 7/12/2019

Swachchhata Pakhwada (16-31 Dec 2019):

As per the assigned activity by nodal officer of the SBM, the team led by Dr. A. B. Singh (I/C HOD Soil Biology Division) took up cleanliness drive in and around the IIS campus and waste management activity on 20.12.2019. Door to door collection of kitchen waste from IIS colony quarters was done. While collecting, the residents were requested to segregate the household waste to the possible extent and store dry waste



Segregation of kitchen waste for vermicomposting in family net vessel



Feeding the kitchen waste in family net vessel



Feeding the kitchen waste in family net vessel



Composting of agro wastes (Maize stalk)



Processing and packing of vermicompost in biodegradable bags

in blue and decomposable waste in a green box. The collected waste was segregated and decomposable material was kept in family net vessel vermicomposting unit developed by the division for recycling of kitchen waste. Also prepared vermicompost from kitchen waste of previous batch was a processed and packed in biodegradable bag mainly for kitchen gardening. The plastics and poly bags spread around the farm pond, composting pits, overhead water supply tank and children's park of residential colony were collected and placed in specified dust bean. Agro waste such as corn stalk were collected and kept in composting pit for decomposition.

Coimbatore

Name of the Training	Name of the Scientist	Date	Sponsor	Host Institution
Information and communication technologies for empowering farm women	Dr.R.Sunitha Asst. Prof. (ENS)	1.2.2019 to 6.2.2019	NAARM, Hyderabad Hyderabad	NAARM, Hyderabad Hyderabad
Winter school on Technological advance made, priorities and future strategies on Organic Agriculture for Sustainable farm production and doubling farmers Income	Dr. R. Sunitha Asst. Prof.(ENS)	03.12.2019 to 23.12.2019	UAS, Organic Farming Research Institute, University of Agricultural Sciences, Raichur, North Karnataka	UAS, Organic Farming Research Institute, University of Agricultural Sciences, Raichur, North Karnataka
Automated Weather Forecasting –Web through App	Dr.R.Jansirani Professor (Agri.Extension)	20.2.2019	ACRC,TNAU Coimbatore	TNAU Coimbatore
On farm production of biological agents and microbial bio pesticides	Dr.K.Ganesan Asst. Prof.(Ento)	13.5.2019 to 22.5.2019	IMPH, Hyderabad	IMPH, Hyderabad



Dr. N. Ravisankar's visit to AINPOF trails, Coimbatore



Jabalpur

- Monitoring visit of Sub centres (Rewa, Powarkheda, Umaria and Anuppur).
- Meeting with honorable Finance Minister Govt. of M.P. on 10-9-2019 regarding sugarcane production in Jabalpur District.
- Contingent crop plan for Kharif 2020 submitted to DRS as desired by Govt. of M.P.
- Submitted best practices under Agriculture- Integrated Farming System, as desired by NEETI Ayog Govt. of India.

S K Nagar

Many scientists, Dignitaries, Scholars and farmers visited to the Integrated Farming Systems, S.D.A.U., Sardar krushi nagar during 2019-20. Knowledge of farming systems was imparted to RAWE students of different universities and field expose was shared with farmers of different districts who occasionally visited to centre.

SN.	Date	Visitors address/Institutes/ Place	Type of Beneficiaries
1	29 th April 2019	DON BOSCO, Kapadvanj and Dakor	160 Farmers +2 staff
2	20 th July 2019	FTC, Patan	60 Farmers
3	23 th July 2019	ATMA, Kheda	51 Farmers+ 1 staff
4	7 th Aug 2019	ATMA, Patan	100 Farmers+ 3 staff
5	8 th Aug 2019	SSK, SKnagar	37 Farmers
6	19 th Aug 2019	KVK, Tharad	46 Farmers
7	27 th Aug 2019	FTC, Bhuj	35 Farmers
8	28 th Aug 2019	ATMA, Navsari	54 Farmers+ 1 staff
9	30 th Aug 2019	FTC, Deesa	44 Farmers
10	31 st Aug 2019	Vadanagar	50 Farmers
11	12 th Sep 2019	FTC, ATMA	30 Farmers
12	13 th Sep 2019	FTC, Patan	60 Farmers
13	16 th Sep 2019	ATMA, Jaipur	50 Farmers+ 2 staff
14	17 th Sep 2019	Polytechnic students	20 students + 2 staff
15	17 th Sep 2019	ATMA, Chhota Udaipur	50 Farmers+ 3 staff
16	20 Sep 2019	ATMA	20 Farmers + 1 staff
17	26 th Sep 2019	ATMA	30 Farmers + 1 staff
18	7 th Oct 2019	RAVE students, Navsari	120 students + 3 staff
19	10 th Oct 2019	FTC, Khedbrahma	48 Farmers
20	10 th Oct 2019	FTC, Deesa	30 Farmers
21	23 rd Oct 2019	KVK, Deesa	21 Farmers
22	24 th Oct 2019	FTC, Patan	60 Farmers
23	7 th Nov 2019	Karol, Prantij	32 Farmers
24	15 th Nov 2019	FTC, Deesa	31 Farmers
25	21 st Nov 2019	KVK, Tharad	34 Farmers



