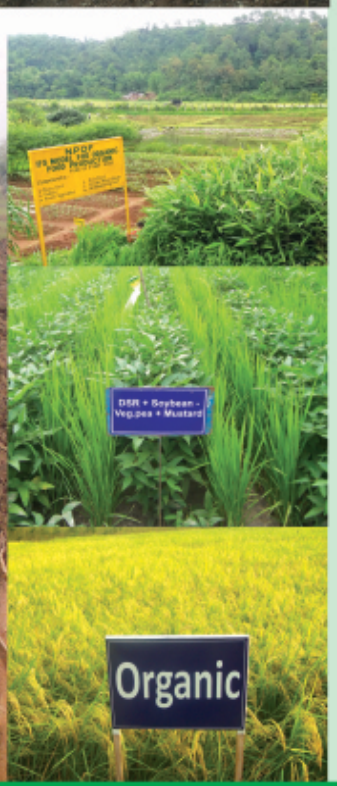
भाकृअनुप
ICAR

Annual Report 2014-15



जैविक खेती पर नेटर्वक परियोजना

Network Project on Organic Farming

ICAR-Indian Institute of Farming Systems Research
Modipuram, Meerut-250 110 (U.P.), 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 resources for 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.
- Coordinate and monitor integrated farming systems research in the country.

All India Coordinated Research project on Integrated Farming Systems (AICRP on IFS) is an integral part of ICAR-IIFSR with 75 centres to undertake on-station main (25 no's), on-station sub (12 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 a Network Project on Organic Farming (NPOF) with 20 centres.

Annual Report
2014-15

NETWORK PROJECT 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 Network Project on Organic Farming (NPOF) at 13 centres and ICAR-IIFSR, Modipuram (report writing, compilation, editing and printing).
- The Annual Report 2014-15 is based on experimental data generated during *kharif*, *rabi* and *summer* seasons of 2013-14. The other details are relevant up to 31 March 2015.
- The report includes both processed and semi-processed data, generated in different experiments under Network Project on Organic Farming (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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Network Project on Organic Farming (NPOF) initiated in 2004 is operating with 13 co-operating centres in 12 states. The results of the experiments conducted during 2013-14 by all the co-operating centres are processed and compiled in the Annual Report 2014-15 of the scheme. I take this opportunity to record my sincere thanks to **Dr. T. Mohapatra**, Secretary, Department of Agricultural Research and Education and Director General, Indian Council of Agricultural Research, New Delhi for offering critical comments and guidance. I extend my gratitude to **Dr. K. Alagusundaram**, Acting Deputy Director General (Natural Resource Management) for his constant support extended to the scheme. The time to time guidance received from **Dr. S. Bhaskar**, Assistant Director General (Agronomy, Agroforestry and Climate Change) for improving the performance and output of the scheme is duly acknowledged. My sincere thanks also extended to **Dr. S. Ayyappan**, Former Secretary, Department of Agricultural Research and Education and Director General, Indian Council of Agricultural Research, New Delhi, **Dr. A.K. Sikka**, Former Deputy Director General (Natural Resource Management) and **Dr. B. Mohankumar**, Former Assistant Director General (Agronomy, Agroforestry and Climate Change) for their critical comments, reviews and suggestions on the performance and improvement of scheme over the years. Scientific inputs received from **Quinquennial Review Team (QRT), Research Advisory Committee (RAC)** and **Institute Management Committee (IMC)** are thankfully acknowledged as those inputs provided immense help in taking new initiatives, shaping and improvement of the programme for practical utility.

I am highly thankful to each and every one of the scientists and research fellows involved in the scheme at 13 centres for putting the meticulous 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 deserves appreciation for compilation and editing of the report. I also extend my appreciation to **Dr. M. Shamim,** Scientist and **Dr. Vipin Kumar**, Chief Technical Officer for their cooperation in compilation of the data, its statistical analysis, drafting and proof correction. Thanks and appreciations are also due to **Dr. Kamta Prasad**, Former Programme Facilitator (Co-ordination Unit) and **Dr. J.P. Singh**, Former Director (Acting) for extending the cooperation in preparation of report.

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 also acknowledged. I am sure; the significant findings obtained from the experiments especially identification of suitable production systems and varieties for various crops, resource conservation practices for organic farming, Integrated Organic Farming System (IOFS) models are of practical in nature and can be adopted by organic growers.

(A.S. Panwar)
Director

CONTENTS

lkjk'k

tfod] jlk;fud vkj lefdr mRiknu ç.kkyh¸k"i dk eY;kdu

- **ctkjk%** fgekpy in'k e lefdr vkj vtfod ic/ku dh ryuk e tfod ic/ku d vUrxr xh"e Qyxkkh ,o Ýpchu u Øe'k% 8220 vkj 4800 fd0xk0@g0 mPp mit nt dhA mMn dh vPNh mit 1070 fd0xk0@g0 75 ifr'kr tfod $ 25 ifr'kr jlk;fud ic/ku d vUrxr ik;h xbA xh"e dnn vkj jch eVj u jkT; }kjk flQkfj'k jlk;u ic/ku d rgr Øe'k% 31110 ,o 8370 fd0xk0@g0 dh mPp mit nt dh gkykfd jch Qy xkHkh] [kjhQ mMn vkj fHk.Mh dh mit e Øe'k% 22] 3 vkj 10 ifr'kr dh deh 75 ifr'kr ik"kd rRok dk tfod [kkn d :i e nu ij n[kh xb A

- **Hkkiky%** e/;in'k e tfod mRiknu ic/ku d rgr ik"kd rRok dk [kkn d ek/;e l 75 ifr'kr vkj 100 ifr'kr d i;kx }kjk lk;kchu] xg] ljlk] puk vkj vylh e Øe'k% 1-8] 1-2] 2-5] 5 vkj 1-8 ifr'kr dk mit e vUrj n[kk x;kA ;g fu"d"k cgr egRoi.k g D;kfd ;g tfod ic/ku d rgr lh/k 25 ifr'kr de [kkn dk i;kx dju ij [krh dh ykxr dk de dju dh xtkb'k nrk gA

- **dkyhdV%** djy e vU; ic/ku d rjhdk dh ryuk e tfod [kkn d ek/;e l 100 ifr'kr ik"kd rRok dh vkifr d lkFk vnjd dh mPp mit 23033 fd0xk0@g0 tfod ic/ku d rgr nt dh xbA gYnh dh mYy[kuh; <x mPp mit 21200 fd0xk0@g0 lefdr ic/ku ½50 ifr'kr tfod $ 50 ifr'kr jlk;u½ d lkFk nt dh xbA jlk;fud vkj ,dhdr d ic/ku dh ryuk e dkyh fep dh mYy[kuh; mPp mit 1800 fd0xk0@g0 tfod ic/ku d rgr nt dh xbA ftll jlk;fud vkj lefdr ic/ku ij Øe'k% 59 vkj 116 ifr'kr dh mit e of} ik;h xbA

- **dk;EcVj%** rfeyukM e 100 ifr'kr ik"kd rRok dh vkifr ¼tfod [kkn d ek/;e l½ dh ryuk e dy tfod ic/ku [kkn dk doy 75 ifr'kr ik"kd rRo tfod [kkn }kjk nu ij lHkh Qlyk e de [kkn d mi;kx l mPp mit ithdr dh FkhA dikl] eDdk] fep] ljte[kh vkj pdUnj dh mit e Øe'k% 18] 12] 14] 7-4 vkj 6 ifr'kr dh of} gkuk ik;h xbA

- **/kkjokM%** dukVd e jkT; flQkfj'k mRiknu i.kkyh d vUrxr ykfc;k] dle] vjgj] ckt jk] exQyh] dikl vkj puk dh mPp mit Øe'k% 1270] 1542] 2653] 4586] 4430] 1637 o 1551 fd0xk0@g0 nt dh xbA ex dh vf/kdre mit lefdr ic/ku ½50 ifr'kr tfod $ 50 ifr'kr jlk;fud½ d lkFk nt dh xbA jlk;fud ik"kd ic/ku dh ryuk e tfod ic/ku d rgr dle] vjgj] ex] Tokj] exQyh] ldj dikl] eDdk vkj fep dh mit e Øe'k% 18-6] 20-8] 15-1] 12-6] 18-6 o 20-8 ifr'kr dh deh ikb xbA

- **tcyij%** e/;in'k e cklerh /kku dh vf/kdre mit tfod ic/ku d lkFk 100 ifr'kr ik"kd rRok dh vkifr tfod [kkn d :i e vkj ,dhdr ic/ku ½50 ifr'kr tfod $ 50 ifr'kr jlk;fud½ d vUrxr nt dh xb tcfd xg ¼3522 fd0xk0@g0½] eDdk ¼4110 fd0xk0@g0½] cjlhe pkjk vkj cht ¼92200 o 241 fd0xk0@g0½] eVj ¼4166 fd0xk0@g0½ dh vf/kdre mit 100 ifr'kr jlk;fud

ik"kd ic/ku d rgr nt dh xbA Tokj dh vf/kdre mit 75 ifr'kr tfod o 25 ifr'kr jlk;fud ik"kd rRo ic/ku d vUrxr nt dh xb FkhA

- **djtV%** egkjk"V e /kku dh vf/kdre mit ¼3914 fd0xk0@g0½ lefdr ik"kd rRo ic/ku ¼50 ifr'kr tfod $ 50 ifr'kr jlk;fud½ d rgr nt dh xbA exQyh] eDdk] ljlk vkj lk;kchu dh mPp mit 100 ifr'kr ik"kd rRok dh vkifr jlk;fud icU/ku }kjk dju d lkFk nt dh xbA

- **yf/k;kuk%** itkc e puk ¼1470 fd0xk0@g0½ vkj /kku ¼4180 fd0xk0½ dh vf/kdre mit tfod mRiknu ç.kkyhd rgr nt dh xb tcfd vjgj ¼620 fd0xk0@g0½ jkT; }kjk lefir idt d rgr cgrj ikb xbA xg dh mPp mit ¼5800 fd0xk0@g0½ iR;d 50 ifr'kr tfod vkj jlk;fud ik"kd rRok dh vkifr d lkFk lefdr idt e nt dh xb FkhA

- **eknh iUje%** mÙkj Án'ke /kku] xg] tk] ex eDdk ¼ikidku½ eDdk ¼ehBh eDdk½ dh mPp mit 75 ifr'kr tfod $ 25 ifr'kr jlk;fud ic/ku d rgr Øe'k% 4680] 4190] 4120] 885] 2270 vkj 11730 fd0xk0@g0 nt dh xbA tfod icU/ku d rgr vky] fHk.Mh] vkj ljlk dh vf/kdre mit Øe'k% 23830] 9860 o 2090 fd0xk0@g0 nt dh xb FkhA

- **iUruxj%** mÙkjk[k.M e /kku dh mPp mit ¼3519 fd0xk0@g0½ lefdr ic/ku ¼75 ifr'kr tfod $ 25 ifr'kr jlk;fud½ d lkFk vU; idt dh ryuk e nt dh xb Fkh tcfd xg dh mPp mit 510-7 fd0xk0@g0 ,dhdr idt ¼50 ifr'kr tfod $ 50 ifr'kr jlk;fud½ d rgr nt dh xbA puk] eVj] vky tlh Qlyk dh vf/kdre mit Øe'k% 1202] 432] vkj 8513 fd0xk0@g0 tfod idt mRiknu ç.kkyh d rgr ikb xbA

- **jk;iqj%** NÙhlx< e lk;kchu] eDdk] eVj] fep vkj l;kt dh mPp mit Øe'k% 2088] 8633] 7067] 9967 vkj 10400 fd0xk0@g0 jkT; }kjk flQkfj'k idt d rgr nt dh xb A

- **jkph%** >kj[k.M e tfod idt d rgr pkoy ¼3570 fd0xk0@g0½ vky ¼19007 fd0xk0@g0½ vkj vylh ¼803 fd0xk0@g0½ dh mPp mit nt dh xb tcfd xg dh mPp mit ¼3000 fd0xk0@g0½ jlk;fud idt d rgr nt dh xbA elj dh mPp mit ¼560 fd0xk0@g0½ ,dhdr ik"kd rRo idt ¼50 ifr'kr tfod $ 50 ifr'kr jlk;fud½ d rgr nt dh xbA

- **mfe;e** e /kku dh vf/kdre mit 4180 fd0xk0@g0 ,dhdr idt ¼50 ifr'kr tfod $ 50 ifr'kr jlk;fud½ lk= l ik"kd rRok dh vkifr nu ij nt dh xbA xktj] vky VekVj dh lcl vf/kd mit Øe'k% 13220] 14370 vkj 14810 fd0xk0@g0 100 ifr'kr tfod [kkn dh vkifr ij tfod ik"kd rRok d icU/ku d rgr nt dh xbA ÝUpchu dh mPp mit 8560 fd0xk0@g0 doy jlk;fud ic/ku d rgr nt dh xb A

tfod [kkrh d fy;s e[; Qly d fdLeksa dh çfrfØ;k dk eY;kdu

- **ctkjk** e fHk.Mh dh fdLe ih&8 u 13364 fd0xk0@g0 dh vf/kdre mit nt dhA bld vulj.k e bUækfuy u 12341 fd0xk0@g0 dh mit nt dhA U;ure idu dh vof/k 45&46 fnu Hkh fdLe]

rlfr] bUækfuy vkj ih&8 }kjk nt dh xbA QyxkHkh dh fdLek ih,lchd&1 vkj dVh&25 }kjk Qy dk mPp otu 508-7 vkj 503-9 xke ,o vf/kdre mit Øe'kh 17590 vkj 16550 fd0xk0@g0 Hkh nt dh xbA VekVj dh fdLe jkek u Qyk dh l[;k ¼7-9 çfr ik/kk½ d lkFk vf/kdre Qy mit ¼6190 fd0xk0@g0½ nt dhA xh"e e VekVj dh fdLek jM xkYM vkj gkbfcM 7730 dh mPp mit Øe'kh 13930 vkj 12190 fd0xk0@g0 ik;h x;h FkhA eVj dh fdLe ih-ch&89 u dh 9-7 leh yEch Qyh d lkFk vf/kdre mit 7950 fd0xk0@g0 dh inkokj mYy[kuh; <x l nt dhA

- **Hkkiky** e lk;kchu] xg] eDdk vkj puk dh fdLek dk tfod çcU/ku d rgr lk;kchu&xg vkj eDdk&puk Qly ç.kkyh d vUrxr eY;kdu fd;k x;kA lk;kchu fdLek d chp vkj-oh-,l 2002&04 e Øe'kh 726 vkj 1741 fd0xk0@g0 dh mPp mit vkj dVkÃ lpdkd fu"dk"kr dhA xg dh fdLek d chp th-MCy&399 }kjk xg vkj Hklk dh mPp mit Øe'kh 2907 vkj 3768 fd0xk0@g0 nt gbA eDdk dh fdLe vjkoyh u 2137 fd0xk0@g0 mit vkj 2430 fd0xk0@g0 ivky dh mPp mit mYy[kuh; <x l nt dhA fdLe çk,xk 4412 vkj lh-ih-ch-th 4202 u Hkh vPNh mit dk in'ku fd;kA pu dh fdLe t-ch 130 u cht Qyh ¼1-7 çfr ik/kk½ d dkj.k vkj cht ,o dy tfod Hkkj mit ¼ Øe'kh 5104 vkj 1979 fd0xk0@g0½ mYy[kuh; <x l nt dhA pu dh fdLek vkj-oh-th&203] t-th-&16] t-th&63 vkj vkj-oh-th&202 dh mit 1733&1872 fd0xk0@g0 d chp nt dh xbA

- **dkyhdV** e gYnh d dn dh vf/kdre mit ln'ku ½29000 fd0xk0@g0½ }kjk nt dh xb Fkh d vulj.k e lxuk u ½24500 fd0xk0@g0½ nt dhA vf/kdre djD;feu rRo 6-9 gYnh dh fdLe lxuk e n[kk x;k ftld vudj.k e çHkk e ;g 6-1 FkkA

- **dk;kEcVj** e /kku dh fdLe lh-vk- 48 dk tfod çc/ku d rgr vPNk gkuk ik;k x;kA /kku dh fdLe lh-ch- 05022 u Øe'kh 4380 vkj 6130 fd0xk0@g0 dh mYy[kuh; mit ,o ivky mit rFkk Qly lpdkd ¼0-50½ nt dhA

- **/kkjokM** e lk;kchu dh fdLe Mh-,l-ch 16 u mPp mit ½2291 fd0xk0@g0½ 'k) çfrQy ¼:- 50089½ vkj ykxr¼ ykHk vuikr ¼3-69½ nt fd;k bld ckn Mh-,l-ch&21 vkj Mh-,l-ch&20 }kjk nt dh xb FkhA fdLe Mh-,l-ch&21 vkj Mh-,l-ch&16 dk /kkjokM e vf/kd ykHkdkjh ik;k x;kA exQyh dh fdLe Vh-th-,y-ih-,l&3 u l[kh Qyh dk otu ¼45-51 xk- çfr ik/kk½] l[kh Qfy;k dh mit ¼3571 fd0xk0@g0½ vkj 'k) ykHk :- 120]196 çfr g0 vkj ykHk ykxr vuikr 6-32 mYy[kuh; <x l nt dhA ftldk fdLe th-ih-ch-Mh&4 u Òh vulj.k fd;kA dikl dh mPp mit fdLe th-,p-,e&82 vkj 34 u nt dhA xg e Mh-MCy-vkj 162 u fdYy çfr ehVj yEckb ¼113-7 l[;k½ dy 'k"d çnkFk ¼126-65 xk- çfr ik/kk½] nku çfr ckyh ¼36-6½] cht mit ¼1678 fd0xk0@g0½ 'k) ykHk :0 18091 çfr g0 vkj ykHk ykxr vuikr 3-6 tfod çcU/ku d rgr mYy[kuh; <x l nt dh x;h FkhA tfod çc/ku d rgr pu dh fdLe t-,d-vkb&9218] ,-vkb- vkj ch-th-Mh&103 u fdLe vkb-lh-lh-oh&2 ½2097 fd0xk0@g0½ dh ryuk e Øe'kh 23] 21 vkj 22% vf/kd cht mit ink dhA

- **tcyij** e /kku dh fdLe ih-,l&3 u 3410 fd0xk0@g0 dh vukt mit d lkFk vU; fdLek d chp egRoi.k vUrj nt fd;kA xg dh fdLe t-MCy&3173 u 4063 fd0xk0@g0 dh mYy[kuh; <x l mit nhA

- **djtV** e /kku dh fdLe lg;kfæ l vukt vkj Hkl dh mPp mit Øe'kh 4710 vkj 5510 fd0xk0@g0 nt dhA tfod mRiknu ç.kkyh d rgr exQyh dh fdLe vkj-,p-vkj-th 6083 u ik/k dh yEckb vf/kdre 47 leh- l[kh Qyh mit 2320 fd0xk0@g0 vkj M.By 3713 fd0xk0@g0 inkokj dhA fdLe Vh-th 26 vkj dkd.kxkjo u Hkh bldk vulj.k fd;kA

- **yf/k;kuk** e cklerh /kku dh fdLe ilk&1612 u mYy[kuh; <x L¨ mPp mit 5367 fd0xk0@g0 nt dh vkj ilk&1592 d }kjk Hkh 52 fd0xk0@g0 dh mit vulj.k djr g, nt dh xbA tcfd ilk cklerh&1509 u lcl de vukt dh mit 2307 fd0xk0@g0 nt dhA xg dh vf/kdre mit MCy-,y&0134 e 4770 dh n[kh xb tcfd lcl de vukt dh mit MCy-,y&1761 d lkFk 2410 fd0xk0@g0 nt dh xb FkhA

- **eknhiUje** e eDdk dh fdLe ih-,e-,p&3 u mYy[kuh; <x L¨ mPp vukt mit] ivky dh mit] ldy ,o 'k) ykHk vkj fuo'k çfr :i; Øe'kh 6170] 8680 fd0xk0@g0] :- 115977 çfr g0] :- 76552 çfr g0 vkj 1-94 nt dh FkhA ljlk vkj-th-,u&48 u 1970 fd0xk0@g0 d lkFk mPp mit nt dh tcfd ilk ljlk&25 u 1530 fd0xk0@g0 dh U;ure mit nt dhA

- **iUruxj** e tfod mRiknu ç.kkyh d rgr ekV /kku dh fdLek dh mit 5130 l 6174 fd0xk0@g0 d chp jgh rFkk iry /kku d fdLek dh vukt mit 2510 l 4185 fd0xk0@g0 d chp nt dh xb FkhA vukt dh mit xkjryc :i l ,u-Mh-vkj 359 d lkFk 6174 fd0xk0@g0 n[kh xb FkhA xg dh mPp vukt dh mit 4101 fd0xk0@g0 ;-ih 1109 e n[kh xb tcfd Hklk dh mPp mit ;-ih- 2572 e nt dh xbA

- **jk;iqj** e /kku dh fdLe ckn'kkg Hkkx u vU; fdLek dh ryuk e 3854 fd0xk0@g0 dh vukt dh mit tfod mRiknu ç.kkyh d rgr nt dh FkhA t;x.Mh] fcluh] fo".kHkkx vkj dcjhekgj u Hkh 3136 l 3703 fd0xk0@g0 d chp mit nt dh FkhA

- **jkph** e /kku dh vf/kdre mit 3722 fd0xk0@g0 fdLe yyr l çklr gb Fkh tk fcjlk fodkl /kku 203 ¼3567 fd0xk0@g0½ fcjlk /kku 201 ¼3567 fd0xk0@g0½ vkj uohu 3404 fd0xk0@g0 dk NkMdj vU; lHkh fdLek l mYy[kuh; :i l cgrj FkhA xg dh fdLe d 0307 u 3378 fd0xk0@g0 dh mPp mit nt dhA /kku dh Qly Øe d vulkj fcjlk /kku&201&xg th-MCy&366 Qly Øe u 7719 fd0xk0@g0 dh mPp Qly ç.kkyh mRiknu nt dhA

- **mfe;e** e eDdk vkj-lh-,e 1&3 u 6400 fd0xk0@g0 dh mPp mit gj Hkê d :lk e nt dh tk vkj-lh-,e&75 u 6030 fd0xk0@g0 vkj Mh-,&61 , u 5950 fd0xk0@g0 d mRikndrk l T;knk FkhA ÝUp chu e gjh Qyh dh mPp mit 4360 fd0xk0@g0] ukxk ykdy u nt dh Fkh ftld vulj.k e vkj-lh-,e ,Q-ch&18 ¼4110 fd0xk0@g0½ ,o vkj-lh-,e ,Q-ch&19 ¼3930 fd0xk0@g0½ u mPp mit nt dhA

tfod mRiknu i)fr;k d rgr xgu to ekukFk Qly i.kkfy;k dk eY;kdu

- /kkjokM e Qly i.kkyh d vUrxr lHkh Qlyk dh mit pkMh D;kjh vkj dM fof/k ¼ch-ch-,Q½ e Qly vo'k"kk d leko'ku d lkFk vf/kd ikb xbA pkMh D;kjh vkj dM ¼ch-ch-,Q½ cvkb dh fof/k Qly vo'k"kk d leko'ku d lkFk u fcuk vo'k"k leko'ku dh ryuk e mPp ekfnd ykHk vkj vf/kd ykxr% ykHk vuikr% nt fd;k FkkA cvkb dh ¼ch-ch-,Q½ fof/k Qly vo'k"kk d leko'ku d lkFk ¼i.kkfy;k e vFkok vUrj Qly i.kkfy;k e½ ex MhOTkhOTkhOoh 2&Tokj ,e035&1 dh ryuk e exQyh GPBD4+dlkkl lkguk dh [krh vUrQlyhdj.k tkfd 2%1 d vuikr e fd;k x;k Fkk mle vf/kd 'k) ekfnd ykHk 88898 ifr g0 nt dh xbA dukVd d mRrjh ijhorh {k= ¼{k= 8½ e tfod if)r d rgr exQyh GPBD4+dlkkl lkguk ft ldh cokb 2%1 d vuikr e dh xb Fkh lk;kchu MhO,lOch021$ vjgj VhO,lO3 vkj 2%1 ,o lk;kchu MhO,lOch021&xg MhOMCY; 2006 Qly Øe dh ryuk e vf/kd ykHkdkjh ikb x;h FkhA

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ABSTRACT

Network project on Organic Farming (NPOF) started in 2004-05 with 13 cooperating centres covering 12 states. The salient research achievements are presented below.

1. Evaluation of organic, inorganic and integrated production systems

- Summer cauliflower (8220 kg/ha) and french bean (4800 kg/ha) recorded higher yield under organic compared to integrated or inorganic production system. Performance of black gram was found to be better with 75% organic+25% inorganic management (1070 kg/ha). Summer squash and *rabi* pea registered higher yield with state recommendation (31110 kg/ha and 8370 kg/ha respectively) having combination of 100% inorganic source of nutrients and integrated package of pest and disease management. However, in case of *rabi* cauliflower, *kharif* blackgram and okra, yield reduction of 22, 3 and 10 % was observed with 75% nutrients through organic manure and innovative package at **Bajaura (Himachal Pradesh)**.

- The yield difference observed between 75 and 100% nutrients application through organic manures under organic production system was only 4.8, 1.2, 2.5, 5 and 1.8 % in soybean, durum wheat, mustard, chickpea and linseed respectively at **Bhopal (Madhya Pradesh)**. These findings are very important as it gives scope to reduce the 25% organic manure application thus directly reducing the cost of cultivation under organic management.

- Ginger recorded significantly higher yield (23033 kg/ha) under organic production system with 100% nutrients through organic manures compared to other system practices. Turmeric recorded significantly higher yield (21200 kg/ha) with integrated system consisting of 50% organic +50% inorganic. Black pepper recorded significantly higher yield (1800 kg/ha) under organic system than inorganic and integrated packages. The yield increase was found to be 59 and 116% over inorganic and integrated package at **Calicut (Kerala)**.

- All the crops registered higher yield under reduced application of manures (75% nutrients only through organic manures with total organic management) compared to 100% nutrients supply through organic manures. The yield increase was found to be 18, 12, 14, 7.4 and 6% for cotton, maize, chillies, sunflower and beetroot respectively at **Coimbatore (Tamil Nadu)**.

- Cowpea, safflower, pigeon pea, sorghum, groundnut, cotton and chickpea recorded higher yield (1270, 1542, 2653, 4586, 4430, 1637&1551 kg/ha respectively) under production system having state recommendation. Green gram recorded highest yield (1322 kg/ha) under integrated production system with 50% organic + 50% inorganic. The yield reduction under organic management in safflower, pigeonpea, green gram, sorghum, groundnut, hybrid cotton, maize and chilli were found to be 18.6, 20.8, 15.1, 12.6, 18.6 & 20.8 % respectively over inorganic production system at **Dharwad (Karnataka)**.

- Basmati rice recorded higher yield under organic package with 100% organic nutrient supply and integrated package with 50% organic and 50% inorganic nutrient source, whereas wheat (3522 kg/ha), maize (4110 kg/ha), berseem (fodder and seed) (241 & 92200 kg/ha), pea (4166 kg/ha) recorded higher yield under inorganic production system with 100% inorganic management. Sorghum recorded higher yield under integrated system with 75% organic and 25% inorganic nutrient sources at **Jabalpur (Madhya Pradesh)**.

- Rice recorded higher yield (3914 kg/ha) in integrated production system with 50% organic and 50 % inorganic nutrient supply. Groundnut, maize, mustard and dolichos bean, recorded higher yield with inorganic system at **Karjat (Maharasthra)**.

- Chick pea (1470 kg/ha) and rice (4180 kg/ha) recorded higher yield under organic production system, while pigeon pea (620 kg/ha) was found to be better under state recommendation package. Wheat recorded higher yield (5800 kg/ha) under integrated production system with 50% each organic and inorganic nutrient supply at **Ludhiana (Punjab)**.

- Rice, wheat, barley, greengram, maize (popcorn) and maize (sweet corn) recorded higher yield (4680, 4190, 4120, 885, 2270, 11730 kg/ha respectively) under integrated production system with 75% organic + 25% inorganic nutrient sources. Potato, okra and mustard recorded higher yield (23830, 9860 & 2090 kg/ha respectively) under organic management at **Modipuram (Uttar Pradesh)**.

- Basmati rice recorded higher yield (3519 kg/ha) under integrated production system with 75% organic+25% inorganic nutrient sources compared to other packages while wheat recorded higher yield (5107 kg/ha) under integrated package having 50% organic + 50% inorganic. Crops like chickpea, vegetable pea, potato recorded higher yield of 1202, 4321, & 8513 kg/ha respectively under organic production system at **Pantnagar (Uttrakhand)**.

- Soybean, maize, pea, chili and onion recorded higher yield of 2088, 8633, 7067, 9967 and 10400 kg/ha respectively with state recommendation having inorganic + organic management at **Raipur (Chhatisgrah)**.

- Higher yield of basmati rice (3570 kg/ha), potato (19007 kg/ha) and linseed (803 kg/ha) recorded under organic package while wheat recorded highest yield (3000 kg/ha) under inorganic system. Lentil recorded higher yield (560 kg/ha) under integrated production system having 50% each of organic and inorganic at **Ranchi (Jharkhand).**

- Rice resulted in higher yield (4180 kg/ha) with integrated production system having 50% each of organic and inorganic. Carrot, potato and tomato recorded highest yield 13220, 14370 and 14810 kg/ha under organic system with 100% nutrients supplied through organic manures. Only French bean recorded highest yield (8560kg/ha) under inorganic system at **Umiam (Meghalaya)**.

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

- Variety P-8 of okra recorded highest fruit yield (13364 kg/ha) followed by Indranil (12341 kg/ha). Days taken to harvest were also recorded to be minimum (45-46 days) in Tripti, Indranil and and P-8. In cauliflower PSBK-1 and KT-25 recorded higher curd weight 508.7 and 503.9 gm and resulted in higher yield of 17590 and 16550 kg/ha respectively. Tomato variety Roma recorded the highest fruit yield (6190 kg/ha) with higher no of fruits/plant (7.90). In summer the fruit yield of tomato variety red gold and hybrid-7730 were found to be higher (13930 and 12190 kg/ha). Pea variety 'Pb-89' gave significantly higher pod yield (7950 kg/ha) and significantly longer pods (9.7 cm) at **Bajaura (Himachal Pradesh)**.

- Varieties of soybean, wheat, maize and chickpea were evaluated in soybean-wheat and maize-chickpea cropping system under organic management. Among the soybean varieties, RVS-2002-4 resulted in higher seed and straw yield (726 and 1741 kg/ha) and harvest index. Among the wheat varieties, GW-399 recorded maximum seed yield and biomass (2907 and 3768 kg/ha). Maize variety Arawali recorded significantly higher yield (2137 kg/ha) and straw yield (2430 kg/ha). Proagro 4412 and CPBG 4202 also exhibited good yield. Chickpea variety JG-130 resulted in significantly higher seed yield of 1979 kg/ha owing to higher seeds/pod (1.7) and total biomass (5104 kg/ha). RVG-203, JG-16, JG-63 and RVG-202 of chickpea also recorded yield ranging from 1733-1870 kg/ha at **Bhopal (Madhya Pradesh)**.

- Maximum rhizome yield of turmeric was recorded by Sudarshana (29000 kg/ha) followed by Suguna (24500 kg/ha). Maximum curcumin content (6.9%) was noticed in the variety Suguna followed by Prabha (6.1%) at **Calicut (Kerala).**

- Significantly higher grain, straw yield and harvest index was recorded with CB05022 (4380, 6130 kg/ha and 0.50 respectively). Variety of rice CO 48 was also found to be better under organic management at **Coimbatore (Tamil Nadu).**

- Soybean genotypes DSB 16 recorded higher seed yield (2291 kg/ha) net return (Rs.50,089/ha) and B:C ratio (3.69) followed by DSB 21 and DSB 20. Cultivar DSB 21 and DSB 16 in organic production system were found more remunerative at **Dharwad (Karnataka).** Significantly higher dry pod weight of groundnut (45.51g/plant), dry pod yield (3571 kg/ha), net return (Rs. 1,20,196/ha) and B:C ratio (6.32) was recorded with TGLPS 3 followed by GPBD 4. Cotton cultivars GHAM 82 and GHAM 34 produced higher seed cotton yield. In wheat, DWR 162 recorded significantly higher tillers/m row length (113.71), total dry matter (126.65 g/plant), nos. of grains/spike (36.56), grain yield (1678 kg/ha), net return (Rs. 18091/ha) and B:C ratio of 3.06 under organic production system. Chickpea varieties, JAKI 9218, A1 and BGD 103 produced 23, 21and 22 % higher seed yield, respectively over cultivar ICCV 2 (2097 kg/ha) under organic production system.

- PS3 (3410 kg/ha) variety of rice recorded significant difference grain yield. In Wheat, JW-3173 variety gave the significantly higher yield (4063 kg/ha) at **Jabalpur (Madhaya Pradesh).**

- Higher grain and straw yield of rice was recorded with sahyadri-5 (4710 and 5510 kg/ha). In groundnut RHRG-6083 produced maximum and significantly higher plant height (47cm), dry pod yield (2320 kg/ha) and haulm weight (3713 kg/ha) followed by TG-26 and Konkan gaurav under organic production system at **Karjat (Maharashtra)**.

- Basmati rice variety Pusa 1612 recorded significantly higher grain yield of 5367 kg/ha closely followed by Pusa-1592 (5247 kg/ha) while, Pusa Punjab Basmati-1509 recorded lowest grain yield (2307 kg/ha). The highest grain yield of wheat was observed in BWL -0134 (4770 kg/ha) while lowest grain yield was recorded with BWL-1761 (2410 kg/ha)at **Ludhiana (Punjab).**

- Maize grain, straw yield, gross return, net return and net return per rupee invested (6170, 8680 kg/ha, Rs.115977/ha, Rs.76552/ha and1.94 respectively) was recorded significantly higher with PMH-3 Higher grain yield of mustard was recorded with RGN-48 (1970 kg/ha) while variety Pusa Mustard-25 gave minimum yield of 1530 kg/ha at **Modipuram (Uttar Pradesh).**

- Grain yield of coarse grain rice varieties ranged from 5133 to 6174 kg/ha and fine grain rice varieties ranged from 2510 to 4185 kg/ha respectively under organic production system. Significantly higher grain yield were observed in NDR-359 (6174 kg/ha). Higher grain yield of wheat were observed in UP-1109 (4101 kg/ha) while higher straw yield of wheat was recorded in UP-2572 at **Pantnagar (Uttarakhand).**

- Rice variety Badshahbhog recorded the higher grain yield (3854 kg/ha) compared with other varietiesunder organic production system. Jaygundi, Bisni, Vishnubhog and Kubrimohar also recorded yield ranging from 3636 to 3730 kg/ha at **Raipur (Chhatisgarh).**

- The maximum grain yield of rice (3722 kg/ha) was obtained with rice variety Lalat which was significantly superior over all the other rice varieties except Birsa Vikas Dhan 203 (3622 kg/ha), Birsadhan-201 (3567 kg/ha) and Naveen (3404 kg/ha). The wheat variety K0307 recorded the higher wheat yield (3378 kg/ha) In terms of system yield of rice with, Birsadhan201- wheat with GW-366 gave significantly higher system yield (7119 kg/ha) at **Ranchi (Jharkhand)**.

- In maize, green cob yield was highest in RCM 1-3 (6400 kg/ha) followed by RCM 75 (6030 kg/ha) and DA 61-A (5950 kg/ha) In Frenchbean, highest green pod yield was recorded in Naga local (4360 kg/ha) followed by RCM-FB-18 (4110 kg/ha) and RCM-FB-19 (3930 kg/ha) at **Umiam (Meghalaya).**

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

- Yield of all crops in cropping systems were found to be higher under broad bed and furrow (BBF) with incorporation of crop residue. BBF method of planting with crop residues produced higher net monetary returns and higher B:C ratio as compared to BBF without crop residues. BBF method of planting with crop residues was found beneficial for different cropping systems (either in sequence or intercropping systems) over conventional flat bed (FB) method of planting with crop residues. Groundnut (GPBD 4) + Cotton (Sahana) (2:1) intercropping system produced highest net monetary returns (Rs. 88,898/ha) compared to Greengram (DGGV 2)-Sorghum (cv. M 35-1) (Rs.74,230/ ha), Soybean (DSB 21) + Pigeonpea (TS 3R) (2:1) intercropping (Rs. 50.042/ha) and Soybean (cv. DSB 21)-Wheat (cv. DWR 2006) system (Rs. 48,254/ha). In Northern Transitional Zone (Zone 8) of Karnataka, Groundnut (GPBD 4) + Cotton (Sahana) (2:1) intercropping system was found more beneficial and more remunerative cropping system under organic production system compared to Soybean (DSB 21) + Pigeonpea (TS 3R) (2:1) intercropping and Soybean (DSB 21)-Wheat (DWR 2006) sequence cropping systems at **Dharwad (Karnataka)**.

- System Rice Intensification **(**SRI)-wheat-*sesbania* system recorded significantly higher grain yield (3336 kg/ha) and straw yield (7740 kg/ha), though, grain yield under SRI-Wheat-*Sesbania* system was at par with basmati rice-wheat-*sesbania* and Direct Seeded Rice (DSR)+ soybean -vegetable pea - mustard. Maximum grain yield of wheat (3450 kg/ha) was observed in DSR-wheat (zero tillage)–*sesbania* followed by 3061 kg/ha in basmati rice-wheat-*sesbania.* Green pod yield of vegetable pea was found highest (5109 kg/ha) in DSR-vegetable pea -cowpea on broad-bed and furrow system compared to 3343 kg/ha in DSR+soyabean -vegetable pea+mustard on furrow in raised-bed system. Chickpea yield under DSR-chickpea–moong on broad-bed and furrow system was 1405kg/ha. Mustard yield was found highest (636 kg/ha) in DSR+soyabean -vegetable pea+mustard on furrow in raised-bed system significantly higher wheat equivalent yield (5876 kg/ ha) was observed in DSR-chickpea–moong on broad-bed and furrow system over all other resource conservation practices at **Pantnagar (Uttrakhand)**.

- The highest vegetable yield was harvested in potato (16820 kg/ha) followed by carrot (14240 kg/ ha) and french bean (10060 kg/ha) on raised beds. The yield of okra during *kharif* was found higher with french bean as preceding crop and ranged from 8300 to 9060 kg/ha under different cropping sequences on raised beds. The rice productivity in sunken beds ranged from 3520 to 4290 kg/ha under various sequences with mean productivity of 3770 kg/ha. Among the rice varieties, Shahsarang-1 recorded the highest yield (4290 kg/ha) followed by Lampnah (4060 kg/ha). During *rabi* season, lentil yield ranged from 1160 to 1340 kg/ha at **Umiam (Meghalaya)**.

4. Development of Integrated Organic Farming System (IOFS) models

- One acre turmeric based IOFS model comprising of turmeric (0.2 ha), banana (0.01 ha), pineapple (0.02 ha), vegetable cowpea (0.01 ha) and fodder grasses *viz*. CO3, CO4 hybrid napier, congosignal (0.14 ha), and dairy (2 cows, 0.02 ha) is being established at **Calicut (Kerala)**. The model is in establishment stage.

- One acre IOFS model comprising of cropping systems [okra+leafcoriander-maize+cowpea (fodder) in 0.12 ha, green manure –cotton- sorghum in 0.12 ha, and fodder grasses COCN4 and desmanthus in 0.10 ha)+agroforestry (*Sesbania grandiflora*, *Thespesia populnea, Leucaena leucocephala* in

0.03 ha)+ dairy (2 cows, one calf in 0.01 ha+vermicompost in 0.01 ha +boundry planttaions (desmanthus, banana, *glyricidia*)+ supporting area (manure pit, threshing floor) in 0.01 ha has been established at **Coimbatore (Tamil Nadu).** The IOFS model couldgenerate net return of Rs. 74,316/acre with B:C ratio of 1.80. The contribution of cropping system and livestock to net return was found to be 87 and 11% respectively. The system also generates 84% of the organic inputs required for one acre IOFS.

- A 0.43 ha IOFS model comprising of cereals (rice, maize) pulses/oilseeds (soybean, lentil, pea), vegetables (frenchbean, tomato, carrot, okra brinjal cabbage, potato broccoli, cauliflower chilli, coriander), fruits (Assam lemon, papaya), livestock (dairy 1 cow 1 calf), fishery and fodder has been established at **Umiam (Meghalaya).** Net income of Rs. 58,321/year was recorded from the model which is 6 times higher than existing system (mono cropping of rice Rs. 8616) in the region. The model could also generate 90% of the seeds /planting materials, nutrients, required within the system.

5. Tribal Sub Plan

- Manarvanadesa farmer group was formed for organic certification from the 25 trained tribal families and registered at Joint Registrar Office at **Coimbatore (Tamil Nadu)**.

- Five members each of vermicompost and azolla production units were established in Kanker district of **Chhatisgarh**. Two trainings were also imparted.

- "Organic food production through integrated farming system" was undertaken in Mynsain village of Ri-bhoi district of **Meghalaya** using cluster approach. A total of 120 farm house holds in the village were covered for various interventions. Development of ponds (4 Nos.) Jalkunds (16 Nos.) community vermicomposting (8 tanks of 2m x 1.5 m x 0.75 m each), terracing (6 households), raised and sunken beds (11 families, total area 1.05ha), fruit tree plantations (200 nos. of guava), improved pig rearing (7 units), improved varieties of crops (13 crops), trainings (20 nos.) and field day (1 nos.) were undertaken to develop the cluster into organic food production unit. ITK's practiced by the villagers were also documented.

1. INTRODUCTION

Organic farming systems are very much native to Indian Agriculture. As of now also, in more than 85% of the farm-households, crop + livestock farming system is prevailing. Nevertheless, during pre-green revolution period (up to 1960s) the rate of national agricultural growth was not able to keep pace with population growth and virtually 'ship to mouth' situation prevailed. This was the major factor for introduction and large-scale popularization of the high yielding varieties (HYVs) of crops, which were highly responsive to the chemical fertilizers and water use. As a result, the total food grain production increased phenomenally – from mere 50.82 million tonnes in 1950-51 to 252 million tonnes in 2014-15 – indicating a 5-times increase. This increase can be primarily attributed to large-scale adoption of HYVs, combined with other green revolution technologies (GRTs) in cereal crops, expansion of gross irrigated area (22.56 million ha in 1950-51 to 89.36 million ha in 2010-11) and increase in fertilizer consumption (0.07 million tonnes in 1950-51 to 25.54 million tonnes in 2012-13). All of them put together have led to substantial increase in the productivity of crops, especially food grains (from 522 kg/ha in 1950-51 to 2125 kg/ha in 2012-13) culminating into the change in the status of India from a food importer to net food exporter in many commodities.

However, total factor productivity growth score prepared by National Institute of Agricultural Economics and Policy Research has revealed that technology-driven growth has been highest in Punjab and lowest in Himachal Pradesh. It implies that some of the states like Himachal Pradesh, Uttarakhand, Madhya Pradesh, Rajasthan, Jharkhand and north-eastern region of India have not been influenced much by the modern inputs of agriculture like chemical fertilizers and pesticides. India's average fertilizer and pesticide consumption stands at 128.3 kg/ha and 0.31 kg a.i./ha, respectively. Moreover, despite all technological advancements, the nutrient use efficiency is on lower side (33% for N, 15% for P and 20% for K and micronutrients). On the other hand, it has been proved scientifically and convincingly that integrated use of organic manures with chemical fertilizers improves the use efficiencies of the latter owing to concurrent improvement of soil physical, chemical and biological properties. The water holding capacity of the soil also gets improved on account of regular use of organic manures. It is estimated that various organic resources having the total nutrient potential of 32.41 million tonnes will be available for use in 2025. Out of these organic resources, considerable tapable potential of nutrients ($N + P_2O_5 + K_2O$) from human excreta, livestock dung and crop residues have been worked out to be only 7.75 million tonnes.

Organic is more of a description of the agricultural methods used on a farm, rather than food itself and those methods combine tradition, innovation and science. Organic agriculture, in simple terms, requires a shift from intensive use of synthetic chemical fertilizers, insecticides, fungicides, herbicides, PGRs, genetically engineered plants to extensive use of animal manures, beneficial soil microbes, bio-pesticides, bio-agents and indigenous technological knowledge, based on scientific principles of agricultural systems.India has a sizable cropped area in different states, which is more prone to weather vagaries; especially those located in rainfed, dryland and hilly areas. Increasing the agricultural productivity and income of the farmers as well as sustaining soil resource in these agricultural systems has always been a challenging task for researchers and policy planners. Presently, in these areas use of fertilizers and pesticides is minimal and much below the national average. At first instance, these are the areas which need to be targeted for organic production by devising proper strategies and identifying niche crops (crops which yield higher under organic production systems and have adequate market demand). The domestic and export markets must be exploited for increasing the income of the farmers, as it is important to note that 78% of Indian organic consumers prefer Indian brand of organic and many other countries also require diversified organic foods of tropical fruits, vegetables, essential oils, flowers, herbs, spices and organic cotton from India. In addition, large-scale adoption of organic agriculture in such areas will not only help in conserving the environmentally fragile ecosystems but also help in supplementing overall food production of the country. This can be clearly brought out by the example of Sikkim – an agriculturally

weak state located in north-eastern hills region of the country. During 2002-03 (before Sikkim Organic Mission) fertilizer consumption was the highest (21.5 kg/ha), the productivity of rice was 1.43 t/ha but 11 years later, i.e., during 2013-14, it increased to 1.81 t/ha, and more interestingly, no yield reduction was observed during conversion period. Productivity increase in other crops was also noted to the tune of 11%, 17% and 24% in maize, finger millet and buckwheat, respectively.

Area under organic farming, production and export (2014-15)

In world, 78 million ha area in 170 countries is under organic agriculture which includes both cultivated and wild harvest. Emerging from 42,000 ha under certified organic farming in 2003-04, the organic agriculture has grown many folds and by 2014-15, India has brought 4.89 m ha area under organic certification process. Out of this cultivated area accounts for 1.18 m ha (24.1 %) while remaining 3.71 m ha (75.9 %) is wild forest harvest collection area. Currently, India ranks 10th among the top ten countries having the cultivable land under organic certification. In terms of wild collection, India ranks 3rd next to Finland and Zambia. Around 6.50 lakhs producers are engaged in the country in various forms. Sikkim state has been declared as organic state from January 2016 and has highest net sown area (100 %) under organic certification while Madhya Pradesh is having largest area (2,32,887 ha) under organic production system. The domestic market for organic products in the year 2014-15 was estimated at Rs. 875 crores. India being a country with different agro-climatic zones, each state produces its own specialty products. Export volume and value from the country during last 3 years indicates highest volume of export to USA and in terms of Value to European Union during 2013-14 and over the years it has grown drastically. Among the various commodities exported, soybean shares 70 %. India's first internationally certified organic products emerged in the mid 70's, supported by UK's Soil Association. Different parts of India have developed their own local or regional systems for ecological agriculture that are now gathered in one umbrella term '*Jaivic Krishi' or* '*Jaivik Kheti'*.

In order to develop a package of practices for organic farming in a system mode, 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. During the year, four on-station experiments and one farmer participatory experiment was undertaken at various locations. The objectives along with significant findings of all the experiments are presented in the subsequent sections.

2. OBJECTIVES AND METHODOLOGY

Sheme 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), pulsesand 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 2013-14, following five experiments were undertaken at different centers:

- Evaluation of organic, inorganic and integrated production systems for crops and cropping systems
- Evaluation of response of different varieties of major crops for organic farming
- Evaluation of bio-intensive complimentary cropping systems under organic production systems
- Development of Integrated Organic Farming System models
- Tribal Sub Plan (TSP) activities in farmers field

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.

3. LOCATION

Multi-location experiments were conducted during 2013-14 at 13 research centers of SAUs/ ICAR Institutes in 12 states. Statewisedetails of centres are given below in the order of results presented in the chapter 7.

Sl. No.	Location of centre	State	Address of SAU/ICAR institute
1.	Bajaura	Himachal Pradesh	CSK HPKVV Hill Agri. Res. &Extn. Centre, Bajaura-175 125
2.	Bhopal	Madhya Pradesh	ICAR-Indian Institute of Soil Science, NabiBagh, 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 KrishiViswaVidyalaya, Jabalpur-482 004
7.	Karjat	Maharashtra	Dr. Balasaheb Sawant Konkan Krishi Vidypeeth, RARS, Karjat, Dist. Raigad – 410 201
8.	Ludhiana	Punjab	Punjab Agricultural University, Ludhiana-141 004
9.	Modipuram	Uttar Pradesh	ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut -250 110
10.	Pantnagar	Uttarakhand	G.B. Pant University of Agriculture Sciences and Technology, Pantnagar, Udham Singh Nagar – 263 145
11.	Raipur	Chhattisgarh	Indira Gandhi KrishiVishwavidyalaya, 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

4. MANPOWER

No regular posts, in any category, have been provided and the responsibility was assigned to a scientist, nominated as Principal Investigator of NPOF, by the parent institute/ university (Names and contact addresses of PIs are given in Annexure-I). The scientists of related disciplines were also involved in the research programme by the respective institution. In addition, two senior research fellows (as contractual staff) have been provided at each centre.

5. SOIL AND CLIMATE

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

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

S. No.	Name of centre	Soil Type	Weather				Latitude (N)	Longi-tude (E)
			Rainfall (mm)	Tempera-ture (°C)		R.H (%)		
				Max.	Min.			
1.	Bajura	Silty loam	883	26.2	11.1	68	31.8°	77°.0’
2.	Bhopal	Vertisols, Clayey Montmorill-onite/smectite type	1080	32.0	22.0	71	23°18’	77°24’
3.	Calicut	Clay loam, ustic Humitropept	4121	31.8	22.0	68	11°34’	75°48’
4.	Coimbatore	Udic, Rhodustalfs, fine loamy red and sandy soil	789	29.8	21.3	86	11°	77°.0’
5.	Dharwad	Verticinceptisoles	540	31.1	17.9	63	15°26’	75°07’
6.	Jabalpur	Vertisoils, Chromusterts	1389	29.7	21.7	67	23°90’	79°90’
7.	Karjat	Haplustultsudic-fluvents, red soil	3295	34 .0	21.0	69	18°33’	77°03’
8.	Ludhiana	Ustochrepts-Usticpramments association, alluvial, sandy & sandy loam	466	30.0	17.4	65	30°56’	75°52’
9.	Modipuram	Alluvium soils Typicustochrept	511	29.9	16.3	71	29°4’	77°46’
10.	Pantnagar	Hapludolls, very deep alluvium coarse loomy soils	2119	29.4	17.0	71	29°08’	79°05’
11.	Raipur	Ochraquals association, deep black soil	1361	32.9	20.4	56	21°16’	81°36’
12.	Ranchi	Ultic Palesustalfs, very deep soils	1020	29.6	15.6	72	23°17’	85°19’
13.	Umiam	Clay loam	3085	20.6	4.6	75	25°41’	91°54’

“The ultimate goal of farming is not the growing of crops, but the cultivation and perfection of human beings.”

–Masanobu Fukuoka, The One-Straw Revolution

Initial nutrient status of soil (2003-04)

S.No.	Centre	OC %	N (kg/ha)	P (kg/ha)	K (kg/ha)	S (ppm)	Fe (ppm)	Zn (ppm)
Experiment 1								
1.	Bajaura	0.45	146	43.3	121	22.4	30.0	1.20
2.	Bhopal	0.53	154	12.7	530	4.9	5.5	0.74
3.	Calicut	2.40	220	24.6	264	-	72	3.80
4.	Coimbatore	0.60	269	17.9	690	-	66.0	10.0
5.	Dharwad	0.41	250	23.0	330	20.0	7.5	0.80
6.	Jabalpur	0.70	264	12.6	282	9.8	2.37	0.32
7.	Karjat	1.10	234	30.0	350	-	-	1.72
8.	Ludhiana	0.34	278	36.3	134	-	-	-
9.	Modipuram	0.59	-	-	-	-	-	-
10.	Pantnagar	0.65	238	16.7	156	65.0	30.24	0.84
11.	Raipur	0.64	237	13.0	274	-	-	-
12.	Ranchi	0.44	320	48.0	270	-	59.8	1.22
13.	Umiam	1.32	186	10.4	165	-	-	-

6. BUDGET

A total budget of ₹ 110 lakh was released to 13 centres during 2013-14. The centre wise allocation of funds are given below.

(₹ in lakhs)

Sl. No.	Name of Centre	T. A.	Cont. Service	Other Cont.	TSP general	Total
1.	HAREC, Bajaura	0.20	4.75	5.83	0.00	10.78
2.	ICAR-IISS, Bhopal	0.30	4.90	3.32	0.00	8.52
3.	ICAR-IISR, Calicut	0.20	4.95	2.80	0.00	7.95
4.	TNAU, Coimbatore	0.20	3.40	3.50	1.00	8.10
5.	UAS, Dharwad	0.30	3.65	1.45	7.65	13.05
6.	JNKVV, Jabalpur	0.20	5.45	3.20	1.00	9.85
7.	ARS, Karjat	0.10	1.40	0.70	1.00	3.20
8.	PAU, Ludhiana	0.20	3.00	2.32	0.00	5.52
9.	ICAR-IIFSR, Modipuram	0.20	6.00	2.43	0.00	8.63
10.	GBPUA&T, Pantnagar	0.30	6.25	3.50	0.00	10.05
11.	IGKV, Raipur	0.10	1.20	0.70	1.00	3.00
12.	BAU, Ranchi	0.10	2.40	1.20	1.00	4.70
13.	ICAR-RC-NEH, Umiam	0.30	6.00	3.00	7.35	16.65
	Total	2.70	53.35	33.95	20.00	110.00

7. RESEARCH RESULTS

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

Title of the experiment: Evaluation of organic, inorganic and integrated production systems for crops and cropping systems and its influence on crop productivity and soil health

Objectives:

- To study the impact of organic, inorganic and integrated management packages on crop productivity and soil health.
- To study the impact of various packages on soil microbial population 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 in Modipuram and Umiamwhere it was started during 2005-06. The cropping system adopted remained almost same for all the years in each centres except Ludhiana where the cropping system was changed during 2008-09 in one set of experiment as Ludhiana centre evaluated two set of cropping systems.