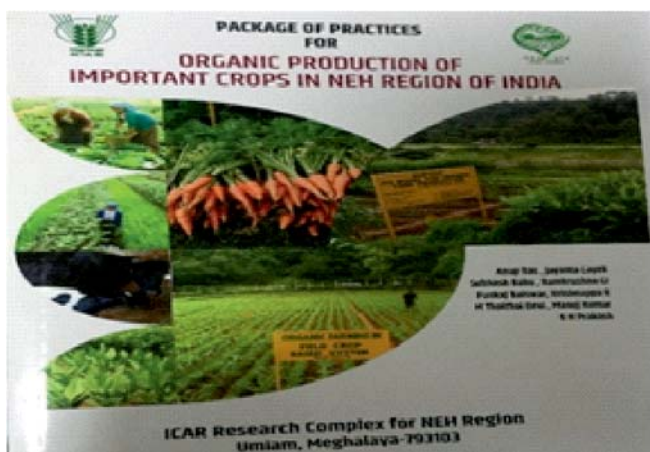
Farmers, students, scientists and trainers visited AICRP-IFS centre (2019-20)



SN.	Date	Visitors address/Institutes/ Place	Type of Beneficiaries
26	22 nd Nov 2019	ATMA, Shirohi	27 Farmers + 1 staff
27	26 th Nov 2019	FTC, Deesa	59 Farmers
28	2 nd Dec 2019	FTC, Junagadh	35 Farmers
29	7 th Dec 2019	Danta	16 Farmers
17	12 th Dec 2019	Lunavada, Mahisagar	114 Farmers
18	18 th Dec 2019	Social Welfare Foundation, Radhanpur	10 Farmers
19	31 st Dec 2019	ATMA, SDAU	41+ 3 staff
20	7 th Jan 2020	Aravalli	36 Farmers
21	16 th Jan 2020	KVK, Tharad	34 Farmers
22	17 th Jan 2020	BRS students	35 students + 2 staffs
23	31 st Jan 2020	GSFC and SSK, FYTP program	38 Farmers + 2 Staffs
24	10 th Feb 2020	ATMA, Tapi	54 Farmers + 2 Staff
25	18 th Feb 2020	Jambusar	44 Farmers
26	2 nd March 2020	Mahesana	75 Farmers
27	3 rd March 2020	SSK, SKNagar	11 Farmers
28	13 th March 2020	ICDP, Patan	29 Farmers

Umiam

Organic production technologies of 30 crops (cereals, pulses, oilseeds, vegetables etc.) were standardized under cropping system mode and a book published



Release of organic book by Hon'ble Union Minister of State for Agriculture & Farmers Welfare, Shri Kailash Choudhary and DG, ICAR, Dr. T. Mohapatra

Farm Visits



Union Minister of State for Agriculture and Farmers Welfare,
Shri Parshottam Rupala



S. Bhaskar, ADG (Agronomy, Agro-Forestry and Climate Change)



Visits of college students

Udaipur

- A. Visits:** During 2019-20, 73 exposure visits and training of farmers, extension functionaries and other stakeholders were conducted and 3173 stakeholders participated in these programmes

Technology dissemination (Visits)



Students from MMVM, Udaipur (Rajasthan) 12th October 2019



Students from Junagarh Agriculture University, Junagarh (Gujarat)
08th October 2019



Farmers of ATMA Bharuch (Gujarat) 24th September 2019



Farmers from ATMA, Chota Udepur, (Gujarat), 08th August 2019



Students from MMVM, Udaipur (Rajasthan) 12th October 2019



Students from Junagarh Agriculture University, Junagarh (Gujarat) 08th October 2019

Dignitaries visits: The details of dignitaries visiting organic farming experiments and unit are given in table.