Treatments: The long term experiment was conducted in split plot design as un-replicated trial with year as application. However, Raipur, Calicut, Karjat, Ludhiana, Bhopal, Pantnagar and Umiam centres have conducted the experiment with three replications. The experiment was modified during 2013-14 by dividing the organic, inorganic and integrated plots into two plots for all the cropping systems.The details of the treatments of modified experiment is given below.

Main Plot	Organic management ***(Organic)***	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 ***(Towards organic)***	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 assigned to the sub plots. The number of cropping systems ranged from 3 (Coimbatore) to as high as 5 (Dharwad) in various centres. The details of cropping systems are given in Table 7.1.1 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 at the 13 locations.

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	Vermicompost	0.90	0.50	0.75
	FYM	1.15	0.50	1.00
	Urea	46.00	-	-
	SSP	-	16.00	-
	MOP	-	-	60.00
	Rock phosphate	-	34.0	-
Bhopal	Vermicompost	1.14	0.72	0.68
	Neem cake	4.17	0.92	1.04
	Sesbania rostrata	2.90	0.7	1.54
Calicut	Farm Yard Manure	0.69	0.38	0.54
	Neem cake	1.62	0.34	1.41
	Ash	-	0.23	6.6
	Vermi-compost	0.89	0.28	0.65
	Green leaf manure	2.22	0.13	0.85
	Rajphos	-	18.5	-
	Urea	46	-	-
	MOP			58
Coimbatore	Vermicompost	1.14	0.72	0.68
	Neem cake	4.17	0.92	1.04
	Sesbania rostrata	2.90	0.7	1.54
Dharwad	Enriched compost	0.70	0.40	0.80
	Vermicompost	1.00	0.86	0.98
	Gliricidia	0.50	0.32	1.15
	FYM	0.50	0.35	0.50
	Urea	46	-	-
	SSP	-	16	-
	MOP	-	-	60
Jabalpur	GM (Sunhemp)	0.66	0.13	0.50
	FYM	0.54	0.20	0.26
	VC	1.8	0.75	1.00
	Neem oil Cake	5.2	1.10	1.50
	Non-edible oil Cake (NEOC)	5.20	1.10	1.50
	Urea	46.0	-	-
	SSP	-	16.0	-
	MOP	-	-	60.0
Karjat	F.Y.M.	0.50	0.25	0.50
	Neem cake	5.20	1.00	1.40
	Vermi-compost	1.50	1.00	1.50
	Glyricidia green leaves	2.74	0.50	1.15
	Paddy straw	0.61	0.16	1.14
Ludhiana	Urea	46.0	-	-
	DAP	18.0	46.0	-
	MOP	-	-	60.0
Modipuram	FYM	0.51	0.30	0.65
	VC	1.28	0.47	1.39
	Sesbania	2.25	0.41	3.01
	Urea	46.0	-	-
	DAP	18.0	46.0	-
	MOP	-	-	60.0

Centre	Nutrient Sources	NPK contents on dry weight basis (%)		
		N (%)	P (%)	K (%)
Raipur	Enriched compost	0.40	0.30	0.60
	Cow dung manure	0.60	0.30	0.70
	N.E.O.C. – Non edible oil cake	3.0	0.70	1.70
	Rock phosphate		23	
Ranchi	FYM	0.5	0.3	0.5
	VC	1.2	0.45	1.4
	KC	4.0	1.0	1.0
	Urea	46.0	-	-
	SSP	-	16.0	-
	MOP	-	-	60.0
Umiam	F.Y.M.	0.72	0.29	0.61
	Vermicompost	1.50	0.62	1.00
	Rock phosphate	-	18.00	-
	Tephrosia spp	3.31	0.44	1.46

Results

The parameter wise result of 2013-14 for each centre are presented and discussed.

Influence of organic management package with reduced dose of organic manures, integrated and inorganic management packages on economic yield, straw yield and system equivalent yield (Table 7.1.1 to 7.1.3)

Bajaura: Vegetable based cropping systems were evaluated. Among the crops evaluated in cropping systems, summer cauliflower (8220 kg/ha) and french bean (4800 kg/ha) recorded higher or on par yield under organic management than integrated or inorganic packages. Crops such as tomato in *Kharif* and *rabi*, cauliflower in *rabi* and okra in *kharif* registered better yield with integrated package consisting of 50% each of organic and inorganic. Response of black gram was found to be better with 75% organic +25% inorganic management approach (1070 kg/ha). Summer squash and rabi pea registered higher yield with state recommendation (31110 kg/ha and 8370 kg/ha) having combination of 100% inorganic source of

Summer squash under integrated crop management practice at Bajaura

Blackgram under integrated crop management at Bajaura

Table 7.1.1. Influence of organic, inorganic and integrated package on grain yield (kg ha^{-1}) of crops at various locations

Locations/Treatments	Organic management						Inorganic management						Integrated management					
	100% organic			75% organic + 2 innovative inputs			100% in organic			State recommendation/ farmer's package			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Bajaura																		
Tomato-cauliflower - french bean	15200	14510	4220	15710	14330	4800	13160	8400	1270	15200	10500	4180	19800	16640	3310	16810	15080	4870
Tomato-cauliflower		13950	8220		14970	6400		7550	3310		9500	5670		15200	7660		14580	6800
Black gram-cauli-flower- summer squash	840	16000	14840	810	16300	15200	500	12050	27020	540	12500	31110	930	18400	22780	1070	17820	25220
Lady finger-pea	13330	6880		11910	7550		5850	4270		6500	8370		14310	7990		13270	7330	
Bhopal																		
Soybean-durum wheat	511	2722		475	2689		423	2344		430	2422		451	2511		473	2656	
Soybean- mustard	533	1003		487	978		362	882		391	896		399	907		481	947	
Soybean- chickpea	456	1478		489	1404		389	1163		412	1278		425	1319		490	1374	
Soybean- linseed	511	1393		459	1367		383	1244		403	1267		391	1315		461	1333	
Calicut																		
Ginger (Varada)	25100	20500					19800						15400					
Ginger (Rejatha)	24500	13700					14300						12600					
Ginger (Mahima)	19500	23800					19500						13000					
Turmeric (Alleppey Supreme)	15200	16700					18300						22600					
Turmeric (Prathibha)	15300	17000					21700						19800					
Black Pepper-fellow	1800						1130						830					
Coimbatore																		
Cotton - maize	1165	5481		1375	6021		1334	5831		1663	6220		1190	5991		1602	6425	
Chillies - sunflower	6215	1373		7108	1475		6987	1405		7214	1510		6522	1484		8265	1642	
Beetroot - maize	24800	4015		26300	4643		26200	4234		28200	4925		25800	4426		28900	5240	
Dharwad																		
Cowpea-safflower	1229	1412		1059	1392		1008	1300		1270	1542		1159	1533		1108	1442	
Pigeonpea (Sole)	2484			2393			2197			2653			2617			2441		
Greengram-sorghum	1266	4418		1222	4290		1095	3987		1321	4586		1322	4476		1212	4313	
Groundnut + hybrid cotton (2:1)	4392	1596		4215	1528		3933	1380		4430	1637		4236	1572		4249	1504	
Maize-chickpea		2550			2393			2197			2653			2551			2474	

Locations/Treatments	Organic management						Inorganic management						Integrated management					
	100% organic			75% organic + 2 innovative inputs			100% in organic			State recommendation/ farmer's package			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*
Jabalpur																		
Basmati rice–durum wheat-green manure	3498	3330		3222	3071		3782	3522		3393	3006		3509	3383		3363	3174	
Basmati rice–chick-pea - maize fodder	4022		37600	3328		35300	3822		41100	3632		34800	3498		38900	3222		37100
Basmati rice–ber-seem (fodder and seed)	3871	223	87500	3385	210	84500	3591	241	92200	3455	206	74800	4022	213	88000	3328	208	88000
Basmati rice–vege-table pea- sorghum (fodder)	3791	3923	42300	3264	3733	39800	3567	4166	46100	3387	3529	35000	3871	3841	40200	3385	3611	46900
Karjat																		
Rice-groundnut	3418	1876		3354	1732		3674	2264		3620	2044		3914	2153		3319	2083	
Rice-maize (Sweet corn for cob)	3129	14166		3155	14012		3338	14755		3241	14074		3234	14327		3211	14248	
Rice-mustard	3137	715		3186	686		3249	877		3165	692		3220	797		3194	744	
Rice-dolichos bean (for green pod vegetable)	3324	4974		3228	4874		3876	5575		3262	5246		3559	5358		3514	5315	
Ludhiana																		
Basmatti rice-chickpea	3960	1470		4180	1270		4060	800		4090	720		4180	1350		4110	1340	
Basmati rice-wheat	3980	3740		4060	3460		4240	5730		4030	5480		4030	5380		4100	5300	
Moong-wheat		4890			4510			5770			5650			5800			5610	
Pegionpea -wheat	450	4830		470	4630		590	5780		620	5570		410	5870		420	5620	
Modipuram																		
Basmati rice–wheat (durum) - Sesbania green manure	4420	3860		4270	4140		3220	2820		3620	3380		4520	3950		4680	4190	
Rice– barley (malt) – green gram	4030	3640	795	3890	3780	814	2970	2710	645	3480	3140	770	4070	3970	864	4210	4120	885
Maize (pop corn) – potato– okra + Sesbania green manure	1960	23830	9860	2030	22420	9540	1530	17020	7450	1720	19530	8230	2120	20350	8890	2270	21340	9240

Locations/Treatments	Organic management						Inorganic management						Integrated management					
	100% organic			75% organic + 2 innovative inputs			100% in organic			State recommendation/ farmer's package			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*
Maize (sweet corn) – mustard - Sesbania green manure	10370	1870		10820	2090		8520	1430		8860	2040		11370	1680		11730	1810	
Pantnagar																		
Rice-wheat - *Sesbania*	3489	4714		3517	4642		2741	4858		2601	4949		3448	5107		3519	5057	
Rice-chickpea + coriander-*sesbania*		1202			1140			988			870			1046			1142	
Rice-vegetable pea+ Coriander-*sesbania*		4321			4242			3642			3542			3821			4046	
Rice-potato-*sesbania*		8513			8032			2597			3961			7006			7195	
Raipur																		
Soybean-maize	1735	8233		1511	7667		1765	8467		1887	8633		1767	7883		1707	8000	
Soybean-pea	1807	6600		1566	6133		1760	6733		1935	7067		1745	6567		1764	6400	
Soybean-chilli	1763	9433		1607	8933		1787	9533		2088	9967		1736	9400		1839	9166	
Soybean-onion	1654	9933		1774	9267		1772	10167		1977	10400		1770	9733		1692	9468	
Ranchi																		
Rice (Basmati rice) - Wheat (K 9107)	3427	2720		3356	2680		2642	3000		2392	2500		3106	2900		2963	2880	
Rice (Basmati rice) - Potato (Kufri Ashoka)	3463	19007		3213	18850		2678	14662		2356	13173		3177	17357		2927	16729	
Rice (Basmati rice) - Linseed (Shekhar)	3570	803		3356	793		2785	571		2570	518		3177	778		3070	768	
Rice (Basmati rice) -Lentil (PL 406)	3320	420		3106	400		2606	440		2249	390		2927	560		2892	480	
Umiam																		
Raised bed systems																		
Rice-carrot	2860	13220		2370	9540		3510	12750					4180	10850				
Rice-potato	3020	14370		2770	10490		3230	13860					4150	11080				
Rice-french bean	3250	8110		2970	7180		3580	8560					4070	6370				
Rice-tomato	3830	14810		3330	11180		3420	14260					4090	11460				
Mean	3240			2860			3435						4123					

Umiam: Sunken bed systems, Megha aromatic 2 (3990 kg/ha), Ngoba (4390 kg/ha), Lampnah (3850 kg/ha) and Shasharang-1 (4470 kg/ha)

Table 7.1.2. Influence of organic, inorganic and integrated packages on straw yield (kg ha^{-1}) of crops at various locations

Locations/Treatments	Organic management						Inorganic management						Integrated management					
	100% organic			75% organic + 2 innovative inputs			100% in organic			State recommendation/ farmer's package			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Bajaura																		
Tomato-cauliflower - french bean	2310	4890	3560	3560	5070	3200	2670	5560	2310	3200	5910	4220	2270	6800	3870	4310	5780	3780
Tomato-cauliflower		5330			5870			5570			6310			6130			6670	
Black gram-cauli-flower- summer squash	1910	5560		1820	5640		1780	6530		2130	5560		2270	5730		2310	5870	
Lady finger-pea	608	6200		579	5890		738	6170		702	6000		721	6540		684	6700	
Bhopal																		
Soybean-durum wheat	1329	3885		1352	3689		1333	3511		1398	3823		1135	3000		1139	2989	
Soybean- mustard	1504	3386		1369	3055		1323	2840		1401	2941		1045	2408		1070	2460	
Soybean- chickpea	1383	2313		1352	2437		1314	2456		1425	2475		1011	1966		1096	1986	
Soybean- linseed	1400	2215		1374	2066		1370	2052		1438	2100		1109	1903		1143	1930	
Coimbatore																		
Cotton - maize		5319			5829			5598			5957			5788			6172	
Chillies - sunflower	5319	3715		5829	4194		5598	4042		5957	4335		5788	4095		6172	4512	
Beetroot - maize		4737			5274			4815			5692			5031			5862	
Dharwad (DMP g/plant)																		
Cowpea-safflower	31.8	42.3		30.3	42.8		28.1	41.5		33.4	40.5		32.8	43.8		29.3	42.9	
Pigeon pea (Sole)	221.3			220.9			214.8			245.6			242.5			210.4		
Green gram-sorghum	0.3	179.3		0.3	167.5		0.2	158.7		0.4	181.4		0.3	179.3		0.3	172.3	
Groundnut + hybrid cotton (2:1)	46.2	197.4		44.4	194.3		36.0	185.8		46.8	198.9		47.5	195.3		40.4	193.9	
Maize-chickpea		24.6			24.2			23.1			26.4			24.5			24.7	
Jabalpur																		
Basmati rice–durum wheat-green manure	5449	5071		5046	5639		6028	6148		4892	5377		5541	5311		5263	5224	
Basmati rice–chickpea - maize fodder	5251	428		4933	415		5561	461		4787	435		5147	456		4936	421	
Basmati rice–berseem (fodder and seed)	4967			4826			5322			4684			5087			4831		

Locations/Treatments	Organic management						Inorganic management						Integrated management					
	100% organic			75% organic + 2 innovative inputs			100% in organic			State recommendation/ farmer's package			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Basmati rice–vegetable pea- sorghum (fodder)	5239			4623			5322			4798			5147			4822		
Karjat																		
Rice-groundnut	4032	2756		3959	2544		4620	3329		3918	3000		4336	3165		4272	3061	
Rice-maize(Sweet corn for cob)	3691	18128		3723	17931		3939	18893		3822	18013		3816	18350		3791	18238	
Rice-mustard	3702	960		3758	918		3834	1177		3735	928		3799	1066		3770	999	
Rice-dolichos bean (for green pod vegetable)	3921	1765		3809	1728		4571	1977		3850	1860		4199	1900		4146	1884	
Ludhiana																		
Basmatti rice-chickpea	6730	4500		6350	4840		6160	1870		6600	1750		6260	5560		6420	4970	
Basmati rice-wheat	6200	4580		6890	4340		6030	6660		6510	6650		6340	6160		6850	6000	
Moong-wheat		6070			5430			6480			6570			6460			6420	
Pegionpea -wheat	10910	5850		10240	5580		10250	6880		10360	6730		10410	6420		9410	6470	
Modipuram																		
Basmati rice–wheat (durum) - *Sesbania* green manure	6900	6410		6920	6330		5510	5300		5830	5780		7280	6240		7210	6410	
Rice– barley (malt) – green gram	6290	6040	2580	6300	6160	2700	4990	4770	2420	5600	5060	2780	6550	6670	3040	6570	6720	3170
Maize (pop corn) – potato– okra + *Sesbania* green manure	3250			3490			2720			2940			3630			3770		
Maize (sweet corn) – mustard-*sesbania* green manure	14100	7340		15360	7850		12520	5870		12490	7560		16030	6690		15960	6770	
Pantnagar																		
Rice-wheat-*sesbania*		6762			5182			5144			6160			6779			7460	
Rice-chickpea + coriander-*sesbania*		2016			2880			1280			1142			2322			3824	
Rice-vegetable pea+ Coriander-*sesbania*																		
Rice-potato-*sesbania*																		

Locations/Treatments	Organic management						Inorganic management						Integrated management					
	100% organic			75% organic + 2 innovative inputs			100% in organic			State recommendation/ farmer's package			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*
Mean	5766			5978			5941			5816			6117			6023		
Raipur																		
Soybean-maize	3294			3163			3580			3689			3073			3133		
Soybean-pea	3162			2797			3334			3610			3326			3350		
Soybean-chilli	3136			3156			3450			3571			3350			3227		
Soybean-onion	3316			3173			3099			3522			3633			3150		
Mean	3227			3072			3366			3598			3346			3215		
Ranchi																		
Rice(Birsamati) - Wheat (K 9107)	5523	3808		5416	3752		4637	4200		4284	3500		5069	4060		4916	4032	
Rice(Birsamati) - Potato (Kufri Ashoka)	5416	2854		5094	2830		4630	2202		4309	1978		5059	2606		4844	2512	
Rice (Birsamati) - Linseed (Shekhar)	5783	1499		5555	1428		4773	1071		4463	1071		5316	1214		5169	1196	
Rice (Birsamati) - Lentil (PL 406)	5237	1155		4952	1100		4166	1210		3881	1073		4702	1540		4630	1320	

Table 7.1.3. Influence of organic, inorganic and integrated package on systems equivalent yield (kg ha^{-1}) at various locations

Location	Cropping Systems/ Management practice	Organic management		Inorganic management		Integrated management		Mean
		100% organic	75% organic + 2 innovative inputs	100% inorganic	State recommendation + farmer's package	50% organic+ 50% inorganic	75% organic+ 25% inorganic	
Bajaura	Tomato-cauliflower-french bean	30130	30913	34800	32558	19540	26080	29003
	Cauliflower-tomato	20115	19770	20945	19680	10033	13753	17383
	Black gram-cauliflower-summer squash	32170	32560	41065	43155	35315	39073	37223
	Lady's finger-pea	16878	16483	18723	17283	8658	13245	15211
	Mean	24823	24931	28883	28169	18386	23038	
Bhopal	Soybean-durum wheat	2036	1981	1736	1786	1857	1960	1893
	Soybean-maize	1757	1680	1437	1485	1506	1637	1584
	Soybean- chickpea	2288	2229	1831	1996	2060	2194	2100
	Soybean- linseed	2516	2427	2175	2227	2284	2381	2335
	Mean	2149	2079	1795	1873	1927	2043	
Calicut	Ginger (Varada)	25100	20500		19800		15400	20200
	Ginger (Rejatha)	24500	13700		14300		12600	16275
	Ginger (Mahima)	19500	23800		19500		13000	18950
	Mean	23033	19333		17867		13667	
	Turmeric (Alleppey Supreme)	15200	16700		18300		22600	18200
	Turmeric (Prathibha)	15300	17000		21700		19800	18450
	Mean	15250	16850		20000		21200	
	Black pepper-fellow	1800			1130		830	1253
Dharwad	Cowpea-safflower	4294	3928	3706	4545	4311	4091	4146
	Pigeonpea	2484	2393	2197	2653	2617	2441	2464
	Sorghum-greengram	7322	7093	6499	7619	7509	7093	7189
	Groundnut + hybrid cotton (2:1)	8459	8114	7505	8549	8191	8143	8160
	Maize-chickpea	2550	2393	2197	2653	2551	2474	2470
	Mean	5022	4784	4421	5204	5036	4848	
Jabalpur	Basmati rice – durum wheat-green manure	5441	5013	5482	5215	5837	5147	5356
	Basmati rice – chickpea - maize fodder	15666	14260	15544	14711	16550	14409	15190
	Basmati rice – berseem (fodder and seed)	44644	42755	45017	44319	46559	38324	43603
	Basmati rice – vegetable pea- sorghum (fodder)	24121	22436	23309	25156	25609	20503	23522
	Mean	22468	21116	22338	22350	23639	19596	
Karjat	Rice-groundnut	15949	15016	14356	13962	15153	13430	14644
	Rice-maize (sweet corn for cob)	25368	25182	20612	20491	21235	20320	22201
	Rice-mustard	8598	8512	7344	7080	7738	6811	7681
	Rice-dolichos bean (for green pod vegetable)	19022	18599	16370	16219	17235	15766	17202
	Mean	17234	16827	14671	14438	15340	14082	

Location	Cropping Systems/ Management practice	Organic management		Inorganic management		Integrated management		Mean
		100% organic	75% organic + 2 innovative inputs	100% inorganic	State recommendation + farmer's package	50% organic+ 50% inorganic	75% organic+ 25% inorganic	
Ludhiana	Basmatti rice-chickpea	5859	5820	5093	5020	5924	5841	5593
	Basmati rice-wheat	6162	6078	7583	7227	7168	7192	6902
	Moong-wheat	2853	2631	3366	3296	3383	3273	3133
	Pegionpea -wheat	3624	3543	4429	4360	4159	4031	4024
	Mean	4624	4518	5118	4976	5159	5084	
Modi-puram	Basmati rice– wheat (durum) - *sesbania* (green manure)	6901	6931	5033	5793	7059	7374	6515
	Rice– barley (malt) – green gram	9922	9972	7527	8833	10487	10832	9596
	Maize (pop corn) – potato– okra + *sesbania* (green manure)	9322	9052	6935	7808	8576	9011	8451
	Maize (sweet corn) – mustard - *sesbania* (green manure)	15980	17090	12810	14980	16410	17160	15738
	Mean	10531	10761	8076	9353	10633	11094	
Pantnagar	Basmati rice-wheat -*sesbania* (GM)	5818	5807	5967	6014	4992	4894	5582
	Basmati rice-chickpea + coriander-*sesbania* (green manure)	6374	6253	5958	6260	4964	4559	5728
	Basmati rice-vegetable pea+coriander *sesbania* (green manure)	4641	4648	4467	4598	3652	3487	4249
	Basmati rice-potato-*sesbania*	5759	5659	5316	5438	3434	3657	4877
	Mean	5648	5592	5427	5577	4260	4149	
Raipur	Soybean-maize	9968	9178	8539	8793	8073	8107	8776
	Soybean-pea	8407	7699	7146	7589	6998	6884	7454
	Soybean-chilli	8838	8306	7507	8069	7376	7339	7906
	Soybean-onion	11587	11041	9906	10297	9557	9266	10275
	Mean	9700	9056	8274	8687	8001	7899	
Ranchi	Basmati rice -wheat	6147	6036	5539	4806	5906	5744	5696
	Basmati rice-potato	14324	13984	10767	9624	12753	12157	12268
	Basmati rice-linseed	5635	5395	4203	3856	5109	4977	4862
	Basmati rice-lentil	4280	4020	3577	3110	4163	3951	3850
	Mean	7597	7359	6021	5349	6983	6707	

nutrients and integrated package of pest and disease management. It is also important to note that *kharif* and *rabi* tomato, summer french bean, rabi cauliflower, summer squash and rabi pea recorded higher yield with organic crop management with only 75% nutrients supplied through organic manures, thus implying possibility of reduced manure application after building up of soil organic carbon. However, in case of rabi cauliflower, *kharif* blackgram and okra, yield reduction of 22, 3 and 10 % was observed with reduced application of nutrients in the form of organic manures under organic management. Residues yield of crops also followed the similar trend. In terms of system equivalent yield, among the different management practices, inorganic management with 100% recommended dose of nutrients resulted in higher tomato equivalent yield (28883 kg/ha) of system across the cropping systems. Among the organic management, application of 75% nutrients only through organic manures, the yield was at par (24931 kg/ha) with organic management with 100% nutrients. Among the different systems evaluated, blackgram-cauliflower-summer squash resulted in higher system equivalent yield of 37223 kg/ha.

Bhopal: Soybean based cropping systems were evaluated. Due to the rainfed situation, all the crops evaluated in cropping systems recorded higher yield under organic management compared to integrated and inorganic practices. Organic management package with 75% nutrients only through organic manures+innovative practices recorded comparable yield with that of organic management with 100% nutrients through manures. The yield difference observed between 75 and 100% nutrients application through organic manures under organic management was only 4.8, 1.2, 2.5, 5 and 1.8 % for soybean, durum wheat, mustard, chickpea and linseed respectively. *These findings are very important as it gives scope to reduce the 25% manure application thus directly reducing the cost of cultivation under organic management, than all the other management practices such as inorganic (100% inorganic management and state recommendation) and integrated (50 % inorganic + 50% organic, 75% organic, 25% inorganic) crop management.* Straw yield of crops also recorded similar trend. In terms of system (soybean) equivalent yield, organic management registered higher yield (2149 and 2079 kg/ha under organic management with 100% and 75% nutrients through organic manures respectively) than integrated and inorganic management packages. Among the systems, soybean-linseed recorded higher yield (2335 kg/ha) followed by soybean-chickpea.

Wheat under towards organic (integrated) crop management practice at Bhopal

General view of evaluation of management practices for ginger at Calicut

Calicut: Spices crops such as ginger, turmeric and black pepper were evaluated under different management packages. Ginger recorded

significantly higher yield (23033 kg/ha) under organic management with 100% nutrients through organic manures compared to other management practices. Among the 3 varieties of ginger, varada recorded higher yield (25100 kg) under organic management. Reduction of 25% nutrients under organic management resulted in significant yield reduction of 16% implying required application of 100% nutrients for ginger in the term of organic manures every year. Turmeric recorded significantly higher yield (21200 kg/ha) with integrated package consisting of 50% organic +50% inorganic. However among the organic management, reduced application of nutrients (75% and 100%) through organic manures resulted in higher yield of turmeric (16850 kg/ha) than organic crop management with 100% nutrients (15250 kg/ha). Alleppey supreme variety of turmeric recorded higher yield than Prathiba in integrated package. However, under organic management, Prathibha variety performed better. Black pepper recorded significantly higher yield (1800 kg/ha) under organic management than inorganic and integrated packages. The yield increase was found to be 59 and 116% over inorganic and integrated package.

Coimbatore: Crops such as cotton, maize, chillies, sunflower and beetroot were evaluated in 3 cropping systems. Among the crops evaluated in cropping systems, maize, chiliee, sunflower and beetroot recorded higher yield under integrated package with 75% organic +25% inorganic. Cotton recorded higher yield under state recommendation of applying 100% nutrients through inorganic sources coupled with application of organic manures. Among the organic management, all the crops registered higher yield under reduced application of manures (75% nutrients only through organic manures with total organic management) compared to 100% nutrients supply through organic manures. The yield increase was found to be 18, 12, 14, 7.4 and 6% for cotton, maize, chillies, sunflower and beetroot respectively. Residues/straw yield also exhibited the similar trend.

Performance of beetroot under integrated crop management at Coimbatore

Performance of cotton under integrated crop management at Coimbatore

Dharwad: All the evaluated crops except green gram recorded higher yield under state recommendations consist of organic and inorganic. Cowpea, safflower, pigeon pea, sorghum, groundnut, cotton and chickpea recorded higher yield (1270, 1542, 2653, 4586, 4430, 1637&1551 kg/ha respectively) under state recommendation of nutrient supply. green gram recorded highest yield (1322 kg/ha) under integrated nutrient management package with 50% organic + 50% inorganic nutrient sources which was at par with inorganic nutrient packages. The yield reduction under organic management found in safflower, pigeonpea, green gram, sorghum, groundnut, hybrid cotton, maize and chilli were 18.6, 20.8, 15.1, 12.6, 18.6 & 20.8

% respectively over inorganic nutrient packages. The straw yield also gave similar trend. The system equivalent yield was found to be higher (5204 kg/ha) under state recommendation. Among the cropping systems, groundnut-hybrid cotton recorded higher yield (8160 kg/ha) among all the cropping systems followed by sorghum-green gram (7189 kg/ha) cropping system.

Jabalpur: Rice based cropping system with crops such as wheat, chickpea, maize, berseem, pea and sorghum were evaluated. Rice recorded higher yield under organic package with 100% organic nutrient supply and integrated package with 50% organic and 50% inorganic nutrient source. Whereas wheat (3522 kg/ha), maize (41100 kg/ha), berseem (fodder and seed) (241 & 92200 kg/ha), pea (4166 kg/ha) were recorded higher under inorganic nutrient package with 100% inorganic nutrient management. Sorghum recorded higher yield under integrated crop management package with 75% organic and 25% inorganic nutrient sources. The yield reduction of rice, wheat, maize, berseem, pea and sorghum in organic management with 75% nutrients through organic manure was found to be 7.9, 7.8, 6.1, 5.8, 4.8, and 5.9 % respectively over 100% nutrients based organic management. Straw yield also recorded same trends. Rice equivalent yield of system were found to be higher (23639 kg/ha) with management package having 50% organic and 50% inorganic nutrient sources. In terms of cropping systems higher yield (43603 kg/ha) were found with rice-berseem (seed &fodder) followed by basmati rice-vegetable pea-sorghum (23522 kg/ha).

Performance of rice under different management practice at Jabalpur

Performance of maize and groundnut under organic management at Karjat

Karjat: Rice based cropping system were evaluated. Among the different crops, rice recorded higher yield (3914 kg/ha) in integrated nutrient package with 50% organic and 50 % inorganic nutrient supply. Groundnut, maize, mustard and dolichos, recorded higher yield with inorganic nutrient package having 100% nutrient supply. Inorganic nutrient management practices were found to be better for mustard, groundnut and dolichos. The reduction of yield of rice, groundnut, maize, mustard and dolichos with 75% nutrient supply through organic manure over 100% nutrient under organic management were recorded 1.8, 7.8, 1.0, 4.0, & 2.0 % respectively. Straw yield also gave to be similar trend. The rice equivalent system yield were recorded higher (19022 kg/ha) with organic package having 100% nutrients through organic manure. Rice- maize was found to be performing better (22201 kg/ha) compared to other cropping systems.

Ludhiana: Basmati rice based cropping systems were evaluated. Among the crops evaluated, chick pea (1470 kg/ha) and rice (4180 kg/ha) recorded higher yield under organic nutrient package. This was also at

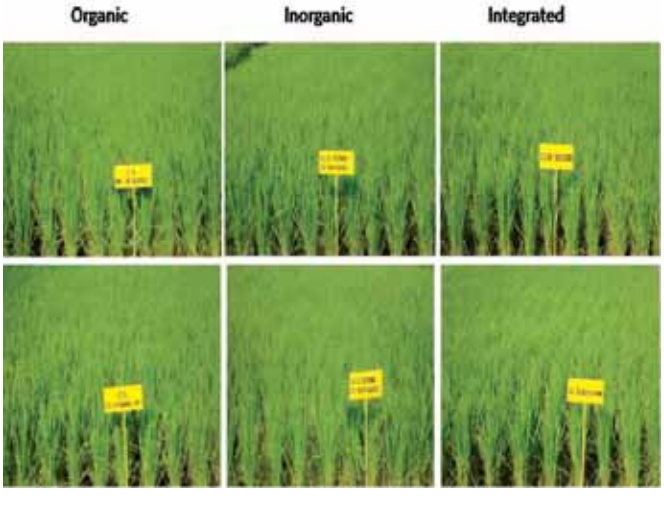
Comparison of soil condition under inorganic and organic management at Ludhiana

Monitoring of experiment by University official at Ludhiana

Observations on insect pest attack on rice at Ludhiana

Modipuram: Different crops were evaluated in rice and maize based cropping system. Rice, wheat, barley, greengram, maize (popcorn), maize (sweet corn), recorded higher yield (4680, 4190, 4120, 885, 2270, 11730 kg/ha respectively) under integrated management system with 75% organic + 25% inorganic nutrient sources. Potato, okra and mustard recorded higher yield (23830, 9860 & 2090 kg/ha respectively) under organic management. Straw yield also gave similar trend. The system equivalent yield were recorded higher (11094 kg/ha) in integrated packages with 75% organic and 25% inorganic nutrients. Among all the cropping systems, higher yield (15738 kg/ha) was recorded with maize (sweet corn)-mustard-sesbania system.

par with integrated and inorganic packages. Crops such as pigeon pea (620 kg/ha) was found to be better under state recommendation package. Wheat recorded higher yield (5800 kg/ha) in integrated package with 50% each organic and inorganic nutrient supply. Residue yield of all the crops also resulted in similar trend. In terms of system equivalent yield, integrated management with 50% organic +50% inorganic source of nutrient resulted in higher rice equivalent yield (5159 kg/ha) as compared to other nutrient packages. In term of cropping systems, rice equivalent yield found higher (6902 kg/ha) was higher with basmati rice- wheat.



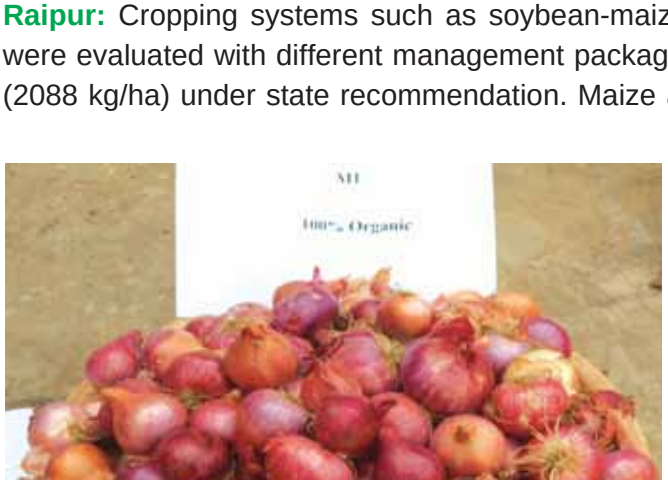
Performance of rice under organic, inorganic and integrated management at Modipuram

Pantnagar: Rice based cropping system was evaluated under different management packages, rice recorded higher yield (3519 kg/ha) under integrated management with 75% organic + 25% inorganic nutrient sources compared to other packages. Wheat recorded higher yield (5107 kg/ha) under integrated package (50% organic + 50% inorganic). Crops like chickpea, vegetable pea, potato recorded higher yield of 1202, 4321, & 8513 kg/ha respectively under organic package of nutrient respectively. The yield increase was found to be 1.0 % in rice and yield reduction in wheat, chick pea, pea, & potato was found to be 1.5, 5.4, 1.9, & 6.0 % respectively under organic management with 75% nutrients over 100% nutrients. Straw yield also gave similar trend. The rice equivalent system yield was found to be higher (5648 kg/ha) with organic management having 100% nutrients. Among all the cropping systems, higher system equivalent yield (5928 kg/ha) was recorded with rice-chickpea +coriander-sesbania system.

Performance of potato under organic management system at Pantnagar

Performance of rice under organic management at Pantnagar

Raipur: Cropping systems such as soybean-maize, soybean-pea, soybean-chili, and soybean-onion were evaluated with different management packages. Soybean (*kharif*) with chili recorded higher yield (2088 kg/ha) under state recommendation. Maize also recorded higher yield (8633 kg/ha) under state



Performance of onion under organic management at Raipur

Performance of maize under organic management at Raipur

recommendation. Pea, chili and onion recorded higher yield (7067, 9967 and 10400 kg/ha respectively) under state recommendation. The yield differences under inorganic package (from 100% to state recommendation) were found to be 16.8, 2.0, 5.0, 4.6 and 2.3% with soybean, maize, pea, chili and onion respectively. The straw yield trend of all crops was also to be found similar. The soybean equivalent system yield of 9700 kg/ha was found higher under organic package having 100% nutrients. Soybean-onion registered higher system equivalent yield (10275 kg/ha) compared to other cropping systems.

Ranchi: Different crops such as wheat, potato, linseed, & lentil were evaluated in basmati rice based cropping system. In rice higher yield (3570 kg/ha) was found with organic package of nutrient with 100% organic nutrient sources. Wheat recorded highest yield (3000 kg/ha) under inorganic package with 100% inorganic nutrients which was at par with integrated nutrient package. Potato and linseed recorded higher yield (19007 & 803 kg/ha) under organic package of nutrient respectively. Lentil recorded higher yield (560 kg/ha) under integrated nutrient package (50% organic+ 50% inorganic). The yield reduction in wheat, rice, potato and linseed under inorganic nutrient package (100% to state recommendation) were recorded 16.7, 2.1, .8 & 6.0% respectively over organic management. The straw yield found similar trend. System equivalent yield was higher (7597 kg/ha) with organic nutrient package with 100% organic source of nutrients. Among the cropping systems, rice-potato recorded higher system equivalent yield (12268 kg/ha).

Umiam: Two different experiments were evaluated. Rice based cropping system with different varieties of crops were evaluated. Rice resulted in higher yield (4180 kg/ha) with integrated nutrient package having 50% organic + 50% inorganic sources. Carrot, potato and tomato recorded highest yield 13220, 14370 and 14810 kg/ha under organic nutrient package with 100% nutrient supplied through organic manures. Only frenchbean recorded highest yield (8560 kg/ha) under inorganic package. Among the varieties of rice, Sharang-1 performed well and recorded higher yield (4470 kg/ha). Straw yield of crops was also found to be in similar trend. The rice equivalent system yield was recorded higher (20630 kg/ha) under integrated nutrient package with 50% organic+ 50% inorganic. In case of cropping system highest yield was recorded with rice-tomato system.

Organic management of vagetable based cropping system at Umiam

Influence of organic management package with reduced dose of organic manures, integrated and inorganic management packages on soil physical and chemical properties (Table 7.1.4 to 7.1.7)

Bajaura: There is no much variation in electrical conductivity among different management packages and cropping systems. The soil pH indicated normal range of 6.40 -7.50. in term of soil organic carbon, organic management with 100% nutrients through organic manures recorded higher organic carbon (1.06%) followed by organic matter with 75% nutrients through organic manure (0.98%) which is 51 and 40% higher than inorganic management with 100% nutrients. Although tomato-cauliflower–french bean system recorded higher organic carbon (0.83%), the variation with other systems is only 0.04%. organic integrated crop management practices resulted in higher soil available N at the end of cropping cycle than inorganic management. Around 9.7% higher soil available N was recorded under organic than inorganic management.

Table 7.1.4. Influence of organic, inorganic and integrated package on soil physico-chemical properties (bulk density and electrical conductivity) at the end of cropping cycle at various locations

Treatments / Management practice	Bulk density							Electrical conductivity						
	Organic management		Inorganic management		Integrated management		Mean	Organic management		Inorganic management		Integrated management		Mean
	100% organic	75% organic + 2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + 2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bhopal														
Soybean-wheat								0.17	0.19	0.16	0.18	0.19	0.16	0.18
Soybean-mustard								0.18	0.18	0.18	0.16	0.16	0.16	0.17
Soybean-chickpea								0.17	0.17	0.17	0.16	0.14	0.18	0.17
Soybean-linseed								0.18	0.19	0.20	0.23	0.18	0.18	0.19
Mean								0.18	0.18	0.18	0.18	0.17	0.17	
Dharwad														
Cowpea-safflower	1.19	1.19	1.25	1.23	1.21	1.25	1.22	0.13	0.14	0.11	0.13	0.12	0.08	0.12
Pigeonpea (Sole)	1.19	1.20	1.27	1.26	1.20	1.23	1.23	0.09	0.10	0.09	0.11	0.09	0.12	0.10
Greengram-sorghum	1.18	1.22	1.29	1.25	1.24	1.26	1.24	0.36	0.11	0.10	0.08	0.30	0.10	0.18
Groundnut + hybrid cotton (2:1)	1.17	1.20	1.26	1.26	1.27	1.23	1.23	0.12	0.12	0.10	0.09	0.14	0.11	0.11
Maize-chickpea	1.18	1.18	1.23	1.22	1.26	1.23	1.22	0.09	0.09	0.12	0.15	0.13	0.13	0.12
Mean	1.18	1.20	1.26	1.24	1.24	1.24		0.16	0.11	0.10	0.11	0.16	0.11	
Jabalpur														
Basmati rice –wheat-green manure	1.27	1.27	1.39	1.38	1.31	1.30	1.32	0.57	0.58	0.71	0.70	0.65	0.63	0.64
Basmati rice – chickpea - maize fodder	1.29	1.28	1.41	1.41	1.32	1.30	1.34	0.56	0.56	0.66	0.64	0.59	0.59	0.60
Basmati rice – berseem (fodder and seed)	1.28	1.26	1.41	1.40	1.32	1.31	1.33	0.54	0.55	0.66	0.65	0.6	0.59	0.60
Basmati rice – vegetable pea- sorghum (fodder)	1.28	1.27	1.39	1.37	1.31	1.29	1.32	0.58	0.59	0.63	0.63	0.64	0.62	0.62
Mean	1.28	1.27	1.40	1.39	1.32	1.30		0.56	0.57	0.67	0.66	0.62	0.61	
Modipram														
Basmati rice– wheat - *sesbania* green manure								0.12	0.12	0.12	0.12	0.12	0.13	0.12
Rice– barley (malt) – green gram								0.12	0.12	0.11	0.12	0.11	0.11	0.12
Maize (pop corn) – potato –okra + *sesbania* green manure								0.17	0.17	0.16	0.32	0.30	0.33	0.24

Treatments / Management practice	Bulk density							Electrical conductivity						
	Organic management		Inorganic management		Integrated management		Mean	Organic management		Inorganic management		Integrated management		Mean
	100% organic	75% organic +2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic +2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic	
Maize (sweet corn) – mustard - *sesbania* green manure								0.25	0.25	0.16	0.26	0.29	0.26	0.25
Mean								0.17	0.17	0.14	0.21	0.21	0.21	
Pantnagar														
Rice-wheat -*sesbania*								0.026	0.036	0.044	0.048	0.033	0.026	0.036
Rice-chickpea + coriander - *sesbania*								0.035	0.026	0.046	0.041	0.031	0.039	0.036
Rice-vegetable pea+ Coriander-*sesbania*								0.031	0.029	0.051	0.037	0.038	0.045	0.039
Rice-potato-*sesbania*								0.043	0.022	0.042	0.036	0.036	0.032	0.035
Mean								0.034	0.028	0.046	0.041	0.035	0.036	

Table 7.1.5. Influence of organic, inorganic and integrated package on soil pH and organic carbon at the end of cropping cycle at various locations

Management practice	pH							Organic carbon						
	Organic management		Inorganic management		Integrated management		Mean	Organic management		Inorganic management		Integrated management		Mean
	100% organic	75% organic + 2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + 2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bajaura								(%)						
Tomato-cauliflower- french bean	7.20	7.10	7.50	7.40	6.20	6.80	7.00	1.25	1.11	0.66	0.69	0.56	0.71	0.83
Tomato-cauliflower	7.30	7.40	7.60	7.30	6.40	7.10	7.20	0.96	0.92	0.78	0.87	0.52	0.69	0.79
Black gram-cauliflower-summer squash	7.50	7.40	7.60	7.50	6.60	7.00	7.30	1.11	1.02	0.53	0.74	0.62	0.74	0.79
Lady finger-pea	7.40	7.50	7.40	7.40	6.30	6.90	7.20	0.91	0.86	0.82	0.86	0.69	0.72	0.81
Mean	7.40	7.40	7.50	7.40	6.40	7.00		1.06	0.98	0.7	0.79	0.6	0.72	
Bhopal								(%)						
Soybean-durum wheat	7.76	7.77	7.88	7.86	7.78	7.76	7.80	0.93	0.83	0.49	0.61	0.70	0.73	0.72
Soybean- mustard	7.80	7.87	7.78	7.91	7.81	7.91	7.85	0.76	0.70	0.51	0.51	0.63	0.61	0.62
Soybean- chickpea	7.77	7.77	7.88	7.84	7.81	7.78	7.81	0.71	0.67	0.55	0.54	0.53	0.64	0.61
Soybean- linseed	7.68	7.78	7.74	7.72	7.77	7.84	7.76	0.83	0.78	0.54	0.55	0.71	0.66	0.68
Mean	7.76	7.80	7.82	7.83	7.79	7.82		0.81	0.75	0.52	0.55	0.64	0.66	
Calicut								(%)						
Varada	5.30	5.10	4.60		4.90		4.98	1.70	1.70	1.30		1.50		1.55
Rejatha	5.70	5.60	5.10		5.40		5.45	2.10	2.50	1.80		1.90		2.08
Mahima	5.70	5.60	4.80		5.00		5.28	1.90	2.00	1.50		1.70		1.78
Turmeric (Alleppey Supreme)	5.90	5.80	5.50		6.00		5.80	1.70	1.70	1.70		1.90		1.75
Turmeric Prathibha)	6.00	6.00	5.40		5.60		5.75	1.70	1.90	1.70		1.70		1.75
Blackpepper-fellow	6.60		5.70		6.10		6.13	1.90		1.50		1.60		1.67
Mean	5.87	5.62	5.18		5.50			1.83	1.96	1.58		1.72		
Dharwad														
Cowpea-safflower	7.79	7.47	7.68	7.58	7.46	7.46	7.57	6.80	6.10	5.80	5.10	5.90	5.80	5.92
Pigeonpea	7.51	7.40	7.42	7.71	7.58	7.58	7.53	7.00	6.20	5.10	5.40	6.40	5.80	5.98
Sorghum-greengram	7.51	7.41	7.84	7.68	7.42	7.67	7.59	7.20	6.50	4.80	6.10	6.20	6.10	6.15
Groundnut + hybrid cotton (2:1)	7.44	7.45	7.68	7.64	7.38	7.37	7.49	6.60	6.30	4.70	5.30	5.30	6.00	5.70
Maize-chickpea	5.91	7.65	7.55	7.60	7.51	7.56	7.30	6.80	6.40	4.90	5.10	5.00	5.80	5.67
Mean	7.23	7.48	7.63	7.64	7.47	7.53		6.90	6.30	5.80	5.90	5.00	5.40	
Jabalpur														
Basmati rice –wheat-green manure	7.21	7.22	7.22	7.21	7.21	7.20	7.21	8.12	8.09	7.06	7.00	7.99	7.85	7.69
Basmati rice – chickpea - maize (fodder)	7.20	7.22	7.20	7.28	7.25	7.23	7.23	7.72	7.67	6.66	6.45	7.39	7.30	7.20

Management practice	pH							Organic carbon						
	Organic management		Inorganic management		Integrated management		Mean	Organic management		Inorganic management		Integrated management		Mean
	100% organic	75% organic +2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic +2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic	
Basmati rice – berseem (fodder and seed)	7.24	7.25	7.22	7.20	7.25	7.21	7.23	7.62	7.59	6.56	6.45	7.49	7.32	7.17
Basmati rice – vegetable pea- sorghum (fodder)	7.26	7.26	7.27	7.26	7.27	7.25	7.26	7.92	7.85	6.96	6.80	7.59	7.46	7.43
Mean	7.23	7.24	7.23	7.24	7.25	7.22		7.85	7.80	6.81	6.68	7.62	7.48	
Modipuram								(%)						
Basmati rice– wheat - *sesbania* green manure	8.20	8.20	8.40	8.30	8.30	8.30	8.28	0.77	0.74	0.62	0.73	0.73	0.70	0.72
Rice– barley (malt) – green gram	8.00	8.10	8.70	8.40	8.20	8.20	8.27	0.50	0.44	0.40	0.43	0.43	0.40	0.43
Maize (pop corn) – potato– okra + *sesbania* green manure	7.60	7.50	7.80	7.40	7.40	7.60	7.55	0.55	0.50	0.35	0.44	0.55	0.53	0.49
Maize (sweet corn) – mustard - *sesbania* green manure	7.80	7.40	7.90	7.30	7.40	7.50	7.55	0.62	0.46	0.40	0.44	0.59	0.52	0.51
Mean	7.90	7.80	8.20	7.85	7.83	7.90		0.61	0.54	0.44	0.51	0.58	0.54	
Pantnagar								(%)						
Rice-wheat -*sesbania*	7.14	6.70	7.82	7.41	7.04	6.49	7.10	1.14	1.05	0.79	0.86	1.02	1.01	0.98
Rice-chickpea + coriander-*sesbania*	6.93	6.81	7.55	7.58	7.04	7.07	7.16	1.17	1.06	0.76	0.9	1.04	1.06	1.00
Rice-vegetable pea+ Coriander-*sesbania*	7.32	6.89	7.38	7.36	6.85	7.08	7.15	1.14	1.04	0.77	0.83	1.04	1.03	0.98
Rice-potato-*sesbania*	7.24	6.99	7.92	7.47	6.94	7.04	7.27	1.23	1.13	0.88	0.87	1.06	1.08	1.04
Mean	7.16	6.85	7.67	7.46	6.97	6.92		1.17	1.07	0.80	0.87	1.04	1.05	
Raipur								(%)						
Soybean-maize								0.67	0.54	0.63	0.67	0.59	0.57	0.61
Soybean-pea								0.67	0.56	0.62	0.67	0.61	0.60	0.62
Soybean-chilli								0.68	0.59	0.64	0.68	0.62	0.57	0.63
Soybean-onion								0.60	0.64	0.64	0.65	0.67	0.56	0.63
Mean								0.66	0.58	0.63	0.67	0.62	0.58	

Table 7.1.6. Influence of organic, inorganic and integrated package on soil available nitrogen and phosphorus at the end of cropping cycle at various locations

Management practice	Available Nitrogen (kg/ha)							Available Phosphorus (kg/ha)						
	Organic management		Inorganic management		Integrated management		Mean	Organic management		Inorganic management		Integrated management		Mean
	100% organic	75% organic + 2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + 2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bajaura														
Tomato-cauliflower- french bean	252.6	249.7	225.4	231.2	243.6	246.4	241.5	92.3	88.2	33.6	34.8	58.2	55.1	60.4
Tomato-cauliflower	243.2	241.6	238.1	243	226.3	224.2	236.1	98.3	92.0	36.8	37.5	53.1	51.0	61.5
Black gram-cauliflower-summer squash	237.4	232	203.5	210.6	259.4	256.4	233.2	78.9	75.0	32.1	34.0	50.2	47.6	53.0
Lady finger-pea	259.1	256.3	221	224.2	269	266.5	249.4	76.0	74.2	33.0	35.2	70.9	67.4	59.5
Mean	248.1	244.9	222	227.3	249.6	248.4		86.4	82.4	33.9	35.4	58.1	55.3	
Bhopal														
Soybean- durum wheat	203.4	200.7	187.1	174.6	189.2	211.2	194.4	36.3	34.6	15.7	13.2	28.7	29.3	26.3
Soybean- mustard	209.9	200.3	195.3	194.4	204.3	201.7	201.0	40.5	30.2	24.2	17.1	27.2	28.2	27.9
Soybean- chickpea	199.4	185.2	200.7	181.9	200.7	198.9	194.5	26.2	25.5	15.5	13.6	23.9	25.2	21.7
Soybean- linseed	221.0	215.3	184.0	176.7	218.5	200.7	202.7	48.8	33.5	24.7	16.7	30.4	29.8	30.7
Mean	208.4	200.4	191.8	181.9	203.2	203.1		37.9	30.9	20.0	15.2	27.6	28.1	
Calicut														
Ginger (Varada)	113.0	114.0	113.0		111.0		112.8	17.6	43.6	60.0		96.6		54.5
Ginger (Rejatha)	118.0	116.0	111.0		117.0		115.5	42.3	22.0	53.0		91.6		52.2
Ginger (Mahima)	122.0	130.0	108.0		120.0		120.0	52.3	35.3	86.6		182.3		89.1
Turmeric (Alleppey Supreme)	101.0	97.0	102.0		107.0		101.8	7.2	13.3	10.3		24.6		13.9
Turmeric (Prathibha)	107.0	116.0	104.0		110.0		109.3	23.0	16.6	15.3		21.0		19.0
Blackpepper-fellow	283.0		205.0		245.0		244.3	17.0		38.0		44.0		33.0
Mean	140.7	114.6	123.8		135.0			26.6	26.2	43.9		76.7		
Coimbatore														
Cotton-maize	261	252	230	236	333	342	276	12.0	11.8	12.4	12.2	9.2	9.5	11.2
Chillies-sunflower	259	268	248	250	368	375	295	11.5	12.4	13.9	15.7	9.4	9.7	12.1
Beetroot-maize	418	411	335	328	465	457	402	9.4	9.5	11.0	11.2	10.6	10.1	10.3
Mean	313	310	271	271	389	391		11.0	11.2	12.4	13.0	9.7	9.8	
Dharwad														
Cowpea-safflower	306.7	290.3	244.7	282.0	282.3	279.3	280.9	30.4	29.7	25.0	29.2	27.8	26.7	28.1
Pigeon pea (sole)	284.0	287.7	255.0	277.3	248.7	279.3	272.0	33.4	28.2	24.3	26.7	26.7	26.5	27.6
Sorghum-greengram	284.0	279.7	258.3	259.0	288.3	288.7	276.3	35.6	34.3	23.6	26.2	32.5	27.3	29.9
Groundnut + hybrid cotton (2:1)	291.7	272.7	241.3	261.0	288.3	274.7	271.6	32.5	33.8	27.3	28.8	25.0	34.5	30.3
Maize-chickpea	289.7	280.3	254.0	261.3	267.7	279.0	272.0	34.2	30.0	23.2	27.6	31.8	31.3	29.7
Mean	291.2	282.1	250.7	268.1	275.1	280.2		33.2	31.2	24.7	27.7	28.8	29.3	