S. No.	Date	Govt. Officials/Scientist
1.	18 th May 2018	Dr Kalp Verma, Assistant Director of Agriculture, Agriculture Department, Udaipur Division, Rajasthan
2.	02 th September 201	Monika Panjwani, Rockwoods High School Udaipur
3.	24 th July 2019	Prof John Varghese, St Stephens College, New Delhi
4.	04 th October 2019	Dr P K Singh, Director, ICAR-DWR, Jabalpur
5.	09 th November 2019	Dr. P S Pandey, ADG (Agri. Education), ICAR, New Delhi
6.	12 th December 2019	Delegates from Uganda
7.	21 th November 2019	Dr. G S Chundawat, Sr Scientist & HOD, KVK, Mandsaur, M.P.
8.	28 th November 2019	Suresh Chand, CGM, NABARD
9.	11 th March 2020	Neeraj Kumar Prajapati, Bycyle Man of Indian Agriculture.



Dr. P S Pandey, ADG (Agri. Education), ICAR, New Delhi



Neeraj Kumar Prajapati, Bycycle Man of Indian Agriculture



Delegates from Uganda



Mr. Suresh Chand, CGM, NABARD & Team



Fig. Dignitaries visits at NPOF Udaipur

Technology demonstration through exhibition in Kisan mela and other programmes:

- ICAR Sponsored 21 days CAFT training programme entitled “Productivity, Economics and Environmental Performance in Organic Agriculture” was organized during 5-25 September, 2019 at Directorate of Research, MPUAT, Udaipur. Prof. S. S. Sarangdevot, Vice-chancellor, JRN Rajasthan Vidhyapeeth University, Udaipur and Dr. N. S. Rathore, Vice-chancellor, MPUAT, Udaipur were present during the Inaugural function held on September 05, 2019 and Dr. N. S. Rathore, Vice-chancellor, MPUAT, Udaipur was the Chief Guest during the Valedictory Function held on September 25, 2019. Twenty-five scientists of 08 disciplines (Agricultural Entomology, Agronomy, Plant Pathology, Plant Physiology (Agricultural/Horticultural Crops), Soil Science-Soil Chemistry/Fertility/Microbiology, Agricultural Economics, Agricultural Extension & Horticulture) from 09 states (Assam, Bihar, Gujarat, Haryana, Jammu & Kashmir, Madhya Pradesh, Maharashtra, Punjab & Rajasthan) participated in the CAFT training programmes. Eminent Resource persons delivered 49 lectures including exposure of scientists to field and laboratory work during the training programme.



- Celebration of “World Soil Day” on December 5, 2019 at MPUAT, Udaipur. 110 Scientists, students & farmers were participated in this programme. The programme was inaugurated by Dr N S Rathore, Hon'ble Vice Chancellor, MPUAT, Udaipur.



- Celebration of “Agriculture Education Day” on December 3, 2019 at MPUAT, Udaipur. 86 Scientists, students & farmers were participated in this programme. The programme was inaugurated by Dr N S Rathore, Hon'ble Vice Chancellor, MPUAT, Udaipur.