Management practice	Available Nitrogen (kg/ha)							Available Phosphorus (kg/ha)						
	Organic management		Inorganic management		Integrated management		Mean	Organic management		Inorganic management		Integrated management		Mean
	100% organic	75% organic + 2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + 2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic	
Jabalpur														
Basmati rice –wheat-green manure	294.0	291.0	280.0	275.0	284.0	281.0	284.2	15.1	14.8	13.7	13.0	14.5	14.1	14.2
Basmati rice – chickpea - Maize fodder	277.0	273.0	278.0	273.0	278.0	275.0	275.7	14.9	14.5	12.4	11.9	13.6	13.2	13.4
Basmati rice – berseem (fodder and seed)	291.0	288.0	279.0	276.0	291.0	288.0	285.5	14.2	14.0	13.5	13.0	14.3	14.0	13.8
Basmati rice – vegetable pea- sorghum (fodder)	282.0	276.0	265.0	261.0	272.0	270.0	271.0	14.3	14.0	12.9	12.1	14.2	19.8	14.6
Mean	286.0	282.0	275.5	271.3	281.3	278.5		14.6	14.3	13.1	12.5	14.2	15.3	
Ludhiana														
Basmatti rice-chickpea	350.2	334.4	265.2			320.5	317.6	64.9	60.9	42.9			54.1	55.7
Basmati rice-wheat	297.2	280.2	252.6			282.4	278.1	60.1	54.6	38.2			52.1	51.3
Moong-wheat														
Pigeonpea -wheat	344.1	331.4	266.3			325.3	316.8	66.1	59.6	41.0			58.2	56.2
Mean	330.5	315.3	261.4			309.4		63.7	58.4	40.7			54.8	
Pantnagar														
Rice-wheat -*sesbania*	326	322	391	322	255	401	336	45.1	55.1	33.6	39.6	53.5	41.6	44.8
Rice-chickpea + coriander-*sesbania*	399	350	348	324	299	294	336	48.8	54.1	48.1	65.5	48.3	46.7	51.9
Rice-vegetable pea+ coriander-*sesbania*	434	379	394	350	313	270	357	36.1	51.3	54.2	64.6	63.9	58.4	54.8
Rice-potato-*sesbania*	387	413	326	370	394	325	369	65.4	49.8	55.2	58.4	57.6	54.7	56.9
Mean	387	366	365	342	315	323		48.9	52.6	47.8	57.0	55.8	50.4	
Raipur														
Soybean-maize	230.0	227.0	239.0	238.0	232.0	225.7	231.9	13.8	12.8	14.1	16.1	14.5	13.5	14.1
Soybean-pea	224.0	224.7	234.7	239.3	231.7	225.0	229.9	14.5	12.1	15.3	15.5	14.9	12.9	14.2
Soybean-chilli	225.0	226.7	236.7	241.3	233.0	225.3	231.3	14.6	12.7	14.7	14.7	14.4	13.1	14.0
Soybean-onion	230.0	225.7	234.7	239.7	227.7	227.3	230.8	14.0	12.5	14.9	15.4	14.1	13.1	14.0
Mean	227.3	226.0	236.3	239.6	231.1	225.8		14.2	12.5	14.7	15.4	14.5	13.1	
Ranchi														
Rice(Birsamati) -wheat (K 9107)	287.5	283.8	246.3	242.2	266.6	270.9	266.2	59.5	58.9	62.8	61.3	56.7	55.2	59.1
Rice(Birsamati) -potato (Kufri Ashoka)	311.5	304.0	266.7	256.4	281.2	284.4	284.0	62.3	61.0	64.2	63.0	57.8	56.8	60.8
Rice(Birsamati) -linseed (Shekhar)	294.3	289.9	242.6	239.8	265.7	268.5	266.8	59.2	57.9	61.1	60.4	57.3	55.6	58.6
Rice(Birsamati) -lentil (PL 406)	299.6	299.7	248.7	246.1	278.4	280.9	275.6	54.1	52.8	59.8	58.9	56.1	55.0	56.1
Mean	298.2	294.3	251.1	246.1	273.0	276.2		58.8	57.6	62.0	60.9	57.0	55.6	

Table 7.1.7. Influence of organic, inorganic and integrated package on soil available potassium at the end of cropping cycle at various locations

Management practice	Available Potassium (kg/ha)						
	Organic management		Inorganic management		Integrated management		Mean
	100% organic	75% organic + 2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic+ 50% inorganic	75% organic+ 25% inorganic	
Bajura							
Tomato-cauliflower-french bean	255.7	252.3	118.6	125.3	228.0	226.8	201.1
Tomato-cauliflower	261.5	258.2	132.0	138.7	187.4	182.6	193.4
Black gram-cauliflower-summer squash	145.2	140.0	110.4	116.3	192.5	189.6	149.0
Lady finger-pea	316.4	300.6	118.6	125.2	334.8	327.4	253.8
Mean	244.7	237.8	119.9	126.4	235.7	231.6	
Bhopal							
Soybean-durum wheat	560.4	531.1	572.5	556.6	489.9	609.3	553.3
Soybean-mustard	544.3	499.9	474.5	489.8	503.6	531.6	507.3
Soybean-chickpea	496.5	447.6	451.0	392.7	441.3	489.1	453.0
Soybean-linseed	544.3	488.3	504.4	521.5	551.0	493.9	517.2
Mean	536.4	491.7	500.6	490.2	496.5	531.0	
Calicut							
Ginger (Varada)	90.3	123.3	153.6		133.3		125.1
Ginger (Rejatha)	106.0	136.0	99.0		135.0		119.0
Ginger (Mahima)	107.6	100.6	131.0		173.3		128.1
Turmeric (Alleppey Supreme)	110.0	104.0	125.0		142.0		120.3
Turmeric (Prathibha)	110.0	112.0	122.0		119.0		115.8
Blackpepper-fellow	255.0		225.0		241.0		240.3
Mean	129.8	115.2	142.6		157.3		
Coimbatore							
Cotton - maize	462	431	419	428	462	466	445
Chillies - sunflower	469	485	452	474	487	491	476
Beetroot - maize	484	482	468	464	482	477	476
	472	466	446	455	477	478	
Dharwad							
Cowpea-safflower	423.3	412.0	312.0	317.0	404.7	392.7	377.0
Pigeonpea	406.0	395.3	324.0	318.7	367.0	405.7	369.5
Sorghum-greengram	409.3	416.7	306.7	320.7	391.3	412.7	376.2
Groundnut + hybrid cotton (2:1)	425.3	404.7	314.7	352.7	389.0	405.0	381.9
Maize-chickpea	402.0	395.3	298.0	366.7	385.0	377.3	370.7
Mean	413.2	404.8	311.1	335.2	387.4	398.7	
Jabalpur							
Basmati rice–durum wheat-green manure	269.0	267.0	252.0	250.0	266.0	265.0	261.5
Basmati rice-Chick-pea - maize fodder	268.0	267.0	248.0	245.0	260.0	257.0	257.5
Basmati rice – berseem (fodder and seed)	268.0	266.0	249.0	244.0	263.0	260.0	258.3

Management practice	Available Potassium (kg/ha)						
	Organic management		Inorganic management		Integrated management		Mean
	100% organic	75% organic + 2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic+ 50% inorganic	75% organic+ 25% inorganic	
Basmati rice – vegetable pea- sorghum (fodder)	267.0	265.0	236.0	230.0	259.0	255.0	252.0
Mean	268.0	266.3	246.3	242.3	262.0	259.3	
Ludhiana							
Basmatti rice-chickpea	192.2	182.6	135.6			188.2	174.7
Basmati rice-wheat	186.6	176.6	130.6			174.4	167.1
Moong-wheat							
Pegionpea-wheat	192.6	190.6	130.4			188.2	175.5
Mean	190.5	183.3	132.2			183.6	
Modipuram							
Basmati rice– wheat (durum) - *sesbania* green manure	317.0	310.2	182.6	197.1	241.9	247.5	249.4
Rice– barley (malt) – green gram	337.1	328.2	321.4	317.0	283.4	277.8	310.8
Maize (pop corn) – potato– okra + *sesbania* green manure	300.2	310.2	274.4	287.8	317.0	297.9	297.9
Maize (sweet corn) – mustard - *sesbania* green manure	336.0	350.6	256.5	379.7	292.3	376.3	331.9
Mean	322.6	324.8	258.7	295.4	283.7	299.9	
Pantnagar							
Rice-wheat-*sesbania*	210.3	234.4	255.0	225.3	255.0	225.3	234.2
Rice-chickpea + coriander-*sesbania*	248.5	259.2	258.1	262.2	258.1	262.2	258.1
Rice-vegetable pea+ coriander-*sesbania*	236.5	242.5	262.0	245.6	262.0	245.6	249.0
Rice-potato-*sesbania*	238.9	245.5	246.2	245.4	246.2	245.4	244.6
Mean	233.6	245.4	255.3	244.6	255.3	244.6	
Raipur							
Soybean-maize	263.7	253.3	292.4	298.0	282.7	278.0	278.0
Soybean-pea	266.3	256.2	290.2	331.3	298.3	275.3	286.3
Soybean-chilli	268.0	259.3	290.0	297.0	280.1	277.7	278.7
Soybean-onion	268.3	260.5	294.7	301.1	280.3	278.3	280.5
Mean	266.6	257.3	291.8	306.9	285.4	277.3	
Ranchi							
Rice(Birsamati)-wheat (K 9107)	210.3	206.1	150.8	142.6	175.9	177.8	177.2
Rice(Birsamati)-potato (Kufri Ashoka)	218.8	213.3	156.8	147.4	182.6	184.5	183.9
Rice(Birsamati)-linseed (Shekhar)	218.6	216.0	147.7	143.6	178.0	179.9	180.6
Rice(Birsamati)-lentil (PL 406)	216.5	215.8	146.1	141.3	162.9	164.4	174.5
Mean	216.0	212.8	150.4	143.7	174.8	176.7	

Due to the presence of leguminous crop of pea in lady finger-pea system, higher soil available N was noticed in this system. In term of soil available phosphorous, organic management with 100% or 75% nutrients through organic manure recorded higher available phosphorous (86.4 and 82.4 kg/ha) than inorganic and integrated packages. Among the cropping systems except black gram-cauliflower-summer squash, all other systems recorded higher and on par availability of phosphorous. Soil available potassium was also found to higher (95%) with organic than inorganic management. Integrated package recorded higher soil potassium than inorganic but increase is lesser than the organic management package. Lady finger- pea system resulted in maximum soil available K (253.8 kg/ha).

Bhopal: There was no much variation was recorded (0.17 to 0.18) in electrical conductivity among all the management practices as well as cropping systems. The pH range was recorded (7.76-7.83) among different management practices. Organic carbon recorded higher (0.81%) under organic package with 100% nutrient through manure and it was 33.3 and 19.8 % higher than inorganic and integrated packages respectively. Higher available N, P and K were recorded under organic practices with 100% nutrient through manure. Available N was 10.3% higher with inorganic and at par with integrated package. P recorded 53.6 and 26.4% higher than inorganic and integrated respectively. Available K recorded 7.6 higher with inorganic and at par with integrated nutrient package. In term of cropping systems, soybean-linseed performs better with available N and P whereas soybean-durum wheat recorded higher available K.

Calicut: Acidic condition was found at Calicut. The pH range was recorded from 5.18 to 5.8. In term of organic carbon, higher OC% (1.96%) was recorded under organic package of nutrient with 75% nutrient through organic manure. It was found 19.38 and 12.2 % higher than inorganic and integrated nutrient packages. Higher available nitrogen (140.7kg/ha) recorded under organic management with 100% organic nutrient through manure. Integrated management with 50% organic and 50% inorganic perform batter in term of available P (76.7kg/ha). It was higher 42.76% and 65.5% than inorganic and organic respectively. In term of available K were recorded (157.3kg/ha) under integrated nutrient package and it was 9.3 and 22.12% higher with inorganic and organic respectively. In term of variety permanence, black piper perform good result with high available N (245kg/ha) and K (240.3 kg/ha) whereas ginger variety Mahima recorded higher available P (89.1 kg/ha).

Coimbatore: Available N P and K were calculated. Higher available N was recorded under integrated nutrient management with 75% organic and 25% inorganic. The available N reduction was found 25.4 and 44.2% compare with organic and inorganic respectively. Higher available P (13 kg/ha) recorded under inorganic management with state recommendation. It was 14.6 and 25.3% higher than organic and integrated respectively. Higher available K were recorded (478 kg/ha) under integrated nutrient management package and it was at par with organic and inorganic management package. In term of cropping systems, beetroot-maize system recorded higher available N (402 kg/ha) and chili-sunflower perform well with available P and both cropping system perform well with available.

Dharwad: Physical and chemical properties of soil were estimated. Lower bulk density (1.17 g/cc) and EC (0.08 ds/m) were recorded under organic and inorganic nutrient packages respectively. The pH range 7.23-7.64 was recorded among different management packages. higher organic carbon (6.90%) were recorded under organic nutrient practice with 100% nutrient supply through manure which was 15.12% and 24.6% higher than inorganic and integrated package respectively. There is no significant effect were found about these nutrients among all the cropping systems. In term of higher available N, P and K (306.7, 35.6 and 425.3 kg/ha), it was recorded under organic nutrient management with 100% nutrient supply

through organic manure. Nitrogen was found 14.1% and 8.4% higher than inorganic and integrated management practices respectively. Cowpea-sawflower resulted higher available nitrogen. Available P was recorded 30% and 16% higher than inorganic and integrated management practices. Groundnut-hybrid cotton copping system recorded higher available k 30.3 kg/ha and 381.9 kg/ha among the rest cropping systems. Available K found 21.8% and 4.9% higher than inorganic and integrated management packages.

Jabalpur: At the end of cropping cycle, soil pH, organic carbon bulk density and available NPK were estimated. Lower bulk density (1.26 g/cc) and EC (0.54 ds/m) were recorded under organic nutrient package. There is no much variation found in soil pH. It shows range (7.22-7.25). Higher organic carbon was recorded under organic package with 100% nutrient and it was found 13.4% and 2.5% increase over inorganic and integrated nutrient packages respectively. Available nitrogen and potassium found higher 294 kg/h and 269 kg/ha respectively under organic package of nutrient with 100% nutrient through manure whereas, in term of available phosphorous it was recorded higher (19.8 kg/ha) under integrated nutrient management practice.

Ludhiana: Soil chemical properties available N, P and K were estimated. Higher available N and P (330.5 & 63.7 kg/ha) were recorded under organic nutrient management with 100% nutrient through manure. Available N and P were 20.9, 6.4 and 36.1, 13.9 % higher than inorganic and integrated nutrient package respectively. Higher available K (190.5 kg/ha) recorded under organic nutrient package with 100% nutrient through manure. It was 30.6% higher than inorganic management and at par with integrated management package. In term of cropping systems, basmati rice- chick pea perform well with available N whereas there was no much variation found with available P and K among all the cropping systems.

Modipuram: Soil EC, pH, organic carbon and available potassium were estimated during the year. Significant variation was found in soil Ec. Lower EC was recorded under inorganic nutrient package. pH range found 7.3-8.70. In term of organic carbon also a significant variation found under different nutrient package and cropping system. Higher organic carbon (0.77 %) were recorded under organic package with 100% nutrient through organic manure followed by organic package with 75% nutrient through manure.. organic package were found 12.3 and 7.1% higher than inorganic and integrated management packages respectively. Basmati rice-wheat-*sesbania* cropping system recorded higher organic carbon (0.70) which was higher than rest cropping systems. In term of available K, higher K (379.7 kg/ha) recorded under inorganic package with state recommendation of nutrient which was 9.5% and 11.9% higher than organic and integrated packages respectively. In term of cropping systems, highest available K were recorded under maize-mustard-*sesbania* cropping system.

Pantnagar: Electric conductivity, pH, organic carbon and available NPK were estimated during the year. Lower EC was recorded under organic package with 75% nutrient through organic manure as compare with other nutrient packages. Range of pH (6.49-7.92) was recorded under all the management packages. In term of organic carbon, higher organic carbon were recorded under 1.23% under organic package of nutrient with 100% nutrient through manure which was also 28.9% and 13% higher than inorganic and integrated package respectively. Rice-potato-susbania recorded higher organic carbon 1.04% which was nearly similar than other cropping system. Organic crop management resulted higher N (434 kg/ha) which was 14.28 and 32.8 % higher than inorganic and integrated nutrient management.

Raipur: There is not much variation were recorded in organic carbon under all management practices. Higher organic carbon (0.67%) recorded under inorganic management practices with state recommendation. It was found at with 100% organic nutrient packages and integrated nutrient packages. There was also no variation recorded In respect of cropping systems. In term of available NP and K, higher value were recorded 239.6, 15.4 and 306.9 kg/ha respectively under inorganic package with state recommendation. These were found higher (5.4 and 4.6) % and (12.9 & 10.4%) and (14.6 & 8.3%) than organic and integrated respectively.

Ranchi: Soil chemical properties available N, P and K were calculated. Soil available N and K were recorded higher (298.2 and 216 kg/ha) under organic management practices with 100% nutrient through manure. Available N and K was recorded (16.6 & 7.9%) and (31.7 &18.6%) higher than inorganic and integrated nutrient management. Available P (62 kg/ha) was recorded under inorganic nutrient management. In term of cropping system, basmati rice- potato (kufri ashoka) perform well with available nitrogen whereas there was no much variation was found with available P and K under all cropping systems.

Influence of organic management package with reduced dose of organic manures, integrated and inorganic management packages on available micronutrient (Table 7.1.8 to 7.1.9)

Bajaura: Soil available micronutrient iron, manganese, zinc and copper were estimated. Higher available iron, manganese and copper (10.73, 9.55 and 1.50 ppm) were recorded under inorganic nutrient package with 100% inorganic nutrient. Fe, Mn and Cu were (27.39 & 34.85 %), (47.33 & 41.15 %) and (26.6 & 40.6 %) higher than organic and integrated nutrient management respectively whereas, higher zinc (3.36 ppm) was recorded under integrated management practice with 75% organic + 25% inorganic nutrient through fertilizer. In term of cropping system, all cropping systems perform well under different management practices. There was no much variation recorded with micronutrient.

Calicut: Higher available iron and copper (36.9 & 13.7 ppm) were recorded under organic management practices with 100% nutrient through manure. It was at par with both management practices with iron and copper whereas, manganese was recorded higher (16.5 ppm) under integrated and higher zinc (2.6 ppm) under inorganic nutrient management practices. Manganese was at par with other management practices and zinc was 23 & 26.9% higher than integrated and organic nutrient management practices respectively. In term of cropping systems, black pepper-fellow perform well with iron and zinc whereas, rajatha variety perform better with copper and turmeric (partibha) found good result with manganese.

Dharwad: Higher available iron was recorded (9.58 ppm) under inorganic management practices and it was at par with organic and integrated nutrient management. Higher available manganese (13.2 ppm) was recorded under organic nutrient management with 100% nutrient through manure and it was also at par with inorganic and integrated nutrient t management. Higher available zinc (0.90 ppm) recorded under inorganic nutrient management and at par with other management practices. Higher available copper recorded higher (1.51 ppm) under integrated nutrient management with 50% organic + 50% inorganic nutrient through manure and it was also at par with other management practices. In term of cropping systems, there was no much variation was recorded among different micro nutrients.

Pantnagar: Available micro nutrient were evaluated. Higher available iron, zinc and copper (56.8, 1.37 and 3.73) ppm were recorded higher under organic management with 100% nutrient through manure. These were found (42.7 & 9.5%), (29.2 & 26.3%) and (28.2 & 10.9%) higher than integrated and inorganic management practice respectively whereas, higher soil available manganese (16.1 ppm) was recorded

Table 7.1.8. Influence of methods of organic, inorganic and integrated package on soil available micronutrients at the end of cropping cycle at different locations

Management practice	Soil Available Iron (ppm)							Soil Available Manganese (ppm)						
	Organic management		Inorganic management		Integrated management		Mean	Organic management		Inorganic management		Integrated management		Mean
	100% organic	75% organic +2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic +2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bajaura														
Tomato-cauliflower-french bean	8.67	7.60	6.85	7.20	10.80	8.70	8.30	6.10	4.68	5.20	5.06	9.98	7.56	6.43
Tomato-cauliflower	8.00	7.10	7.02	8.30	10.70	8.52	8.27	5.25	4.34	6.05	5.80	8.78	6.80	6.17
Black gram-cauliflower-summer squash	6.34	5.30	6.87	7.07	10.60	8.65	7.47	4.68	3.97	4.46	6.00	10.20	8.45	6.29
Lady finger-pea	10.40	8.90	6.50	6.06	10.80	8.55	8.54	6.34	4.89	7.10	5.30	9.23	7.80	6.78
Mean	8.35	7.23	6.81	7.16	10.73	8.61		5.59	4.47	5.70	5.54	9.55	7.65	
Calicut														
Varada	35.3	33.3	34.6		34.6		34.5	8.10	6.10	8.20		6.50		7.2
Rejatha	41.6	21.6	38.6		38.3		35.0	11.00	10.50	9.50		8.80		10.0
Mahima	39.3	37.0	36.3		37.6		37.6	11.80	9.30	11.60		7.70		10.1
Turmeric (Alleppey Supreme)	29.3	29.3	28.6		28.3		28.9	19.00	17.00	22.00		20.00		19.5
Turmeric Prathibha)	31.0	32.0	30.0		30.0		30.8	19.60	28.60	30.60		30.30		27.3
Blackpepper-fellow	45.0		46.0		45.0		45.3	22.00		17.00		19.00		19.3
Mean	36.9	30.6	35.7		35.6			15.3	14.3	16.5		15.4		
Dharwad														
Cowpea-safflower	9.52	9.65	9.53	9.40	9.53	9.46	9.52	13.3	12.3	12.7	12.7	12.5	13.3	12.8
Pigeon pea (sole)	8.93	9.61	9.51	9.64	9.38	9.63	9.45	13.2	13.1	13.0	12.7	12.5	13.0	12.9
Sorghum-greengram	9.56	9.41	9.54	9.44	9.34	9.56	9.48	13.1	13.3	12.4	12.8	12.9	12.0	12.7
Groundnut + hybrid cotton (2:1)	9.73	9.46	9.39	9.23	9.58	9.69	9.51	13.1	12.2	12.9	12.3	13.4	13.6	12.9
Maize-chickpea	9.57	9.47	9.54	9.46	9.58	9.56	9.53	13.1	12.6	12.6	12.7	13.0	12.7	12.8
Mean	9.46	9.52	9.50	9.43	9.48	9.58		13.2	12.7	12.7	12.6	12.9	12.9	
Pantnagar														
Rice-wheat -*sesbania*	48.9	47.6	35.9	32.7	43.3	42.5	41.8	12.3	11.5	9.0	8.7	12.6	12.0	11.0
Rice-chickpea + coriander-*sesbania*	55.4	53.2	34.7	30.7	49.6	48.8	45.4	10.4	10.3	9.1	7.9	17.5	16.9	12.0
Rice-vegetable pea+ coriander-*sesbania*	60.1	58.6	29.8	28.9	58.2	56.9	48.8	15.7	12.3	9.5	9.0	20.8	19.3	14.4
Rice-potato-*sesbania*	62.8	60.8	34.6	33.3	56.6	55.0	50.5	14.5	11.9	10.3	9.9	13.4	12.3	12.0
Mean	56.8	55.1	33.7	31.4	51.9	50.8		13.2	11.5	9.5	8.8	16.1	15.1	

Table 7.1.9. Influence of methods of organic, inorganic and integrated package on soil available micronutrients at the end of cropping cycle

Management practice	Zinc (ppm)							Cooper (ppm)						
	Organic management		Inorganic management		Integrated management		Mean	Organic management		Inorganic management		Integrated management		Mean
	100% organic	75% organic + 2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + 2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bajaura														
Tomato-cauliflower-french bean	2.80	2.08	1.96	1.08	2.80	2.65	2.23	1.24	1.14	0.85	0.96	1.30	1.21	1.12
Tomato-cauliflower	2.90	2.68	1.75	1.00	2.86	2.70	2.32	1.10	0.92	0.88	1.00	1.56	1.34	1.13
Black gram-cauliflower-summer squash	2.68	2.34	2.01	1.45	2.60	2.35	2.24	1.10	0.92	0.80	0.92	1.60	1.40	1.12
Lady finger-pea	2.10	1.85	1.90	1.06	2.50	2.24	1.94	1.14	1.01	0.80	0.92	1.55	1.42	1.14
Mean	2.80	2.38	1.68	3.36	3.11	2.80		1.15	1.00	0.83	0.95	1.50	1.34	
Calicut														
Varada	1.20	1.30	1.30		2.10		1.5	16.00	19.60	14.00		16.00		16.4
Rejatha	1.90	1.70	1.50		2.10		1.8	16.30	16.00	20.00		18.30		17.7
Mahima	1.70	1.70	1.40		1.90		1.7	15.60	15.60	18.30		18.60		17.0
Turmeric (Alleppey Supreme)	1.20	1.30	1.10		1.60		1.3	10.20	8.40	9.30		11.30		9.8
Turmeric Prathibha)	1.60	1.50	1.20		1.20		1.4	12.40	8.90	7.30		7.20		9.0
Blackpepper-fellow	6.30		5.40		6.80		6.2	7.90		7.30		7.30		7.5
Mean	2.3	1.5	2.0		2.6			13.1	13.7	12.7		13.1		
Dharwad														
Cowpea-safflower	0.89	0.89	0.89	0.88	0.88	0.90	0.89	1.32	1.50	1.49	1.46	1.49	1.49	1.46
Pigeon pea (sole)	0.86	0.82	0.87	0.84	0.86	0.91	0.86	1.41	1.43	1.49	1.47	1.50	1.53	1.47
Sorghum-greengram	0.77	0.88	0.83	0.85	0.88	0.92	0.86	1.42	1.34	1.55	1.43	1.50	1.46	1.45
Groundnut + hybrid cotton (2:1)	0.88	0.86	0.83	0.85	0.92	0.88	0.87	1.56	1.51	1.48	1.48	1.48	1.37	1.48
Maize-chickpea	0.87	0.86	0.88	0.81	0.86	0.87	0.86	1.41	1.44	1.53	1.53	1.41	1.48	1.47
Mean	0.85	0.86	0.86	0.85	0.88	0.90		1.42	1.44	1.51	1.47	1.48	1.47	
Pantnagar														
Rice-wheat-*sesbania*	1.36	1.32	0.96	1.09	0.96	0.94	1.11	3.69	3.58	2.40	2.35	3.63	3.52	3.20
Rice-chickpea + coriander-*sesbania*	1.42	1.39	1.08	1.10	1.08	1.03	1.18	3.74	3.65	2.58	2.52	3.46	3.28	3.21
Rice-vegetable pea+ coriander-*sesbania*	1.38	1.35	0.98	0.96	1.13	1.10	1.15	3.89	3.85	2.95	3.90	3.40	3.32	3.55
Rice-potato-*sesbania*	1.30	1.29	0.80	0.78	0.98	0.93	1.01	3.58	3.49	2.38	2.30	3.08	2.92	2.96
Mean	1.37	1.34	0.96	0.98	1.04	1.00		3.73	3.64	2.58	2.77	3.39	3.26	

under inorganic nutrient management with 100% nutrient supply. It was 23.3 and 43.2% higher than organic and integrated management practices respectively. In term of cropping system, overall well performance found under rice-vegetable pea+coriander-sesbania with all micronutrients.

Influence of organic management package with reduced dose of organic manures, integrated and inorganic management packages on N, P and K uptake (Table 7.1.10 to 7.1.12)

Seven centres estimated uptake of nutrient for all the crops evaluated under different management practices.