8.2.2. Training/workshop /programme conducted:

Bhopal

- Dr A B Singh had given training on “Organic Farming and Vermicomposting techniques to enhance crop yield, grain quality and soil health on dated 29/09/2019 in Model training Course on Balanced Nutrient Management for Sustainable Crop Production and Soil Health held during 23-30, September, 2019 at ICAR-IISS, Bhopal. Twenty five participants were attended training.
- I had demonstrated the rapid composting technology to recycle city and rural waste at KVK Deoghar, Jharkhand during 29 August to 3rd September, 2019.
- I had given training on “Promotion of Soil Health for sustaining productivity at Khamkheda village” to the farmers on 07/12/2019.
- I had given training on “Organic farming and vermicomposting technique to 50 SC farmers under SCSP Plan on dated 06/12/2019 at ICAR-IISS, Bhopal.
- I had given training to the farmers on “Organic farming and soil health management in Farm School programme; arranged by Project Director ATMA at Sonkatch village, Berasia Block Bhopal on dated 07/12/2019.
- I had given training on “Organic Farming & Soil health management” For Diploma in Agricultural Extension Services for Input Dealers (DAESI) programme, organized by KrishiVigyan Kendra Raisen Run by DKVAAS, Bhopal (Madhya Pradesh) on dated 28/09/2019.
- I had given training on “Organic Farming and Composting techniques” to the farmers from Project Director Dausa Rajasthan on dated 13/12/2019. Fifty farmers were participated in the training.
- I had given training on “Organic Farming & Soil health management” For Diploma in Agricultural Extension Services for Input Dealers (DAESI) programme, organized by KrishiVigyan Kendra Dhar, on dated 20/11/2019. Thirtyfive input dealers were participated in the training.
- I had given training on “Organic Farming and vermicomposting techniques to the 150 farmers on dated 28/11/2019, arranged by KVK Betul and ICAR-IISS, Bhopal under TSP programme.
- Dr. A B Singh had given training on “Organic Farming and Vermicomposting techniques to 50 B Sc. students of BSSS College Bhopal on 02/12/2019 on Occasion of Agricultural Education day at ICAR-IISS, Bhopal.
- Dr. A B Singh had given lecture on “Soil health Management to 100 School students on 02/12/2019 on Occasion of Agricultural Education day at Sardar Patel School, Karond Bhopal.
- Dr A B Singh had given training on “Organic Farming” to the 25 candidates of Agri-Clinic and Agri- Business on dated 10/01/2019, arranged by Centre for Entrepreneurship Development, Madhya Pradesh (CEDMAP).

- Dr AB Singh had given training on “Composting of municipal solid waste, animal and farm wastes for entrepreneurship development to the 31 students of B Sc. Agriculture VIII semester of Mahatma Phule KrishiVidypeeth College of Agriculture, Pune.
- Dr AB Singh had given training on “Vermicomposting, organic farming and soil health to the 52 SC farmers from Khamkheda and Bhairapura village under SC and ST programme at ICAR- IISS Bhopal on dated 14/03/2019.
- Dr AB Singh had given training on “Organic farming and soil health” to the farmers in KisanSangosthi, arranged by Project Director, ATMA, Bhopal at Farmer Training Block Berasia. 100 Farmers were participated in the sangosthi.
- Organized 01 day training under SCSP Plan for 50 SC farmers on Organic farming and Soil Health Management on 06/11/2019 at ICAR-IISS, Bhopal
- Organized 01 day training under SCSP Plan for 50 SC farmers on Organic farming and Soil Health Management on 06/12/2019 at ICAR-IISS, Bhopal
- Organized 01 day training under SCSP Plan for 50 SC farmers on Organic farming and Soil Health Management on 18/12/2019 at ICAR-IISS, Bhopal. Farmers from Mugalia Hut and PuraChhindwara were participated in the Training.
- Organized Farmers meeting/KisanSangosthi on Soil Health Awareness Campaign under Farmer FIRST Project for 100 farmers on 07/12/2019 at Khamkheda Village. Farmers from Khamkheda, Bhairapura, Kanera and Golkhedi were participated in the programme.
- Organized World Soil Day-2019 on 5th December, 2019 at Perwalia Sadak, Bhopal (Madhya Pradesh) and Agricultural Education day on 3rd December, 2019 at ICAR-IISS, Bhopal.
- Organized oneday workshop on improving soybean yield in Central India-Potential Strategies under the aegis of NAAS-Bhopal Chapter on dated 01/10/2019 at ICAR-IISS, Bhopal.

Coimbatore

Trainings	Sponsor	Date	No.of participants
Organic Agriculture training	SPC TANII	27.06.2019	35
Organic Agriculture training	SPC TANII	04.07.2019	39
Organic Agriculture training to organic farmers under RKVY Agri - entrepreneurship programme	RKVY	05.07.2019	20
Organic Agriculture training to organic farmers	SPC TANII	19.07.2019	33
Organic Agriculture training to organic farmers	SPC TANII	02.08.2019	31
Organic Agriculture training to organic farmers	SPC TANII	09.08.2019	30
Organic Agriculture training to organic farmers	SPC TANII	22.08.2019	40
Organic Agriculture training to organic farmers –field day	SPC TANII	07.01.2020	150
Organic agriculture stakeholder meet	Core project	21.02.2020	68

Coimbatore

- Organized “Special lecture on Nutrient buffer power concept” by Dr.K.Prabakaran Nair, Formerly Professor, National Science Foundation, Kerala on 24.4.2019.
- Training on Organic Agriculture to Agricultural Officers of Maldives from 21.10.2019 to 26.10.2019.
- Organized special lecture by Sarvdaman Patel, President, Bhaikaka Krishi Kendra, Ravipura, Anand, Gujarat, on seminar on organic farming and bio dynamic India on 30.10.2019.

- Organized three days training programme on Organic Agriculture from 10.01.19 to 12.12.19 to extension officials of Tamil Nadu under SAMETI scheme.
- Organized three days training programme on Organic Agriculture from 22.01.2020 to 24.1.2020 to extension officials of Tamil Nadu under SAMETI scheme.
- Organized Organic Stakeholder Meet on 21.02.20 with coronation of TNOCD.
- Skill training in organic agriculture were conducted all over the State of Tamil Nadu in coordination with TNAU KVKs during 27.06.19, 4.07.19, 19.07.19, 02.08.19, 09.08.19 and 22.08.19. About 211 farmers were participated.
- Organized 'Field day on organic agriculture' on 07.02.20 and 09.03.20 under TANII programme. Around 400 farmers were participated in the field day.

Ludhiana

- Agronomic practices for organic cultivation of rabi crops. In: Training camp of members of PAU organic farmers club organized by School of organic farming and Skill development center, PAU, Ludhiana. 17 Oct., 2019, and participants' no-30.
- Good Agricultural Practices (GAP) standards. In: Farmers' training on Good Agricultural Practices (GAP) in wheat, PAU Ludhiana, 10 Oct., 2019, and participants' no-65.
- Marketing strategies for organic produce of club members. In: *Training camp for PAU-Organic Farmers Club*, PAU Ludhiana, 15 January 2020, and participants' no-65.
- Organic Farming: An Overview. For *RAWE students of College of Agriculture*. Department of Extension Education, PAU Ludhiana, 1 Aug. 2019, participant's farmer's no.-100.
- Organic farming standards and certification. In: Three-month skill development integrated crop production training course organized by Skill development center, PAU, Ludhiana. 19 Aug., 2019, and participants' no-20.
- Organic farming. In: *Training cum exposure visit of farmers of Jammu division of J & K UT* organized by Skill development center, PAU, Ludhiana, 01 January 2020, and participants' no-55.
- Organic standards and cultivation of field crops. In: Training on PKVY for farmer clusters of districts of Amritsar, Faridkot, Hoshiarpur, Pathankot 15 January 2020, and participants' no-65.
- PGS Certification system for organic produce. In: *Training on PKVY for farmer clusters of districts of Amritsar, Faridkot, Hoshiarpur, Pathankot*, 15 January 2020, and participants' no-65.
- Organic farming standards and certification. In: Three-month training course on integrated crop production for young farmers organized by Skill development center, PAU, Ludhiana. 16 January 2019, and participants' no-55.
- Scope of Organic cultivation. In: Training course on, "Scope of Aromatic, Medicinal and Spice crops" for farmers and farm women organized by skill development center, PAU, Ludhiana. 17 January 2020, and participants' no-20.
- Importance of Good Agricultural Practices (GAP). In: Training course on, "Pack house worker" organized by Skill development center, PAU, Ludhiana. 03 Feb., 2020, and participants' no-35.
- Organic Standards and crop production. In: Two-day training cum exposure visit of organic growers adopted by HPCL Mittal Foundation, Bathinda organized by School of Organic Farming, PAU, Ludhiana, 04 Feb., 2020, and participants' no-35.
- Tips for successful organic farming. In: Two-day training cum exposure visit of organic growers adopted by HPCL Mittal Foundation, Bathinda organized by School of Organic Farming, PAU, Ludhiana, 04 Feb., 2020, and participants' no-35.