Bajaura: Different vegetable crops in cropping systems were evaluated. Tomato recorded higher N uptake (3.0) under integrated nutrient management. Cauliflower recorded higher N uptake under inorganic nutrient management with 100% nutrient through manure. Frenchbean recorded higher N uptake with inorganic nutrient management with state recommendation. Black gram recorded higher N uptake under integrated nutrient management. Summer squash also found higher N uptake under inorganic with state recommendation. Lady finger (2.01) under integrated and pea (3.45) under inorganic recorded higher N uptake.Tomato, cauliflower, frenchbean, black gram, summer squash, lady finger and pea were recorded higher P uptake (02.28, 0.55, 0.20, 0.27, 0.28, 0.29 and 0.35%) respectively under inorganic nutrient management with state recommendation and frenchbean was at par with integrated nutrient management practices (50% organic+ 50% inorganic). Crops Cauliflower, frenchbean, lady finger and pea recorded higher K uptake (2.60, 2.01, 2.12 & 0.95) respectively under inorganic nutrient management practices with state recommendation. Frenchbean and cauliflower was at par with integrated nutrient management and no much variation was found among all management practices. Tomato and summer squash recorded higher K uptake (2.35 & 2.20 %) respectively under integrated nutrient management and both was at par with inorganic nutrient management practices.

Calicut: NPK were estimated for different varieties of ginger, turmeric and blackpepper were evaluated. Organic nutrient package (1.60%) performs well over inorganic (1.36%) and integrated (1.42%). it was found 15 and 11.3% higher than inorganic and integrated nutrient management respectively. In term of variety performance, turmeric (alleppysupreame) recorded higher N uptake (1.65%) and it was 16.4, 15.15, and 19.4 % higher than varada, rejatha and mahima whereas, it was found at par with turmeric (partibha). Higher P uptake % were recorded under organic nutrient management practice with 100% nutrient through manure and it was (20.5 & 13.6 %) higher than inorganic and integrated nutrient management respectively. In term of variety performance, turmeric alleppy (0.53%) recorded higher P uptake and it was 43.4, 41.5 and 39.6 % higher than varada, rejatha and mahima whereas it was at par with turmeric (partibha). Higher K uptake (1.6%) were recorded under organic nutrient management with 100% organic nutrient through manure and it was (16.3 & 19.4%) higher than inorganic and integrated nutrient management respectively. In term of variety performance, turmeric (partibha) 1.75% performs well as compare with other varieties. It was found (48, 32 & 46.9%) higher than varada, rejatha and mahima whereas it was found at par with turmeric (alleppy).

Influence of organic, inorganic and integrated nutrient management on iron, manganese, zinc and copper (mg ha^{-1}) uptake at Bajaura (Table 7.1.13)

Bajaura: Different vegetable crops were evaluated at Bajaura. Tomato, frenchbean, summer squash, black gram, lady finger and pea were recorded higher iron uptake (54.0, 118.0, 49, 118.0, 45 and 40.0) mg ha^{-1} respectively under integrated nutrient management with 75% organic + 25% nutrient. Cauliflower

Table 7.1.10. Influence of organic, inorganic and integrated package on N uptake (%) of crops and cropping systems at various locations

Cropping system/ Management package	Organic management						Inorganic management						Integrated management					
	100% organic			75% organic + 2 innovative inputs			100% inorganic			State recommendation/ farmer's package			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Bajaura																		
Tomato-cauliflower-french bean	2.00	2.79	2.28	1.82	2.74	2.25	2.12	2.98	2.45	2.25	3.00	2.52	2.18	2.90	2.43	1.96		
Cauliflower-tomato	2.82	2.02		2.76	1.98			2.92	2.12		2.99	2.20		3.00	2.22	2.41	2.95	2.18
Black gram-cauliflo-wer-summer squash	2.24	2.79	1.78	2.10	2.85	1.74	2.36	2.96	1.82	2.40	3.00	1.85	2.41	2.95	1.82	2.34	2.92	1.79
Lady's finger-pea	1.86	3.38		1.78	3.36		1.93	3.42		1.98	3.45		2.01	3.40		1.96	3.39	
	Organic 100%			Organic 75%			Inorganic						Integrated					Mean
Varada	1.50			1.40			1.30						1.30					1.38
Rejatha	1.50			1.40			1.30						1.40					1.40
Mahima	1.50			1.40			1.10						1.30					1.33
Turmeric (Alleppey Supreme)	1.80			1.70			1.50						1.60					1.65
Turmeric (Prathibha)	1.70			1.70			1.60						1.50					1.63
Blackpepper-fellow																		
Mean	1.60			1.52			1.36						1.42					

Table 7.1.11. Influence of inorganic, inorganic and integrated on P uptake (%) of crops at different locations

Cropping system/ Management package	Organic management						Inorganic management						Integrated management					
	100% organic			75% organic + 2 innovative inputs			100% inorganic			State recommendation/ farmer's package			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Bajaura																		
Tomato-cauliflo-wer-french bean	0.22	0.49	0.18	0.19	0.45	0.15	0.27	0.54	0.18	0.28	0.55	0.20	0.25	0.50	0.20	0.24	0.48	0.16
Cauliflower-tomato	0.45	0.25		0.44	0.20		0.52	0.25		0.54	0.27		0.50	0.27		0.46	0.24	
Black gram-cauliflo-wer-summer squash	0.25	0.50	0.25	0.20	0.48	0.20	0.22	0.55	0.25	0.27	0.55	0.28	0.23	0.52	0.24	0.26	0.50	0.21
Lady's finger-pea	0.18	0.32		0.12	0.28		0.25	0.34		0.29	0.35		0.20	0.34		0.24	0.32	
Calicut	Organic 100%			Organic 75%			Inorganic						Integrated					Mean
Varada	0.32			0.32			0.25						0.30					0.30
Rejatha	0.36			0.32			0.25						0.29					0.31
Mahima	0.36			0.37			0.24						0.30					0.32
Turmeric (Alleppey Supreme)	0.63			0.52			0.49						0.49					0.53
Turmeric (Prathibha)	0.51			0.57			0.50						0.50					0.52
Blackpepper-fellow																		
Mean	0.44			0.42			0.35						0.38					

Table 7.1.12. Influence of inorganic, inorganic and integrated on K uptake (%) of crops at various locations

Cropping system/	Organic management						Inorganic management						Integrated management					
Management package	100% organic			75% organic + 2 innovative inputs			100% inorganic			State recommendation/ farmer's package			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Bajaura																		
Tomato-cauliflower-french bean	2.20	2.53	1.97	2.19	2.50	1.96	2.28	2.55	1.99	2.31	2.58	2.01	2.35	2.56	2.01	2.29	2.55	1.99
Cauliflower-tomato		2.55	2.24		2.52	2.20		2.55	2.30		2.60	2.32		2.59	2.35		2.57	2.33
Black gram-cauliflower-summer squash	2.10	2.50	2.12	2.03	2.54	2.10	2.12	2.57	2.15	2.15	2.60	2.18	2.14	2.55	2.20	2.12	2.56	2.08
Lady's finger-pea	2.10	0.84		2.07	0.83		2.06	0.95		2.12	0.92		2.11	0.90		2.06	0.88	
Calicut	Organic 100%			Organic 75%			Inorganic						Integrated					Mean
Varada	1.50			0.90			0.90						0.89					0.91
Rejatha	1.50			0.92			0.93						1.82					1.19
Mahima	1.50			0.97			0.88						0.94					0.93
Turmeric (Alleppey Supreme)	1.80			1.50			1.80						1.50					1.65
Turmeric (Prathibha)	1.70			1.80			2.20						1.30					1.75
Blackpepper-fellow																		
Mean	1.60			1.22			1.34						1.29					

Table 7.1.13. Influence of organic, inorganic and integrated management on iron, manganese, zinc and copper uptake (mg ha^{-1}) of crops at Bajura

Cropping system/ Management package	Organic management						Inorganic management						Integrated management					
	100% organic			75% organic + 2 innovative inputs			100% inorganic			State recommendation/ farmer's package			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*
Iron																		
Tomato-cauliflo-wer-french bean	52.0	50.0	107.0	50.0	49.0	104.0	45.0	42.0	100.0	46.0	48.0	102.0	50.0	52.0	112.0	54.0	53.0	118.0
Cauliflower-tomato	47.0	50.0		48.0	49.0		42.0	44.0		43.0	44.0		54.0	52.0		50.0	50.0	
Black gram-cauliflo-wer-summer squash	110.0	52.0	45.0	108.0	49.0	42.0	102.0	43.0	40.0	104.0	44.0	42.0	116.0	50.0	46.0	118.0	52.0	49.0
Lady's finger-pea	41.0	32.0		35.0	30.0		31.0	29.0		33.0	31.0		43.0	40.0		45.0	38.0	
Manganese																		
Tomato-cauliflo-wer-french bean	22.0	22.0	18.0	24.0	18.0	17.0	18.0	14.0	14.0	20.0	16.0	14.0	22.0	25.0	19.0	23.0	27.0	20.0
Cauliflower-tomato	16.0	23.0		16.0	24.0		13.0	17.0		15.0	19.0		26.0	23.0		28.0	23.0	
Black gram-cauliflo-wer-summer squash	20.0	21.0	20.0	18.0	20.0	17.0	12.0	12.0	13.0	14.0	16.0	15.0	20.0	24.0	19.0	19.0	28.0	20.0
Lady's finger-pea	15.0	21.0		14.0	20.0		11.0	14.0		12.0	16.0		16.0	22.0		18.0	20.0	
Zinc																		
Tomato-cauliflo-wer-french bean	18.0	20.0	28.0	16.0	18.0	27.0	11.0	13.0	20.0	13.0	14.0	22.0	19.0	21.0	30.0	19.0	20.0	29.0
Cauliflower-tomato	18.0	18.0		15.0	17.0		12.0	11.0		14.0	14.0		20.0	18.0		20.0	19.0	
Black gram-cauliflo-wer-summer squash	30.0	19.0	18.0	28.0	17.0	17.0	20.0	12.0	10.0	23.0	14.0	13.0	32.0	18.0	19.0	29.0	20.0	18.0
Lady's finger-pea	14.0	8.0		12.0	7.5			8.0	5.0		10.0	6.5	14.0	7.8		16.0	8.0	
Copper																		
omato-cauliflo-wer-french bean	7.8	11.2	11.4	7.3	11.5	10.9	4.0	6.4	6.0	5.3	7.3	8.3	7.4	11.5	11.9	7.6	11.8	12.0
Cauliflower-tomato	11.8	7.5		11.5	7.2		7.7	5.2		8.5	6.4		11.6	7.7		10.2	7.8	
Black gram-cauliflo-wer-summer squash	11.8	11.3	6.5	11.2	11.0	6.0	6.2	7.5	3.8	7.5	8.4	4.7	12.3	11.2	6.8	12.7	11.6	6.9
Lady's finger-pea	6.2	18.0		6.0	16.0	3.2	3.2	10.0		4.1	11.0		6.4	17.0		6.5	19.0	

recorded higher iron under integrated nutrient management with 50% organic+ 50% inorganic nutrient management. Couliflower, frenchbean, lady finger recorded higher Manganese uptake (28, 20, 18 mg ha^{-1}) under integrated nutrient management with 75% organic + 25% inorganic and pea, black gram (18 and 22 mg ha^{-1}) with 50% organic + 50% inorganic. French bean, summer squash and pea found at par with organic management practices. Whereas black gram and tomato (24 & 20 mg ha^{-1}) were recorded higher Mn under organic nutrient management with 100% organic and 75% organic nutrient through manure respectively. Tomato found at par with integrated nutrient management (75% organic+ 25% inorganic). Higher zinc was found among all the evaluated crops under integrated nutrient management. Tomato, cauliflower, frenchbean, black gram and summer squash recorded higher zinc (19.0, 21.0, 30.0, 32.0 and 1.9 mg ha^{-1}) respectively under integrated nutrient management practices with 50% organic + 50% inorganic. Whereas lady finger and pea (16.0 & 8.0 mg ha^{-1}) recorded higher zinc under integrated nutrient management with 75% organic+ 25% inorganic nutrient through manure.Tomato, cauliflower, frenchbean, black gram, summer squash, lady finger and pea were recorded higher Copper uptake (7.8, 11.8, 12.0, 12.7, 6.9, 6.5, and 19.0 mg ha^{-1}) respectively under integrated nutrient management with 75% organic+ 25% inorganic practices. Tomato and cauliflower were at par with organic nutrient management with 100% nutrient through manure. Summer squash was at par with integrated nutrient (50% organic+ 50% inorganic). Lady finger and pea were also at par with organic nutrient management with 100% nutrient through manure.

Soil micronutrients (zinc, copper, iron and manganese) availability of ginger at Calicut (Table 7.1.14).

Higher zinc availability was recorded under integrated nutrient management. It was found higher (23 & 26.9%) than inorganic and organic management practices. In term of variety performance, black pepper performs batter as compare with other varieties.Higher copper (13.7%) was recorded under organic nutrient management practices with 75% nutrient through manure. It was found 7% higher than inorganic management and at par with integrated nutrient management. In term of Variety performance, ginger (Rejatha) performs well compare to other varieties. Higher iron (30.9%) was recorded under organic nutrient management practices with 100% nutrient through manure. It was found at par with inorganic and integrated nutrient management. In term of crop performance, black pepper recorded good result (45.3%) as compare with other varieties. Higher manganese (16.5%) was recorded under inorganic nutrient management and it was (6.6 & 10.3%) higher than integrated and organic nutrient management. In term of crop variety, turmeric (partibha) found higher manganese (27.3%) as compare with other crops varieties.

Rhizosphere microbial (bacteria and fungi microorganism) population in soil as influenced by the different nutrient management practices and cropping systems are reported only Jabalpur and Dharwad centres. (Table 7.1.15 to 7.1.16)

Jabalpur: Higher bacteria ($55.4x10^6$ CFU/g) were recorded under organic nutrient management with 100% organic nutrient through manure. It was found (33.4 & 22.2 %) higher than inorganic and integrated nutrient management. In term of cropping system, basmati rice- vegetable pea-sorghum recorded higher bacteria ($47.9x10^6$ CFU/g).Higher fungi were recorded ($47.3x10^6$ CFU/g) under organic nutrient management with 100% organic nutrient through manure. It was found (35.5 & 17.8 %) higher than inorganic and integrated nutrient management practices. In term of cropping systems, basmati rice-wheat-green manure recorded higher fungi ($40.7x10^6$ CFU/g) higher as compare with other cropping systems.Higher *actinomycetes* ($14.6x10^6$ CFU/g) were recorded higher under organic nutrient management practice with 100% organic

Table 7.1.14. Effect of different management systems on soil micro nutrient (zinc, copper, iron and manganese) availability of ginger at Calicut

	Organic 100%	Organic 75%	Inorganic	Integrated	Mean	Organic 100%	Organic 75%	Inorganic	Integrated	Mean
	Zn					Cu				
Varada	1.20	1.30	1.30	2.10	1.5	16.00	19.60	14.00	16.00	16.4
Rejatha	1.90	1.70	1.50	2.10	1.8	16.30	16.00	20.00	18.30	17.7
Mahima	1.70	1.70	1.40	1.90	1.7	15.60	15.60	18.30	18.60	17.0
Turmeric (Alleppey Supreme)	1.20	1.30	1.10	1.60	1.3	10.20	8.40	9.30	11.30	9.8
Turmeric Prathibha)	1.60	1.50	1.20	1.20	1.4	12.40	8.90	7.30	7.20	9.0
Black Pepper-Fellow	6.30		5.40	6.80	6.2	7.90		7.30	7.30	7.5
Mean	2.3	1.5	2.0	2.6		13.1	13.7	12.7	13.1	
	Fe					Mn				
Varada	35.3	33.3	34.6	34.6	34.5	8.10	6.10	8.20	6.50	7.2
Rejatha	41.6	21.6	38.6	38.3	35.0	11.00	10.50	9.50	8.80	10.0
Mahima	39.3	37.0	36.3	37.6	37.6	11.80	9.30	11.60	7.70	10.1
Turmeric (Alleppey Supreme)	29.3	29.3	28.6	28.3	28.9	19.00	17.00	22.00	20.00	19.5
Turmeric Prathibha)	31.0	32.0	30.0	30.0	30.8	19.60	28.60	30.60	30.30	27.3
Blackpepper-fellow	45.0		46.0	45.0	45.3	22.00		17.00	19.00	19.3
Mean	36.9	30.6	35.7	35.6		15.3	14.3	16.5	15.4	

Table 7.1.15. Rhizosphre microbial (Bacteria and Fungi micro-organisms) population in soil as influenced by the different nutrient management practices and cropping systems

Management practice	Bacteria (x10^6 CFU/g)							Fungi (x10^6 CFU/g)						
	Organic management		Inorganic management		Integrated management		Mean	Organic management		Inorganic management		Integrated management		Mean
	100% organic	75% organic + 2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + 2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic	
Dharwad														
Cowpea-safflower	8.24	8.12	7.49	7.37	7.56	7.57	7.73	4.63	4.39	4.16	4.55	4.48	4.30	4.42
Pigeonpea	7.59	7.64	7.76	7.77	7.69	7.62	7.68	4.86	4.39	4.60	4.56	4.59	4.00	4.50
Sorghum-greengram	7.82	7.67	7.79	7.60	8.11	7.68	7.78	4.83	4.30	4.70	4.39	4.60	4.46	4.55
Groundnut + hybrid cotton (2:1)	7.80	7.78	7.00	7.75	7.19	7.10	7.44	4.44	4.33	4.33	4.74	4.00	4.39	4.37
Maize-chickpea	6.92	7.26	7.45	7.78	7.29	7.34	7.34	4.39	4.30	4.64	4.44	4.60	4.82	4.53
Mean	7.67	7.69	7.50	7.65	7.57	7.46		4.63	4.34	4.49	4.54	4.45	4.39	
Jabalpur														
Basmati rice–wheat-Green manure	56.3	56.0	39.1	38.5	44.9	45.1	46.6	48.3	48.0	32.4	30.1	42.3	43.0	40.7
Basmati rice – chickpea - Maize fodder	52.7	51.5	33.9	33.0	39.9	40.5	41.9	46.2	45.9	30.4	29.2	35.3	36.1	37.2
Basmati rice – berseem (fodder and seed)	52.5	52.2	36.1	35.8	42.8	43.2	43.7	47.5	47.0	30.1	30.0	39.7	40.0	39.1
Basmati rice – vegetable pea- sorghum (fodder)	60.3	60.0	39.4	39.1	43.9	44.5	47.9	47.1	47.0	31.3	31.1	37.4	37.5	38.6
Mean	55.4	54.9	37.1	36.6	42.9	43.3		47.3	47.0	31.0	30.1	38.7	39.1	

Table 7.1.16. Rhizosphre microbial (Actinomycetes and phosphate solubilizing micro-organisms) population in soil as influenced by the different nutrient management practices and cropping systems

Management practice	Actinomycetes (x10⁶ CFU/g)							PSB (x10⁶CFU/g)						
	Organic management		Inorganic management		Integrated management		Mean	Organic management		Inorganic management		Integrated management		Mean
	100% organic	75% organic + 2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + 2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic	
Dharwad														
Cowpea-safflower	4.73	4.43	4.42	4.61	4.66	4.43	4.55	5.95	5.93	5.65	5.91	5.90	5.74	5.85
Pigeonpea	4.69	4.42	4.32	4.11	4.75	4.60	4.48	5.59	5.26	5.16	5.30	5.83	5.64	5.46
Sorghum-greengram	4.34	4.17	4.32	4.11	4.16	4.23	4.22	5.67	5.16	5.39	5.26	5.30	5.39	5.36
Groundnut + hybrid cotton (2:1)	4.52	4.35	3.96	4.23	4.15	3.95	4.19	5.46	5.46	5.16	5.79	5.64	5.39	5.48
Maize-chickpea	4.02	4.00	4.37	4.50	4.08	4.23	4.20	5.51	5.39	5.46	5.51	5.39	5.26	5.42
Mean	4.46	4.27	4.28	4.31	4.36	4.29		5.64	5.44	5.36	5.55	5.61	5.48	
Jabalpur														
Basmati rice –wheat-Green manure	17.4	17.1	6.4	6.1	12.2	13.0	12.0	16.9	16.5	13.4	12.5	15.5	16.1	15.2
Basmati rice – chickpea - Maize fodder	14.2	14.0	5.8	5.2	10.7	11.1	10.2	16.7	16.0	11.2	11.0	11.9	12.6	13.2
Basmati rice – berseem (fodder and seed)	14.5	14.0	5.7	5.0	10.7	11.5	10.2	16.4	16.1	9.4	9.1	11.7	12.3	12.5
Basmati rice – vegetable pea- sorghum (fodder)	12.4	12.1	5.9	5.5	11.5	11.9	9.9	15.8	15.0	10.3	9.5	13.7	14.2	13.1
Mean	14.6	14.3	5.9	5.5	11.3	11.9		16.5	15.9	11.1	10.5	13.2	13.8	

nutrient through manure. It was found (61 and 20.5%) higher than inorganic & integrated nutrient management, in term of cropping systems, higher *actinomycetes* recorded (12.0x10^6 CFU/g) under basmati rice-wheat-green manure cropping system & it was (15, 15 and 17.5 %) higher than basmati rice-chickpea-maize fodder, rice-berseem and rice-vegetable pea-sorghum respectively.Higher PSB (16.5x10^6 CFU/g) recorded under organic nutrient management with 100% organic nutrient through manure. It was found (34.5 and 18.18%) than inorganic and integrated nutrient management respectively. In term of cropping system, basmati rice-wheat-green manure recorded (15.2x10^6 CFU/g) higher PSB as compare with other system. It was found (13.2, 17.8 & 13.8%) higher than rest cropping system respectively. Higher *azotobacter* recorded under organic nutrient management (30.5x10^6 CFU/g) and it was found 34.7 & 19.7 % higher than inorganic and integrated nutrient management respectively. In term of cropping systems, basmati rice-wheat-green manure recorded higher *azotobacter* (27.8x10^6 CFU/g) and it was found 16.9, 17.6 and 7.9 % higher than basmati rice-chickpea-maize fodder, basmati rice-berseem and basmati rice-vegetable pea-sorghum respectively.

Dharwad: Different cropping systems were evaluated. There was no much variation were found among different management practices as well as cropping systems. Higher bacterial population (7.69x10^6 CFU/g) were recorded under organic nutrient management with 75% organic nutrient through manure and it was at par with other management practices. In term of cropping system, sorghum-greengram recorded higher bacteria (7.78x10^6 CFU/g) and it was also at par with other cropping systems.In term of fungi similar result were recorded. Higher fungal population recorded under organic nutrient management and it was at par with other management practices. In term of cropping system, sorghum-green gram perform well and also at par with other cropping systems.Higher *actinomycetes* (4.46x10^6 CFU/g) were recorded under organic nutrient management through manure. It was at par with other nutrient packages. In term of cropping system, there was no much variation was found. Higher *actinomycetes* recorded (4.55x10^6 CFU/g) with cowpea-safflower cropping system and it was at par with other system.Similar trend recorded with PSB among all the cropping systems and nutrient package. Higher PSB recorded (5.64x10^6 CFU/g) under organic nutrient management with 100% nutrient through manure and it was at par with other management package. Cowpea-safflower also recorded higher *PSB* (5.85x10^6 CFU/g) and at par with other cropping system.

Effect of different management systems on quality aspects of organic produce

Influence of organic, inorganic and integrated package on protein, oil and methionine (%) in soybean and total chlorophyll (mg/g FW) in *rabi* crops at Bhopal (Table 7.1.17)

Organic nutrient management with 100% nutrient through manure performs well in term of protein, oil and methionine. It was found at par with inorganic and integrated nutrient management with protein, oil and methionine respectively.Higher chlorophyll was recorded under integrated nutrient management (2.24 mg/g FW) and it was found 17.4 & 8.9% higher than inorganic and integrated nutrient management respectively. In term of crops, chick pea recorded higher chlorophyll (20.7 mg/g FW) and it was found 27.6, 44 and 28% higher than wheat, mustard and linseed respectively.

Influence of organic, inorganic and integrated package on quality of ginger, turmeric and black pepper at Calicut (Table 7.1.18)

Oleoresin and oil %: Ginger variety Rejatha and Mahima recorded higher oleoresin (2.95 & 3.55%) under organic nutrient management with 100% organic nutrient through manure whereas ginger (Varada)

Table 7.1.17. Influence of organic, inorganic and integrated package on protein, oil and methionine (%) in soybean and total total Chlorophyll (mg/g FW) in rabi crops at Bhopal

Management practice	Organic management		Inorganic management		Integrated management		Mean
	100% organic	75% organic + 2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic+ 50% inorganic	75% organic+ 25% inorganic	
Protein	36.7	36.3	35.6	35.5	35.8	35.9	36.0
Oil	19.1	18.8	18.6	18.2	18.7	18.7	18.7
Methionine	1.7	1.7	1.6	1.6	1.6	1.6	1.6
Total Chlorophyll (mg/g FW)							
Wheat	1.74	2.20	1.85	1.85	2.04	2.24	1.99
Mustard	1.62	1.45	1.66	1.46	1.40	1.62	1.54
Chickpea	2.60	2.84	2.87	2.63	2.82	2.74	2.75
Linseed	2.01	1.83	1.96	2.00	2.10	1.98	1.98
Mean	1.99	2.08	1.85	1.85	2.04	2.24	

turmeric (Alleppey) and black pepper recorded higher oleoresin (3.67, 1.90 & 8%) under inorganic nutrient management. Turmeric (Partibha) recorded (1.30%) oleoresin under organic nutrient management with 75% nutrient management. Ginger varieties Varada, Rejatha and Mahima recorded higher oil% (1.65, 1.43 & 1.54) under organic nutrient through manure. Rejatha found no variation under different management practices. Turmeric (alleppey) found higher oil % under organic nutrient management. Turmeric (Pratibha) and black pepper found higher oil % (2.50) under integrated nutrient management.

Influence of organic, inorganic and integrated management on quality of tomato and carrot at Umiam (Table 7.1.19)

Ascorbic acid in tomato and carrot cultivated through 100% organic management at Umiam was found higher (28.3 and 41.08 mg/100 g, respectively). Higher total sugar (%) was recorded in tomato 5.30% and in carrot 6.22% under organic management. Other quality parameters *viz*. lycopene, beta carotene and total carotenoides in case of tomato and carrot respectively under organic management practices.