- Organic seed production. In: *Training course on "Quality seed grower"* organized by Skill development center, PAU, Ludhiana in collaboration with ATARI-ICAR, 06 Feb., 2020, and participants' no-40.
- Scope of organic farming. In: *Training course for farmers of Kathua (J&K)* organized by skill development center, PAU, Ludhiana, 11 Feb., 2020, and participants' no-70.
- Scientific organic farming: Concepts and Principles. In: *Model training course on Integrated Farming system - An approach for climate change mitigation and natural resource management* organized by Skill development center, PAU, Ludhiana, 18 Feb., 2020, and participants' no-30.
- Organic farming: Standards and certification. In: *Two-day training course on "Organic farming & vermicomposting" for farmers and farm women* organized by School of Organic Farming, PAU, Ludhiana in collaboration with Skill development center, PAU, Ludhiana, 18 Feb., 2020, and participants' no-33.
- Organic cultivation of field crops. In: *Two-day training course on "Organic farming & vermicomposting" for farmers and farm women* organized by School of Organic Farming, PAU, Ludhiana in collaboration with Skill development center, PAU, Ludhiana, 18 Feb., 2020, and participants' no-33.
- Scope of organic farming. In: *Exposure visit of 45 students of KVM School, Ludhiana* to School of Organic Farming, PAU, Ludhiana in collaboration with skill development center, PAU, Ludhiana, 25 Feb., 2020, and participants' no-45
- Organic standards and cultivation of field crops. In: *Exposure visit of farmers of Samrala tehsil* to School of Organic Farming, PAU, Ludhiana in collaboration with KVK, Samrala (Ludhiana), 06 March 2020, and participants' no-20.

Umiam

- Field day on "No-Till Vegetable Production under AICRP - IFS (TSP) on 30 March, 2019.
- Field Day on "No-till Cultivation of Pea and Lentil in Rice Fallow and Integrated Organic Farming System (IOFS), 25 February 2020.
- Integrated Organic Farming System for Improving System Productivity and Profitability, 05 March 2020.
- Training cum awareness programme on "Integrated organic farming system for improving system productivity and profitability" at Lowland Agronomy Farm, Umiam, and 26 March, 2019.
- Two days Training Programme on "Integrated Farming Systems for Livelihood Improvement" 14-15 March, 2019.

S K Nagar

- Training programme on "Production technology of oilseed crops", "Livestock management and importance of feed and fodder", "Production technology of oilseed crops and livestock management" and "Preparation of vermin compost and management of problematic soil and water" at Aritha and Dev on 20/02/2020 and 04/03/2020.

Udaipur

- Agriculture Education Day at DOR, MPUAT, Udaipur on 3 December, 2019 and no of participants 86.
- Celebrated Mahila Kisan Diwas under Rashtriya Krishi Vikash Yojna on Organic Farming on 15 October, 2020, and no of participants 68.
- Entrepreneurship Opportunities for Agri-Students in Organic Agriculture at Directorate of Research, MPUAT, Udaipur (Raj.) on 25 January, 2020, and no of participants 70.
- Organized ICAR-CAFT 21 days Training Programme on "Productivity, Economics and Environmental Performance in Organic Agriculture" from 525 September, 2019 at MPUAT, Udaipur (Raj.) and no of participants 25.
- जैविक आदान उत्पादन हेतु प्रोटोकॉल एवं तकनीकें पर पशिक्षण on 3 Feb 2020 of state govt., officials, and no of participants 25.



- जैविक आदान उत्पादन हेतु प्रोटोकॉल एवं तकनीकें पर पशिक्षण on 6 Feb 2020 of state govt., officials, and no of participants 25.
- One Day Online Awareness Programme on Organic Farming for Quality Foods & Safe Ecosystem on the Occasion of World Food Day under Rashtriya Krishi Vikash Yojna on Organic Farming on 16 October, 2020, and no of participants 257.
- Entrepreneurship Development in Production & Marketing of Lemon Grass based Products, and no of participants 72.
- Organized one day national webinar on Scope and Scenario of Agriculture after COVID-19 at MPUAT, Udaipur on 29th May, 2020, and no of participants 890..
- One day training programme on Organic input production at Jhadole on 16 March, 2020, and no of participants 75.
- 73 exposure visits and training of farmers, extension functionaries and other stakeholders June, 2019 to June, 2020, and no of participants 3173.
- World Soil Day" at MPUAT, Udaipur on 5 December, 2019, and no of participants 110.