Influence of methods of organic, inorganic and integrated nutrient packages on economics of different crops and cropping systems (Table 7.1.20)

Bajaura: Different cropping systems and management practices was evaluated under organic production systems. Higher gross return (630329 Rs/ha) was recorded under organic nutrient management practices with 75% nutrient through manure. It was 39.6 and 12.1 % higher than inorganic and integrated nutrient management. In term of cropping systems, black gram- cauliflower-summer squash recorded higher gross return (691198 Rs/ha) and it was 7.8, 39.7 and 51.2% higher than tomato-cauliflower-frenchbean, tomato-cauliflower and lady finger-pea respectively. Lower cost of cultivation (208647 Rs/ha) recorded under inorganic nutrient management with 100% inorganic nutrient whereas Inorganic nutrient management with state recommendation recorded higher cost of cultivation (305422 Rs/ha). In term of cropping system, tomato-frenchbean-cauliflower recorded higher cost (304153 Rs/ha) and lady finger-pea recorded lower

Table 7.1.18. Effect of different management packages on quality of various cultivars of ginger, turmeric and black pepper at Calicut

Cropping Systems/	Oil (%)				Oleoresin (%)				Curcumin (%)				Piperine (%)			
Management practice	100% Organic	75% Organic	Inorganic	Integrated	100% Organic	75% Organic	Inorganic	Integrated	100% Organic	75% Organic	Inorganic	Integrated	100% Organic	75% Organic	Inorganic	Integrated
Ginger (Varada)	1.32	1.65	1.43	1.32	3.29	3.66	3.67	3.51								
Ginger (Rejatha)	1.43	1.43	1.43	1.43	2.95	3.04	2.88	3.90								
Ginger (Mahima)	1.43	1.54	1.32	1.32	3.55	3.49	3.00	3.29								
Turmeric (Alleppey Supreme)	2.20	1.98	1.98	2.10	1.30	1.20	1.90	1.30	5.20	5.90	5.20	6.00				
Turmeric Prathibha)	1.98	2.10	2.30	2.50	1.21	1.30	1.20	1.25	4.80	5.10	4.60	5.60				
Blackpepper-fellow	3.30		3.50	3.50	7.80		8.00	7.90					4.40		3.90	3.70

Organic ginger production at Calicut

Table 7.1.19. Quality parameters of tomato and carrot under different nutrient management practices at Umiam

Nutrient sources	Ascorbic acid (mg/100 g)		Total sugar (%)		Lycopene (mg/100g)	Beta carotene (mg/100g)	Total caroteniodes (mg/g)
	Tomato	Carrot	Tomato	Carrot	Tomato	Carrot	
100% Organic	28.36	41.08	5.01	5.76	16.95	9.01	73.31
75% Organic	18.52	32.02	2.48	4.10	11.92	8.76	63.1
Inorganic	24.17	38.76	4.46	4.47	14.21	6.14	59.99
Integrated	26.94	40.5	5.30	6.22	16.05	8.61	68.17
SEm(+)	0.36	0.35	0.04	0.05	0.19	0.04	0.48
CD (P=0.05)	1.25	NS	0.14	0.17	0.64	0.15	1.65

cost of cultivation (186705 Rs/ha). Net return was recorded higher (396167 Rs/ha) under organic nutrient management practices. It was 68.6 and 19.6% higher than integrated and inorganic nutrient management. In term of cropping system, black gram- cauliflower-summer squash found higher net return (409665 Rs/ha) as compare with other cropping systems. Organic nutrient management with 75% nutrient through manure found higher B:C ratio (1.67). It was recorded 72.5 & 20.9% higher than integrated and inorganic nutrient practices respectively. In term of cropping system, black gram-cauliflower-summer squash found more beneficial with B:C ratio (1.48) as compare with other cropping system.

Bhopal: Higher gross return (71460 Rs/ha) was recorded under organic nutrient management and it was 31.9 and 26.2% higher than inorganic and integrated nutrient management. In term of cropping systems, soybean-linseed found higher gross return (63171 Rs/ha) and it was higher than other cropping systems.Higher cost of cultivation (27149 Rs/ha) was recorded under organic nutrient management with 75% organic nutrient through manure and it was found 11.1 & 13.2 % higher than inorganic and integrated nutrient management. In term of cropping systems, soybean-mustard (23619 Rs/ha) was recorded lower cost and it was at par with other cropping systems. Organic nutrient management recorded higher net return (48746 Rs/ha) under organic input method with 100% nutrient through manure and it was found 49.7 & 40.2% higher than integrated and inorganic nutrient management. In term of cropping system, soybean-lineseed recorded higher net return (39249 Rs/ha) as compare with other cropping systems. Organic nutrient management recorded higher cost benefit ratio (3.1) and it was found 35.5 and 27.4 % higher than integrated and inorganic nutrient management practices. Soybean-linseed also perform well with higher B:C ratio (2.6).

Calicut: Organic nutrient management recorded higher gross return (593246 Rs/ha) with 100% organic nutrient through manure. It was found 29.5 & 19.7 % higher than inorganic and integrated nutrient management practices. In term of cropping system, ginger-fallow found good result with higher gross return (569109 Rs/ha). Higher cost of cultivation under (171496 Rs/ha) organic nutrient management with 100% nutrient through manure and lower found with inorganic nutrient management practices (132716 Rs/ha). In term of cropping system, turmeric-fallow found higher (160427 Rs/ha) and ginger fallow (160427 Rs/ha) found lower cost of cultivation.Higher net return recorded (421750 Rs/ha) under organic nutrient management with 100% organic nutrient through manure and it was 38.8 & 24.4% higher than integrated and inorganic nutrient management. In term of cropping systems, ginger-fellow found higher net return (423000 Rs/ha) and it was found 32.7% higher than turmeric-fellow. Higher B:C ratio recorded (2.56) under organic nutrient management with 75% organic nutrient through manure. It was found 16 & 18 %

Table 7.1.20. Influence of methods of organic, inorganic and integrated package on economics of different crops and cropping system

Management practice	Gross returns (Rs ha^{-1})							Cost of cultivation (Rs ha^{-1})						
	Organic management		Inorganic management		Integrated management		Mean	Organic management		Inorganic management		Integrated management		Mean
	100% organic	75% organic + 2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + 2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bajaura														
Tomato-cauliflower-french bean	772306	792450	390733	521556	696022	651083	637358	302635	292135	260931	390931	283736	294549	304153
Tomato-cauliflower	544750	544917	227333	276333	462333	458933	419100	205340	196090	168815	258815	187844	195789	202116
Black gram-cauliflower-summer squash	748667	757000	571222	625900	707378	737022	691198	280260	272910	239788	339288	274203	282747	281533
Lady finger-pea	438600	426950	173150	264900	374450	345650	337283	179765	175515	165055	232655	181132	186107	186705
Mean	626081	630329	340610	422172	560046	548172		242000	234163	208647	305422	231729	239798	
Bhopal														
Soybean- wheat							59570							25171
Soybean- mustard							48057							23619
Soybean- chickpea							58161							24130
Soybean- linseed							63171							23922
Mean	71460	69115	47629	49698	51093	54366		22714	27149	23871	24396	23614	23520	
Calicut														
Ginger-fallow	741496	635346	399031		500564		569109	163996	152846	125031		142564		146109
Turmeric-fallow	444996	446096	437201		451964		445064	178996	150346	140401		171964		160427
Blackpepper-fellow														
Coimbatore														
Cotton - maize	120845	137042	126321	149709	134816	155021	137292	88788	79228	51773	76075	65839	76136	72973
Chillies - sunflower	146820	164819	160891	169102	154496	189820	164325	113478	88908	61868	121356	83382	95683	94113
Beetroot - maize	310759	333603	327376	355666	325498	367191	336682	135224	110338	66311	116867	97175	108260	105696
Cotton - maize	192808	211821	204863	224826	204937	237344		112497	92825	59984	104766	82132	93360	
Dharwad														
Cowpea-safflower	61,292	57,372	53,960	65,492	63038	59652	60134	18,557	18,907	18,939	22,339	20,167	20,103	19835
Pigeon pea (sole)	67,068	64,611	59,319	71,631	70659	65907	66533	17,595	17,545	16,854	19,854	17,905	18,165	17986
Sorghum-greengram	1,02,958	99,814	91,869	1,07,024	105176	99985	99211	24,502	25,402	25,078	29,878	26,662	27,325	26475
Groundnut + hybrid cotton (2:1)	130128	124766	114314	131804	126552	124610	125362	38,288	39,005	35,309	41,309	38,184	36,189	38047
Maize-chickpea	40,800	38,288	35,152	42,448	40816	39584	39515	11,596	12564	11,565	13,676	13,078	13,456	12656
Mean	74822	76970	70923	77844	81248	77948		22108	22685	21549	25411	23199	23048	
Karjat														
Rice-groundnut							197706							
Rice-sweet corn							299723							
Rice-mustard							103693							
Rice – dolichos bean							232227							
Mean	232677	227186	207094	190104	198049	194913								

Management practice	Gross returns (Rs ha^{-1})							Cost of cultivation (Rs ha^{-1})						
	Organic management		Inorganic management		Integrated management		Mean	Organic management		Inorganic management		Integrated management		Mean
	100% organic	75% organic +2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic +2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic	
Modipuram														
Basmati rice– wheat - *sesbania* green manure	241550	242600	140920	162200	197660	206460	198565	89740	84806	51091	55991	70265	80077	71995
Rice– barley (malt) – green gram	153994	154806	94090	110410	131090	135405	129966	101940	99706	62835	67735	82163	92163	84424
Maize (pop corn)- potato – okra + *sesbania* green manure	582680	565725	346760	390380	428820	450540	460818	201333	193500	141613	150363	171249	186403	174077
Maize (sweet corn)- mustard- *sesbania* green manure	199601	213663	127950	149860	167910	167820	171134	74295	70222	38591	44191	56294	65369	58160
Mean	294456	294199	177430	203213	231370	240056		116827	112059	73533	79570	94993	106003	
Pantnagar														
Rice-wheat -*sesbania*	218175	217763	149760	146820	179010	180420	181991	69225	63725	61450	63950	65960	65225	64923
Rice-chickpea + coriander-*sesbania*	239025	234488	148920	136770	178740	187800	187624	61265	55765	55620	58120	63520	57265	58593
Rice-vegetable pea+ coriander-*sesbania*	174038	174300	109560	104610	134010	137940	139076	63150	57650	58280	60780	65830	59150	60807
Rice-potato-*sesbania*	215963	212213	103020	109710	159480	163140	160588	114225	108725	109725	112225	111682	110225	111135
Mean	211800	209691	127815	124478	162810	167325		76966	71466	71269	73769	76748	72966	
Raipur														
Soybean-maize	249208	229458	213465	219835	201833	202675	219413	55123	54433	57151	60151	56137	55540	56423
Soybean-pea	210183	192467	178652	189715	174950	172108	186346	42754	42440	45051	48051	43975	43344	44269
Soybean-chilli	220952	207661	187675	201713	184408	183473	197647	45954	45365	48613	51613	47354	46634	47589
Soybean-onion	289666	276017	247648	257416	238918	231652	256886	44338	43886	47763	50763	46121	45209	46347
Mean	242502	226401	206860	217170	200027	197477		47042	46531	49645	52645	48397	47682	
Ranchi														
Rice (Birsamati) - wheat (K 9107)	127095	124846	95576	82771	100190	97805	104714	63361	54796	37926	34376	50610	56985	49676
Rice (Birsamati) - potato (Kufri Ashoka)	303067	296551	188011	168625	221818	212108	231697	90968	81460	65920	62342	78435	84694	77303
Rice (Birsamati) - linseed (Shekhar)	85453	81422	52886	48784	62232	60469	65208	40783	35068	24665	22779	32715	36736	32124
Rice (Birsamati) - lentil (PL 406)	83369	78467	56766	49960	66372	62681	66269	40285	35523	28206	25649	34241	37250	33526
Mean	149746	145322	98310	87535	112653	108266		58849	51712	39179	36287	49000	53916	
Umiam														
Rice-carrot	156100	119100	143600		174000		148200	50518	42428	40752		46314		45003
Rice-potato	168800	132600	143100		185200		157425	69128	59308	58064		65942		63111
Rice-french bean	203700	173300	163200		202900		185775	56485	51098	45488		51360		51108
Rice-tomato	252200	201000	206100		263050		230588	55973	48828	44452		53328		50645
Mean	195200	156500	164000		206288			58026	50416	47189		54236		

Table 7.1.20. Influence of methods of organic, inorganic and integrated package on economics of different crops and cropping system

Management practice	Net returns (Rs ha^{-1})							B:C ratio						
	Organic management		Inorganic management		Integrated management		Mean	Organic management		Inorganic management		Integrated management		Mean
	100% organic	75% organic +2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic +2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bhopal														
Tomato-cauliflower-french bean	469671	500315	129802	130625	412286	356534	333206	1.55	1.71	0.5	0.33	1.45	1.21	1.13
Tomato-cauliflower	339410	348827	58518	17518	274489	263144	216985	1.65	1.78	0.35	0.07	1.46	1.34	1.11
Black gram-cauliflower-summer squash	468407	484090	331434	286612	433175	454275	409665	1.67	1.77	1.38	0.84	1.58	1.61	1.48
Lady finger-pea	258835	251435	8095	32245	193318	159543	150579	1.44	1.43	0.05	0.14	1.07	0.86	0.83
Mean	384081	396167	131962	116750	328317	308374		1.58	1.67	0.57	0.35	1.39	1.25	
Bhopal														
Soybean- wheat							34399							2.4
Soybean- mustard							24438							2.0
Soybean- chickpea							34031							2.4
Soybean- linseed							39249							2.6
Mean	48746	41966	23758	25302	27479	30846		3.1	2.5	2.0	2.0	2.2	2.3	
Calicut														
Ginger-fallow	577500	482500	274000		358000		423000	3.50	3.16	2.20		2.50		2.84
Turmeric-fallow	266000	295750	296800		280000		284638	1.48	1.96	2.10		1.63		1.79
Black pepper-fellow														
Coimbatore														
Cotton - maize	32056	57814	74548	73634	68977	78885	64319	1.36	1.73	2.44	1.97	2.05	2.04	1.93
Chillies - sunflower	33342	75911	99023	47746	71114	94137	70212	1.29	1.85	2.60	1.39	1.85	1.98	1.83
Beetroot - maize	175534	223265	261065	238799	228322	258931	230986	2.30	3.02	4.94	3.04	3.35	3.39	3.34
Cotton - maize	80311	118997	144879	120060	122804	143984		1.65	2.20	3.33	2.13	2.42	2.47	
Dharwad														
Cowpea-safflower	42,735	38,465	35,021	43,153	42,871	39,549	40299	2.30	2.03	1.85	1.93	2.13	1.97	2.04
Pigeon pea(sole)	49,473	47,066	42,465	51,777	52,754	47,742	48546	2.81	2.68	2.52	2.61	2.95	2.63	2.70
Sorghum-greengram	78,456	74,412	66,791	77,146	78,514	72,660	74663	3.20	2.93	2.66	2.58	2.94	2.66	2.83
Groundnut + hybrid cotton (2:1)	91,840	85,761	79,005	90,495	88,368	88,421	87315	2.40	2.20	2.24	2.19	2.31	2.44	2.30
Maize-chickpea	29,204	25,724	23,587	28,772	27,738	26,128	26859	2.52	2.05	2.04	2.10	2.12	1.94	2.13
Mean	58342	54286	49374	58269	58049	54900		2.65	2.38	2.26	2.28	2.49	2.33	
Karjat														
Rice-groundnut	58673	53548	73736	51380	50042	38241	54270	1.37	1.36	1.56	1.40	1.35	1.25	1.38
Rice – sweet corn	147433	156155	145646	135414	110203	95040	131649	1.76	1.85	2.03	1.97	1.66	1.52	1.80
Rice – mustard	-16655	-4789	19082	7980	-9930	-25363	-4946	0.87	0.96	1.22	1.10	0.91	0.79	0.98
Rice – dolichos bean	43388	48134	53647	36331	24762	14084	36724	1.20	1.24	1.30	1.21	1.13	1.07	1.19
Mean	58210	63262	73028	57776	43769	30501		1.30	1.35	1.53	1.42	1.26	1.16	

Management practice	Net returns (Rs ha^{-1})							B:C ratio						
	Organic management		Inorganic management		Integrated management		Mean	Organic management		Inorganic management		Integrated management		Mean
	100% organic	75% organic +2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic +2 innovative inputs	100% inorganic	State recomm-endation/ farmer's package	50% organic + 50% inorganic	75% organic + 25% inorganic	
Modipuram														
Basmati rice– wheat - Sesbania green manure	151810	157796	89829	106209	127395	126383	126570	3.35	3.69	3.47	3.72	3.58	3.12	3.49
Rice– barley (malt) – green gram	52054	55102	31255	42675	48927	43242	45543	1.64	1.74	1.53	1.98	1.87	1.51	1.71
Maize (pop corn)- potato –okra + *sesbania* green manure	381348	372226	205147	240017	257571	264137	286741	6.56	6.80	6.02	6.13	5.85	5.39	6.13
Maize (sweet corn)- mustard- *sesbania* green manure	125306	143442	89359	105669	111616	102451	112974	3.30	4.00	4.45	4.82	3.80	3.00	3.90
Mean	177630	182142	103898	123643	136377	134053		3.71	4.06	3.87	4.16	3.78	3.26	
Pantnagar														
Rice-wheat -*sesbania*	148950	154038	88310	82870	113050	115195	117069	2.15	2.42	1.44	1.30	1.71	1.77	1.80
Rice-chickpea + coriander-*sesbania*	177760	178723	93300	78650	115220	130535	129031	2.90	3.20	1.68	1.35	1.81	2.28	2.21
Rice-vegetable pea+ coriander-*sesbania*	110888	116650	51280	43830	68180	78790	78270	1.76	2.02	0.88	0.72	1.04	1.33	1.29
Rice-potato-*sesbania*	101738	103488	-6705	-2515	47798	52915	49453	0.89	0.95	-0.06	-0.02	0.43	0.48	0.44
Mean	134834	138224	56546	50709	86062	94359		1.92	2.15	0.98	0.84	1.25	1.46	
Raipur														
Soybean-maize	194085	175025	156314	159684	145696	147135	162990	3.52	3.22	2.74	2.65	2.60	2.65	2.90
Soybean-pea	167429	150027	133601	141664	130975	128764	142077	3.92	3.54	2.97	2.95	2.98	2.97	3.22
Soybean-chilli	174998	162296	139062	150100	137054	136839	150058	3.81	3.58	2.86	2.91	2.89	2.93	3.16
Soybean-onion	245328	232131	199885	206653	192797	186443	210540	5.53	5.29	4.18	4.07	4.18	4.12	4.56
Mean	195460	179870	157216	164525	151631	149795		4.19	3.90	3.19	3.15	3.16	3.17	
Ranchi														
Rice (Birsamati)-wheat (K 9107)	63734	70050	57651	48395	49580	40820	55038	2.13	2.70	3.09	2.89	2.04	1.48	2.39
Rice (Birsamati)-potato (Kufri Ashoka)	212099	215091	122091	106283	143384	127414	154394	4.15	4.68	3.58	3.34	3.32	2.63	3.62
Rice (Birsamati)-linseed (Shekhar)	44670	46354	28222	26005	29518	23732	33084	1.79	2.21	1.86	1.86	1.47	1.01	1.70
Rice (Birsamati)-lentil (PL 406)	43085	42944	28560	24311	32131	25431	32744	1.86	2.12	1.91	1.78	1.77	1.24	1.78
Mean	90897	93610	59131	51249	63653	54349		2.48	2.93	2.61	2.47	2.15	1.59	
Umiam														
Rice-carrot	105582	76672	102848		127686		103197	3.09	2.81	3.52		3.76		3.30
Rice-potato	99672	73292	85036		119258		94315	2.44	2.24	2.46		2.81		2.49
Rice-french bean	147215	122202	117712		151540		134667	3.61	3.39	3.59		3.95		3.64
Rice-tomato	196227	152172	161648		209722		179942	4.51	4.12	4.64		4.93		4.55
Mean	137174	106085	116811		152052			3.41	3.14	3.55		3.86		

higher than integrated and inorganic nutrient management. In term of cropping systems, ginger –fellow found higher B:C ratio (2.84). It was found 37% higher than turmeric-fellow systems.

Coimbatore: Higher gross return (237344 Rs/ha) was recorded under integrated nutrient management with 75% organic+25% inorganic nutrient. It was found 14.7 & 9.5% higher than organic and inorganic nutrient management. In term of cropping systems, beetroot-maize recorded higher gross return (366682 Rs/ha) and it was found (51.2 & 59.2%) higher than chili-sunflower and cotton-maize respectively. High cost of cultivation (112497 Rs/ha) recorded under organic nutrient management and lower cost (59984 Rs/ha) under inorganic nutrient management with 100% inorganic nutrient. In term of cropping systems, cotton-maize found more profitable response with lower cost of cultivation (72973 Rs/ha) whereas beetroot-maize found higher cost (105696 Rs/ha). Higher net return (144879 Rs/ha) was recorded under integrated nutrient management with 50% organic+50% inorganic. It was at par with inorganic nutrient management with state recommendation and 31.2% higher than organic nutrient management. In term of cropping systems, beetroot-maize found higher net return (230986 Rs/ha) and it was higher than as compare with other cropping systems. Integrated nutrient management with 50% organic+50% inorganic recorded higher B:C ratio (3.33) and it was found 27.32 and 42.9 % higher than inorganic and organic nutrient management respectively. In term of cropping systems, beetroot-maize found high B:C ratio (3.34) and it was found 42.2 & 45.2 % higher than cotton-maize and chili-sunflower cropping systems.

Dharwad: Higher gross return (81248 Rs/ha) was recorded under integrated nutrient management with 75% organic+25% inorganic. It was found 6.6 and 8.4% higher than organic and inorganic nutrient management respectively. In term of cropping systems, groundnut-hybrid cotton recorded higher gross return (125362 Rs/ha) and it was 52, 46.9, 20.9 and 68.5 % higher than cowpea-safflower, pigeon pea, sorghum-greengram and maize-chickpea respectively. Higher (25411 Rs/ha) and lower (21549 Rs/ha) cost of cultivation were found under inorganic nutrient with state recommendation and inorganic with 100% inorganic respectively. In term of cropping systems, groundnut-hybrid cotton (38047 Rs/ha) found higher cost whereas, pigeon pea recorded lowest cost (17986 Rs/ha). Higher net return (58342 Rs/ha) was recorded under organic nutrient management. It was found at par with integrated nutrient package with 75% organic+ 25% inorganic nutrient and inorganic nutrient management respectively. In term of cropping system, groundnut+hybrid cotton (2:1) found higher net return (87315 Rs/ha) as compare with other systems. Organic nutrient management found more beneficial for farmer. Higher B:C ratio recorded (2.65) under organic nutrient management practices. It was found 14.3 & 9.1% higher than integrated and inorganic nutrient management. In term of cropping system, sorghum-greengram recorded higher B:C ratio (2.83) as compare with other cropping systems.

Karjat: Higher gross return was recorded (232677 Rs/ha) under organic nutrient management with 100% organic nutrient through manure and it was found 14.6 & 15.6 % higher than inorganic and integrated nutrient management respectively. In term of cropping systems, rice-sweet corn performs well with higher gross return (299723 Rs/ha) and it was 34.0, 65.4 & 22.5 % higher than rice-groundnut, rice-mustard and rice-dolichos bean. Integrated nutrient management recorded higher net return (73028 Rs/ha) at karjat. It was found (16.8&49.1) higher than organic and inorganic management practices respectively. In term of cropping system, rice-sweet corn recorded higher net return (131649 Rs/ha) and found more beneficial than other cropping system. Integrated nutrient management recorded higher B:C ratio (1.53) and it was found 20.9& 13.4 % higher than organic and inorganic nutrient management respectively. In term of cropping systems, rice-sweet corn found good result with (1.89) B:C ratio.

Modipuram: Organic nutrient management practices with 100% organic nutrient through manure recorded higher gross return (294456 Rs/ha). It was 35.4&19.9% higher than inorganic and integrated nutrient management respectively. Maize-potato-okra+green manure perform well with higher gross return (460818 Rs/ha) and it was 56.9, 71.8 and 62.8 % higher than basmati rice-wheat-sesbania, rice-barley-green gram and maize-mustard-sesbania respectively. Higher cost of cultivation (116827 Rs/ha) recorded under organic nutrient management and lower (73533 Rs/ha) recorded under inorganic nutrient management with 100% inorganic nutrient through manure. In term of cropping systems, maize-potato-okra+*sesbania* recorded higher (174077 Rs/ha) and lower (58160 Rs/ha) cost of cultivation under maize-mustard-*sesbania*. Higher net return (182142 Rs/ha) were recorded under organic nutrient management with 100% nutrient through manure at modipuram station. It was found 37.5& 25.8% higher than integrated and inorganic nutrient management respectively. In term of cropping system, maize-potato-okra+sesbania green manure found good result (286741 Rs/ha) as compare with other cropping system. Higher B:C ratio (4.06) recorded under integrated nutrient management and it was at par with organic nutrient management with 75% nutrient through manure and 15.4% higher than inorganic nutrient practices. In term of cropping system, maize-potato-okra+sesbania perform well with higher B:C ratio(6.13).

Pantnagar: Organic nutrient management recorded higher gross return (211800 Rs/ha) with 100% nutrient through manure. It was found 40.4 & 22.1 % higher than inorganic and integrated nutrient management. Rice-chick pea-+coriander+sesbania recorded higher gross return (187624 Rs/ha) and also at par with rice-wheat-sesbania. It was found 25 & 14.4% higher than rice-vegetable pea+coriander-sesbania and rice-potato respectively. Higher cost (76966 Rs/ha) was recorded under organic nutrient management with 100% nutrient through manure and lower (71269 Rs/ha) under inorganic nutrient management with 100% inorganic nutrient. In term of cropping systems, rice-potato-sesbania recorded higher (111135 Rs/ha) cost whereas rice-chickpea+coriander-sesbania found lowest cost (58593 Rs/ha).

Higher net return (138224 Rs/ha) was recorded under organic input package with 75% organic nutrient through manure. It was found 61.2 and 34.7% higher than integrated and inorganic nutrient management respectively. In term of cropping system rice-chickpea+coriandar-*sesbania* perform well with higher net return (129031 Rs/ha) as compare with other cropping system. Higher B:C ration was recorded under organic nutrient management practices with 75% organic nutrient through manure. It was found 57.7 and 36.9% higher than integrated and inorganic input package respectively. In term of cropping system, rice-chickpea+coriander-sesbania perform good result with higher B:C ratio(2.21) as compare with other cropping systems.

Raipur: Higher gross return (242502 Rs/ha) was recorded under nutrient management with 100% organic nutrient through manure and it was found 12.8& 18.1% higher than inorganic and integrated nutrient management respectively. In term of cropping systems, soybean-onion recorded higher (256886 Rs/ha) gross return and it was 14.6, 27.5 and 23.1 % higher than soybean-maize, soybean-pea and soybean chili respectively. Higher cost (52645 Rs/ha) was recorded under inorganic nutrient management with state recommendation and minimum cost (46531 Rs/ha) under organic nutrient management with 75% organic nutrient through manure. In term of cropping systems, soybean-pea found minimum cost of cultivation (44269 Rs/ha) and soybean-maize recorded higher (56423 Rs/ha) cost of cultivation respectively. Organic input package with 100% nutrient through manure perform well with higher net return (195460 Rs/ha). It was found (17.7 & 22.9 %) higher than integrated input package and inorganic nutrient management practice respectively. In term of cropping system, soybean-maize performs well with higher net return (162990 Rs/ha) as compare with other cropping system. Higher B:C ratio (4.19) also recorded under

organic input package with 100% organic nutrient through manure. Whereas integrated and inorganic nutrient management practices was at par with each other. In term of cropping system, soybean-onion recorded higher B:C ratio among all the systems at the experiment site.

Ranchi: Higher gross return (149746 Rs/ha) was recorded under organic nutrient management with 100% nutrient through manure. It was found 37.9 and 26.2 % higher than inorganic and integrated respectively. In term of cropping systems, rice (basmati)-potato (kufri ashoka) recorded higher gross return (231697 Rs/ha) as compare with other management practices.