8.2.3. List of Radio talk/Television talks

Bhopal

- Dr. A. B. Singh had given Radio talk on "Kenchua Khad Kheti ke liye Vardan" dated 13/03/2020 at Prasar Bharati, All India Radio Bhopal.

Jabalpur

- For Television talks Reliance Foundation Channel on 1st Feb 2020

- ✓ Conservation Technology in maize crop production.
- ✓ Integrated Farming Systems
- ✓ Organic Farming

- For E-Tv Anndata on May 2019

- ✓ Cotton production technology
- ✓ Groundnut production technology
- ✓ Pulses production technology

Ludhiana

- Television talk Jevik kheti de miar ate kisana layee sujaa, AIR, Jalandhar, 16.05.2020
- Radio talk Jevik kheti de miar ate kisana layee sujaa, AIR, Jalandhar, 16.05.2020

Udaipur

- Dr. S. K. Sharma delivered talk on topic "Locust problem and their management" in Aakashvani, Udaipur
- Dr. Roshan Choudhary delivered talk on topic "Rabi Faslon main Vegyanic paripakvata kadhar par katai" on 12.03.2020. Aakashvani, Udaipur



8.2.4. Gosthis

S K Nagar

- One Kishan gosthi & Shibir at Aritha on 20/02/2020
- One Kishan gosthi & Shibir at Dev on 04/03/2020

8.2.5. Linkage and collaborations

Coimbotore

- Organic Stakeholders Meet was conducted in coordination with Tamil Nadu Organic certification Department (TNOCD).

Udaipur

Sl. No.	Collaboration with	Purpose
1.	AICRP on Weed Management, MPUAT, Udaipur	• Experiment on organic weed management in Sweet corn • Experiment on organic weed management in Fennel
2.	AICRP on IFS, MPUAT, Udaipur	Geo-referenced on – farm characterization of organic growers of Rajasthan.
3.	All India Network Project on Soil Biodiversity and Biofertilizers	CFU analysis and molecular characterization
4.	Rajasthan College of Agriculture, MPUAT, Udaipur	• Growth, yield, fruit quality and economics of organic management practices on guava (Ph. D. thesis) • Effect of organic manures on growth, yield and quality of pomegranate (Ph. D. thesis) • Effect of organic manures and liquid formulations on growth, yield and quality of cauliflower (Ph. D. thesis) • Effect of different liquid organic manures on biochemical properties of soil and plant growth of blackgram under pot culture (M. Sc. thesis) • Effect of soil and foliar application of compost tea on growth, yield and quality of soybean (M.Sc. thesis) • Effect of aerated and non-aerated liquid manures on growth, yield and quality of organic blackgram (M. Sc. thesis) • Effect of cow urine-based bio stimulant on growth, yield and quality of onion (M. Sc. thesis) • Effect of organic manures and liquid formulations on growth, yield and quality of okra (M. Sc. thesis)
5.	Madhyantar Start up, udaipur	To provide marketing linkage to organic growers
6.	Seema Metals & Minerals, Udaipur	Research and awareness on use of silica in organic agriculture.
7.	Department of FarmMachinery, CTAE, Udaipur	Experiment regarding testing of drilling of organic manure through combined seed drill by Ph. D. student.

APPENDIX

9

Details of crops and varieties used in evaluation of organic, inorganic and integrated production systems for crops and cropping systems at various locations

Location	Crop	Variety
Bajaura	Black gram (<i>Kharif</i>) Lady's Finger (<i>Kharif</i>) Tomato (<i>Kharif</i>) Cauliflower (<i>Rabi</i>) Pea (<i>Rabi</i>) French bean (<i>Summer</i>) Tomato (<i>Summer</i>) Summer Squash (<i>Summer</i>)	Palampur- 93 P-8 Hybrid 2853 PSBK-1 Azad P-1 Vaishnavi 264 Hybrid Himalaya Australian Green
Bhopal	Soybean Durum wheat Mustard Chickpea Linseed	JS-335 HI-8737 Pusa Bold RVG-203 JL-9
Calicut	Ginger Turmeric Black Pepper	Varada, Rejatha Prathibha, Alleppey Supreme, Varna, Sobha, Sona, Kanthi, Suvarna, Suguna, Sudarsana, Kedaram, Prabha, Pragati Sreekara, Panniyur-1
Coimbatore	G M (Daincha) Brinjal Pearl millet Chillies Barnyard millet Tomato Finger millet	Local CO-2 CO-10 Co 1 Hybrid MDU 1 PKM 1 CO(Ra)-15
Dharwad	Pigeonpea Greengram Sorghum Groundnut Hy. cotton Maize Chickpea Safflower	TS-3R DGGV 2 M 35-1 GPBD 4 ARBH-813 NK-6240 Jaki-9218 A 1
Karjat	Rice Brinjal Chickpea Field bean Onion (White)	Karjat-4 Krishna F1 Vijay Konkanwal-1 Alibag local



Location	Crop	Variety
Jabalpur	Basmati rice Wheat Chickpea Berseem Vegetable pea Maize fodder Sorghum fodder	Pusa Basmati -1 MPO-1106 JG-322 JB - 1 Arkel African Tall MP Chari
Ludhiana	Basmati rice Kharif moong Summer Moong Soyabean Wheat Sunhemp Chickpea	Panjab basmati 1509 ML 2056 SML 832 SL 958 PBW 343 Local PBG 7
Modipuram	Basmati rice Coarse rice Maize Grain Maize (Green cob) Wheat (durum) Okra Potato Barley Green gram Mustard	PB-6 Saket-4 Bajaura pop corn Madhuri sweet corn HI - 8498 Arka Anamika Chipsona-3 DWRB-91 Pusavishal Pusa bold
Pantnagar	<i>Sesbania</i> Basmati rice Wheat Chickpea Vegetable Pea Potato Coriander	Pant Ses-1 Pusa basmati-1 UP-2572 Pant kabuli chana-1 Arkel Kufri jyoti Harit RS-5
Raipur	Soybean Maize Vegetable pea Chilli Onion	JS – 9752 Sugar-75 Pant sabji matar" (PSM 3) Agnirekha Nasik red
Ranchi	Rice Wheat Onion Potato Okra	Birsamati K- 9107 Arka niketan Kufri Ashoka Aprajita
Umiam	Rice (sunken bed) <i>kharif</i> Broccoli Carrot Potato French bean Tomato	Megha Aromatic-2, Shahsarang-1, Lampnah, Ngoba Green Magic New Koroda Kufri jyoti Naga local Rocky

Location	Crop	Variety
New Centres		
Ajmer	Green gram	SML-668
	Fennel	-
	Cluster bean	RGC-1038
	Coriander	-
Gangtok	Maize	RCM-1-1
	Ginger	<i>Gorubuthane</i>
	Turmeric	RCT-10
	Soybean	RCS-1-10
	Buckwheat	Local Teethay
	Rajmash	SKR-57
	Blackgram	SK-PD-3 (Pahenlo dal)
	Toria	TS-38
Narendrapur	Paddy	Shatabdi/Pusa Basmati 1
	Broccoli	Princess
	Veg. Pea	MS10
	Mustard	B9
	French Beans	Falguni
	Green gram	Samrat
	Sesame	Tilotomma
Sardar Krushinagar	Groundnut	TG 37
	<i>Kharif</i> Green gram	GM 4
	Wheat	GW 451
	Fennel	GF 12
	Summer 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	PHM-3
	Wheat (Durum)	HI 8713
	Wheat (Aestivum)	Raj 4120
	Gram	GNG 1581
	Fenugreek	RMT-305
	Soyabean	RKS-24



ANNEXURES



Contact Address of NPOF Centres (as on 31 March 2019)

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	(Off.) 0121- 295 6318 (Fax) 0121-288 8546 (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	(Off.) 0121-288 8571 (Fax) 0121-288 8546 (Mob.) 08755195404	npinpof.iifsr@gmail.com; npinpof.iifsr@icar.gov.in
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ACRONYMS

ALE	: Aquous leaf extract	Mn	: Manganese
ASE	: Aquous seed extract	MOP	: Muriate 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		



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