Lower cost of cultivation (36287 Rs/ha) was recorded under inorganic nutrient management with state recommendation and higher cost (58849 Rs/ha) was recorded under organic nutrient management. In term of cropping systems, rice- linseed recorded lower (65208 Rs/ha) cost of cultivation and rice (basmati)-potato (kufri ashoka) recorded higher (231697 Rs/ha) cost of cultivation. Organic input package recorded higher net return (93610 Rs/ha). It was found 41&36.9% higher than integrated and inorganic nutrient package respectively. In term of cropping systems, rice basmati-potato (kufri ashoka) performs well with higher gross return (152394 Rs/ha) as compare with other cropping systems. Higher B:C ratio recorded higher 2.93 under organic input package an d it was 13.3 & 36.2% higher than integrated and inorganic nutrient management respectively. In term of copping systems, rice basmati-potato perform good with higher B:C ratio (3.62) as compare with other cropping system.

Umiam: Higher gross return (206288 Rs/ha) was recorded under integrated nutrient management with 75% organic+25% inorganic nutrient through manure. It was found 14.8 and 20.5% higher than organic and inorganic nutrient practices. In term of cropping systems, rice-tomato recorded higher gross return (230588 Rs/ha) as compare with other systems. Organic nutrient management practice recorded higher cost of cultivation (58026 Rs/ha) whereas inorganic nutrient management (47189 Rs/ha) recorded lower cost of cultivation. In term of cropping systems, rice-potato recorded higher cost of cultivation (63111 Rs/ha) and rice-carrot recorded lower (45003 Rs/ha) cost of cultivation. Inorganic nutrient management with 100% organic nutrient recorded higher net return (152052 Rs/ha). It was found 20 & 25.2% higher than organic and integrated nutrient packages. In term of cropping system, rice-tomato found higher net return (179942 Rs/ha) than other cropping systems. It was found 42.6, 47.5 & 25.2% higher than rice-carrot, rice-potato and rice-frenchbean respectively. Higher B:C ratio was recorded under in organic nutrient management (3.86) and it was found 15.2 and 8.03 % higher than organic & integrated nutrient management respectively. In term of cropping system, rice-tomato perform well with higher B:C ratio (4.55) as compare with other cropping systems.

7.2 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. Varieties were evaluated with 3 replications in RBD having the minimum plot size 20 m^2.

Year of start: 2013-14

Locations: All the 13 centres conducted the experiments.

Results

Bajaura (Table 7.2.1 to 7.2.4)

Response of varieties/hybrids of important crops in okra-cauliflower and tomato-pea-tomato system under organic management.

Six varieties of lady finger, seven varieties of cauliflower, twelve varieties of tomato and eight varieties of vegetable pea were evaluated for their performance in okra-cauliflower and tomato-pea-tomato system under organic conditions during *kharif* and *rabi* 2013-14

Okra (Table 7.2.1): Six varieties of okra were evaluated in okra-cauliflower system for their performance under organic conditions during *kharif* 2013-14. Results revealed that significant differences among the varieties for the entire traits for okra except plant population were observed. Variety P-8 recorded highest fruit yield (13364 kg/ha) followed by Indranil (12341 kg/ha) owing to more nos. of fruits/plants (15.6 and 14.3) respectively. Days taken to harvest were also recorded to be minimum (45-46 days) in Tripti, Indranil and NOL 303 and P-8. Maximum fruit length was found in Indranil and Pusamakhmali (12.1 cm) but these

Table 7.2.1 Yield attributes and yield of okra (*kharif*) at Bajaura

Varieties/hybrids	Plant height (cm)	No of fruits/ plant	Fruits length (cm)	Days to harvest	Yield (kg/ha)
Tripti	202.0	13.5	10.6	45.0	12029
Pusamakhmali	249.1	12.0	12.1	52.7	8961
Perskin long green	239.3	7.8	9.7	55.0	8545
Indranil	194.1	14.3	12.1	45.0	12341
NOL-303	213.1	13.8	12.0	46.0	9447
P-8	219.5	15.6	11.4	45.0	13364

were statistically at par with NOL 303.Pusamakhmali and Perskin long green attained higher plant height of 249.1 and 239.3 respectively.

Cauliflower (Table 7.2.2): PSBK-1 and KT-25 recorded higher curd weight 508.7 and 503.9 gm, numbers of curds/ha (34567.9 and 32561.7) and resulted in higher yield of 17590 and 16550 kg/ha and total biomass of 27050 and 27480 kg/ha respectively. Curd size was also higher with KT-25 (113.8 cm^2).

Table 7.2.2. Yield attributes and yield of Cauliflower (*Rabi*) at Bajaura

Varieties/hybrids	Curd weight (g)	Curd size (cm^2)	No of curds/ ha	Yield (kg/ha)	Total Biomass (kg/ha)
PSB-1	374.8	102.2	25462.9	9610	15020
KT-25	503.9	113.8	32561.7	16550	27480
Maharani	384.3	98.6	21913.6	8300	13920
US 178	472.9	106.7	25462.9	12080	19520
Chandra mukhi	439.0	111.3	25308.6	11190	17920
Palam uphar	285.0	64.6	22839.5	6580	10170
PSBK-1	508.7	87.4	34567.9	17590	27050

Tomato (Table 7.2.3): Twelve varieties of tomato were evaluated in the system for their performance under organic conditions. Maximum plant height was observed with Naveen-2000 (127.7 cm) during *kharif* followed by Manisha 114.9 cm. The tomato variety Roma recorded the highest fruit yield (6190 kg/ha) with higher no of fruits/plant (7.90). In summer the fruit yield of tomato varieties red gold and hybrid-7730 were recorded maximum (13930 and 12190 kg/ha) respectively compared to other varieties.

Table 7.2.3. Yield attributes and yield of tomato at Bajaura

Varieties/hybrids	Plant height (cm)		Nos. of fruits/plant		Fruit size (cm)		Days to harvest		Yield (kg/ha)	
	Kharif	*Summer*	*Kharif*	*Summer*	*Kharif*	*Summer*	*Kharif*	*Summer*	*Kharif*	*Summer*
Yash	99.3	94.4	6.5	4.2	11.3	20.6	68.7	68.3	5430	6080
HeemSohna	103.7	98.9	5.1	8.7	14.1	17.4	70.3	68.3	3800	10250
Naveen 2000	127.7	99.5	5.7	3.8	24.3	17.6	78.0	68.3	3900	5260
RK 123	101.9	98.2	5.0	8.7	18.9	22.9	66.0	69.7	5830	10030
Manisha	114.9	96.9	7.1	8.8	24.2	23.4	68.7	69.7	5860	11910
Red Gold	110.3	97.1	6.2	8.5	23.6	22.3	66.3	67.0	5240	13930
Hybrid 7730	108.3	99.0	6.7	3.6	18.6	22.3	64.7	67.0	5150	12190
Palam Pink	75.9	77.9	4.3	4.2	24.8	21.6	65.3	71.0	5200	6760
Sioux	106.7	99.7	7.2	2.7	19.0	21.8	69.3	71.0	4280	5990
Best of All	109.7	93.2	5.5	4.0	11.2	21.4	71.3	69.7	5710	2440
Mar Globe	91.5	93.0	6.7	10.5	28.5	23.3	72.7	68.3	4750	3860
Roma	105.1	97.9	7.9	6.9	25.7	26.4	61.3	68.3	6190	7530
CD (P=0.05)										

Cauliflower variety US-178 under organic management at Bajaura

Hybrid Heem Sohna tomato under organic management at Bajaura

Performance of pea hybrid ten plus under organic management at Bajaura

Pea (Table 7.2.4): Eight varieties of pea for their performance under organic condition were studied.Variety 'Pb-89' gave significantly higher pod yield (7950 kg/ha) and significantly longer pods (9.7 cm) than the other varieties evaluated. Nirali and Ten plus also produced good yield of 7170 and 7000 kg/ha. GC-477 gave minimum yield of 4570 kg/ha, while it attained highest plant height (94 cm) as compared to all other varieties evaluated in the experiment.

Table 7.2.4. Yield attributes and yield of vegetable pea at Bajaura

Varieties/hybrids	Plant height (cm)	No. of seed/ pod	No. of pods/ plant	Pod length (cm)	Yield (kg/ha)
GC-477	94.0	5.2	12.3	7.0	4570
Pb-89	78.6	7.2	12.4	9.7	7950
Azad-P1	69.2	6.3	11.7	8.5	4890
PlamSumol	84.2	5.4	9.6	8.9	4800
PalamTriloki	60.4	5.5	10.2	8.7	6840
Nirali	64.0	5.8	11.1	8.8	7110
Annapurna	74.2	8.1	10.6	8.9	6350
Ten Plus	61.0	7.2	10.7	8.5	7000
CD (P=0.05)					

Bhopal

Response of varieties/hybrids of important crops in soybean-wheat and maize-chickpea system under organic management at Bhopal (Table 7.2.5 to 7.2.11)

Varieties of soybean, wheat, maize and chickpea were evaluated in soybean-wheat and maize-chickpea cropping system.

Soybean (Table 7.2.5): Among the varieties of soybean grown under similar nutrient source and doses, RVS-2002-4 resulted in higher seed and straw yield (726 and 1741 kg/ha)and harvest index but closely followed by FS 97-52 (723 kg/ha)) and JS-20-41 (705 kg/ha). Pods per plant (25.3) were also found significantly higher with these varieties than the other. Numbers of seeds per pod recorded higher in JS-97-52(3.2) with 114 days to maturity.

Wheat (Table 7.2.6): Among the wheat varieties, GW-399 recorded maximum seed yield and biomass (2907 and 3768 kg/ha). C-306 recorded lowest grain yield of wheat 2179 kg/ha.Malwashakti recorded higher seeds/spikes 73.9.

Table 7.2.5. Response of different varieties/hybrids of soybean under organic management at Bhopal

Varieties/hybrids	No. of Pods/ plant	Seeds/pod	Test weight (g)	Duration (No. of days)	Yield	Straw yield	Harvest index
JS-335	22.0	3.1	10.4	101.0	410	1226	0.25
JS-93-05	16.5	3.0	10.7	98.0	392	1065	0.27
JS-95-60	15.3	3.0	10.5	104.0	394	1148	0.26
JS-20-41	23.2	2.9	10.6	97.0	705	1673	0.30
NRC-7	19.3	3.1	10.5	101.0	671	1576	0.30
NRC-37	15.7	2.9	10.2	101.0	423	1266	0.25
RVS-2002-4	25.3	3.1	10.6	97.0	726	1741	0.29
RVS-2002-6	14.4	2.7	10.6	100.0	384	1103	0.26
RVS-2002-7	19.8	2.7	10.8	97.0	651	1622	0.29
JS-97-52	25.0	3.2	10.9	114.0	723	1768	0.29

Table 7.2.6. Response of different varieties/hybrids of Wheat (*Rabi*) under organic management at Bhopal

Varieites/hybrids	Spike/length (m)	Seeds/spikes	Yield (kg/ha)	Straw yield (kg/ha)	Harvest index
C-306	78.0	66.8	2179	2902	0.43
HI-8663	60.8	68.1	2272	3051	0.43
HI-1544	63	63.3	2545	3377	0.43
MALWASHAKTI	69.3	73.9	2684	3430	0.44
GW-322	62.5	72.3	2493	3083	0.46
GW-366	81.2	71.7	2907	3768	0.44
HI-1531	82.7	55.3	2718	3504	0.44
HI-8498	61.3	70.3	2640	3312	0.44
HI-1500	63.3	52.1	2461	3325	0.43
JW-1202	78.3	61.0	2708	3556	0.43
HD-932	66.0	60.0	2383	2930	0.45
LOK-1	67.7	57.0	2281	2947	0.44
CD (P= 0.05)	7.7	4.7			

Table 7.2.7. Response of different varieties/hybrids of Maize (*Kharif*) under organic management at Bhopal

Varieties/hybrids	Plant height (cm)	Cob/plant	Row/ cob	Seeds/ row	Yield	Straw yield	Harvest index
Kanchan	129.3	1.0	12.5	17.3	1340	1592	0.46
Pratap 5	138.8	1.0	10.6	15.4	1098	1546	0.42
Arawali	142.3	1.1	12.8	21.3	2137	2430	0.47
Sona 222	134.6	1.0	12.1	18.2	1410	1773	0.44
Pratap 6	140.2	1.0	10.0	15.2	1265	1714	0.42
JM 216	131.2	1.0	12.8	20.2	960	1292	0.43
Popcorn 1	123.8	1.0	10.5	18.8	886	1163	0.43
JM 8	141.1	1.0	11.9	17	1537	1962	0.44
JM 12	136.7	1.0	10.5	16.3	1252	1839	0.41
Proagro 4412	137.2	1.1	12.2	21.8	1801	2138	0.46
Sweet Corn	123.1	1.0	12.2	19.8	1171	1536	0.43
CPBG 4202	126.3	1.0	11.7	19.8	1634	2137	0.43
CD	13.7	NS	1.1	4.3	272	276	

Table 7.2.8. Response of different varieties/hybrids of Chickpea (*Rabi*) under organic management at Bhopal

Varieties/hybrids	Pods/plant	Seed/pod	Yield	Straw yield	Harvest index
RVG-202	62.1	1.6	1733	4519	0.38
JG-16	64.3	1.5	1807	4679	0.39
JGK-3	115.3	1.5	1159	3300	0.35
RVG-203	69.8	1.3	1870	4830	0.39
JG-11	73.5	1.5	1489	4100	0.36
JG-6	61.7	1.1	1433	3789	0.38
JG-130	76.5	1.7	1979	5104	0.39
JG-315	51.9	1.6	1483	3911	0.38
JG-63	54.4	1.3	1736	4556	0.38
JG-74	66.2	1.6	1467	4233	0.35
VIRAT	106.5	1.7	1248	3448	0.36
UJJWALA	98.7	1.1	963	2619	0.37
CD (P=0.05)	7.5	0.2	215	647	

Table 7.2.9. Response on physical and chemical properties under organic management at the end of cropping cycle (Soybean-wheat) at Bhopal

Soybean varieties/ hybrids	Wheat varieties/ hybrids	pH	EC	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
JS-335	C-306	7.72	0.18	215	27.5	525
JS-93-05	HI-8663	7.71	0.19	230	24.9	521
JS-95-60	HI-1544	7.67	0.19	234	28.3	520
JS-20-41	Malawshakti	7.73	0.19	240	30.9	572
NRC-7	GW-322	7.80	0.19	245	30.5	539
NRC-37	GW-366	7.81	0.18	215	28.7	582
RVS-2002-4	HI-1531	7.74	0.20	247	33.6	553
RVS-2002-6	HI-8498	7.76	0.21	233	18.8	495
RVS-2002-7	HI-1500	7.74	0.2	218	27.6	530
JS-97-52	JW-1202	7.79	0.19	234	22.5	589
	HD-932	7.80	0.18	228	20.0	513
	LOK-1	7.79	0.18	222	20.9	543
	CD (P=0.05)	NS	NS	NS	7.8	44

Table 7.2.10. Response on chemical and physical properties under organic management at the end of cropping cycle (Maize-chickpea) at Bhopal

Maize varieties/ hybrids	Chickpea varieties/ hybrids	pH	EC	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
Kanchan	RVG-202	7.81	0.21	236	22.69	574
Pratap 5	JG-16	7.76	0.20	205	25.19	597
Arawali	JGK-3	7.72	0.20	230	24.76	594
Sona 222	RVG-203	7.66	0.20	271	24.67	601
Pratap 6	JG-11	7.92	0.18	249	20.08	609
JM 216	JG-6	7.93	0.19	223	21.75	659
Popcorn 1	JG-130	7.70	0.22	263	32.47	622
JM 8	JG-315	7.74	0.20	227	31.14	610
JM 12	JG-63	7.73	0.23	255	30.15	648
Proagro 4412	JG-74	7.82	0.21	242	23.91	620
Sweet Corn	VIRAT	7.89	0.19	244	18.93	598
CPBG 4202	UJJWALA	7.83	0.19	255	19.79	608
	CD (P=0.05)	NS	NS	33.94	7.0	27.8

Table 7.2.11. Influence of quality of soybean and maize under organic management at Bhopal

Soybean			Maize				
Varieties/ hybrids	Protein (%)	Oil (%)	Varieties/ hybrids	Protein (%)	Oil (%)	Ash (%)	Tryptophan (g/16 g N)
JS-335	36.2	19.6	Kanchan	9.71	3.45	1.41	0.81
JS-93-05	36.5	19.4	Pratap- 5	9.53	3.29	1.39	0.78
JS-95-60	36.1	18.8	Arawali	8.75	4.11	1.38	0.72
JS-20-41	36.1	18.8	Sona- 222	9.67	3.77	1.44	0.8
NRC-7	35.2	18.7	Pratap- 6	9.35	3.8	1.43	0.74
NRC-37	36.0	18.7	JM -216	9.51	3.76	1.39	0.71
RVS-2002-4	35.0	19.7	Popcorn -1	8.9	4.23	1.43	0.65
RVS-2002-6	35.2	20.0	JM- 8	9.4	3.66	1.45	0.84
RVS-2002-7	35.7	20.8	JM- 12	9.22	3.54	1.42	0.8
JS-97-52	35.7	18.9	Proagro- 4412	10	3.34	1.33	0.87
CD (P=0.05)	0.2	0.4	Sweet Corn	8.9	4.09	1.37	0.68
			CPBG 4202	9.74	3.55	1.35	0.79
			CD (P=0.05)	0.1	NS	NS	0.005

Maize (Table 7.2.7): Arawali recorded significantly higher yield (2137 kg/ha) and straw yield (2430 kg/ha). Proagro 4412 and CPBG 4202 also exhibited good yield.Arawali also recorded the maximum height of 142.3 cm while,Proagro 4412 recorded highest seeds/row.

Chick pea (Table 7.2.8): Among the Twelve varieties of chickpea grown, JG-130 resulted significantly higher Seed yield of 1979 kg/ha owing to higher seeds/pod (1.7) and total biomass (5104 kg/ha). RVG-203, JG-16, JG-63 and RVG-202 recorded yield ranging from 1733-1870 kg/ha. Ujjwala observed lowest yield of 963 kg/ha.Number of pods/plant resulted higher in Virat and JGK-3 106.5 and 115.3 respectively.

Soil chemical properties (Table 7.2.9): No significant effects were observed in soil pH, EC and available nitrogen. In term of available P, soybean variety (RVS-2002-4) and wheat (HI-1531) recorded highest available P (33.6 kg/ha), whereas in term of available K, soybean (JS-97-52) and wheat (JW-1202) recorded

Varietal evaluation of mazie under organic management at Bhopal

Varietal evaluation of chickpea under organic management at Bhopal

Varietal evaluation of wheat under organic management at Bhopal

Quality of maize (Table 7.2.11): Among the all maize varieties evaluated, higher protein (10%) and tryptophan (87g/16gN) was recorded with variety PROAGRO-4412. Other maize varieties resulted in protein value ranging from 9.74 (CPBG 4202) to 9.22% (JM 12). Sweet corn and (CPBG 4202) recorded lower protein and oil. Non-significant effect was found in oil and ash among all the varieties.

Calicut (Table 7.2.12)

Nine varieties of turmeric were evaluated in turmeric–fallow systems at Calicut

Nine varieties such as Suvarna, Suguna, Sudarshana, Kedaram, Prabha, Varna, Sobha, higher available K (589 kg/ha) under soybean-wheat system at the end of cropping cycle. Significantly higher available N (271 kg/ha) was recorded in maize variety (Sona 222) and chickpea (RVG-203), however, higher available P (32.47 kg/ha) was recorded with maize (popcorn-1) and chickpea (JG-130).

Quality of soybean (Table 7.2.10): Among the soybean varieties there were difference recorded in protein and oil content. Higher protein (36.5%) was recorded with JS-93-05 whereas higher oil (20.8%) was found with RVS-2002-7. Other soybean varieties protein value ranged from 35 to 36.2% and oil ranged from 18.7-20%.

Evaluation of turmeric varieties under organic management at Calicut

Table 7.2.12: Response on yield and quality of varieties/hybrids in turmeric-fellow system under organic management at Calicut

Name of varieties	Rhizome yield (kg/ha)	Curcumin (%)
Varna	13600	4.2
Sobha	17100	4.6
Sona	20500	3.9
Kanthi	20100	4.4
Suvarna	17600	3.9
Suguna	24500	6.9
Sudarshana	29000	5.7
Kedaram	19500	5.2
Prabha	13200	6.1

Sonaand Kanthi were evaluated to study the response to organic farming. Maximum rhizome yield was recorded by Sudarshana (29000 kg/ha) followed by Suguna (24500 kg/ha). Sona, Kanthi, Kedaram Suvarnaan and Sobha also yield higher ranging from 20500-17100 kg/ha. Variety Prabha recorded lowest turmeric yield (13200 kg/ha). Among the varieties, maximum curcumin content (6.9%) was noticed in the variety Suguna followed by Prabha (6.1%) while Sona and Suvarna recorded (3.9%).

Coimbatore (Table 7.2.13 to 7.2.17)

Twelve rice varieties *viz.,*Bhavani, White ponni, Mappillai samba, Kitchilisamba, IR 20, CO 43, CO 48, CO 51, CB 05022, KDML 105, Red Kavuni and Jeeraga Samba were evaluated in RBD design with three replication for suitability under organic production system.

Table 7.2.13. Response on yield attributes and yields of rice varieties/hybrids under organic management at Coimbatore

Varieties/ hybrids	No. of productive tillers/hill	No. of spikelet/ panicle	% filled grains	Grain wt. (g)	Plant ht. (cm)	Growth duration (days)	Grain yield (kg/ha)	Straw yield (kg/ha)	HI (%)
Bhavani	8.5	103.7	88.2	20.89	94.6	128	2580	3420	0.44
White ponni	14.7	105.0	72.0	15.45	91.2	125	2740	4620	0.37
Mappilai Samba	5.0	124.7	77.9	27.42	110.1	140	2180	6130	0.26
Kitchili Samba	12.1	102.0	83.1	16.49	112.0	129	2710	4210	0.42
IR 20	9.6	120.0	82.2	16.91	79.0	127	2550	3370	0.45
CO 43	6.1	159.3	70.9	19.41	92.7	129	2130	3890	0.36
CO 48	8.7	151.7	84.4	17.91	109.6	129	3190	4640	0.46
CO 51	7.0	115.7	68.9	16.04	88.8	106	1440	2670	0.35
CB05022	11.3	176.7	72.6	18.80	93.1	130	4380	4440	0.5
KDML 105	8.5	57.7	78.5	23.89	111.8	106	1490	3150	0.32
Red Kavuni	6.3	146.0	80.8	20.20	122.7	130	2370	4240	0.36
Jeeraga Samba	10.2	180.7	83.7	10.00	111.0	126	2460	5510	0.36
SEm±	0.9	8.7	3.3	0.44	8.7		300	530	0.04
CD (p=0.05)	1.8	18.2	6.8	0.91	18.1		610	1120	0.08

Table 7.2.14. Physical and cooking parameters of different rice varieties under organic production systems at Coimbatore

Varieties/ hybrids	Kernel length (mm)	Kernel breadth (mm)	L/B ratio	Hulling %	Milling %	KLAC (mm)	KBAC (mm)	LER	BER	Water absorption ratio	Volume expansion ratio
Bhavani	5.6	1.9	2.95	78.0	72.8	8.3	2.7	1.48	1.42	3.02	2.6
White Ponni	5.6	1.9	2.95	84.0	74.0	8.5	2.6	1.52	1.37	3.05	2.6
Mappillai samba	5.6	1.8	3.11	81.6	73.6	8.8	2.8	1.57	1.56	3.18	2.7
Kitchili samba	5.9	1.8	3.28	74.8	68.0	7.2	2.0	1.22	1.11	3.38	2.5
IR 20	5.7	1.9	3.00	80.4	71.2	8.4	2.6	1.47	1.37	3.00	2.7
CO 43	5.6	2.1	2.67	88.4	79.2	8.3	2.8	1.48	1.33	3.13	2.8
CO(R) 48	5.8	1.8	3.22	76.0	68.4	8.5	2.6	1.47	1.44	3.52	3.0
CO(R) 51	5.8	1.8	3.22	71.6	65.6	8.4	2.5	1.45	1.39	3.10	2.8
CB 05022	5.9	1.9	3.11	70.0	60.0	8.9	2.6	1.51	1.37	3.23	3.0
KDML 105	7.0	1.8	3.89	85.2	78.0	10.3	2.5	1.47	1.39	3.81	3.4
Red kavuni	5.6	2.0	2.80	76.0	66.8	8.4	2.8	1.50	1.40	3.25	2.6
Jeeraga samba	4.0	1.8	2.22	82.8	77.2	6.0	2.3	1.50	1.28	3.36	2.9

L/B ratio-Length breadth ratio; KLAC=Kernel length after cooking; KBAC=Kernel breadth after cooking; LER=Linear elongation ratio; BER= Breadth wise elongation ratio

Table 7.2.15. Bio-chemical parameters of various rice genotypes grown under organic management at Coimbatore

Varieties/hybrids	Amylose content (%)	Amylose character	Aroma	Gelatinization temperature		Gel consistency	
				Alkali	Rating	Length of digestion gel (mm)	Category
Bhavani	17.5	I	2	I	3	58	Flaky
White Ponni	18.0	I	2	I	3	60	Flaky
Mappillai samba	26.6	H	2	I	4	65	Soft
Kitchili samba	26.5	H	2	H	6	70	Soft
IR 20	24.3	H	2	L	2	67	Soft
CO 43	18.8	I	2	I	3	60	Flaky
CO(R) 48	16.2	L	2	I	5	60	Flaky
CO(R) 51	17.2	I	2	L	2	75	Soft
CB 05022	15.8	L	2	I	5	70	Soft
KDML 105	17.3	I	4	H	7	65	Soft
Red kavuni	20.4	I	2	I	4	50	Flaky
Jeeraga samba	17.3	I	3	I	5	56	Flaky

L-Low; I-Intermediate; H-High

Yield characters and yield (Table 7.2.13): Significantly higher grain yield, straw yield and harvest index was recorded with CB 05022 (4380, 6130 kg/ha and 0.50 respectively) compared to all the other 11 varieties evaluated in the experiment. Variety CO 48 was able to produce second highest grain yield (3190 kg/ha) and harvest index (0.46%), which is statistically on par with White Ponni (2740kg/ha) and Kichedi Samba (2710 kg/ha). Varieties Bhavani, IR 20, Jeeraga Samba, Red Kavuniand Mappilai samba recorded yield ranging from 2180-2580 kg/ha in terms of grain yield. The variety KDML and CO 51 could produce only less than two tonnes of grain yield (1490 and 1440 kg/ha respectively).The variety Jeeraga Sambare coded significantly higher spikelet/panicle (180.7), while Mappilai samba recorded highest thousand grain weight (27.42g). Though White Ponni recorded significantly higher productive tillers 14.7/hill, but due to moderate spikelets (105.0/panicle), 72% filled grain/panicle and moderate grain weight (15.45 mg) could produce only 2740 kg/ha of grain yield. Variety Red kavuni attained maximum plant height 122.7 cm.

Evaluation of rice varieties under organic management at Coimbatore

Quality parameters (Table 7.2.14): Physical quality parameter such as kernel length, kernel breadth, length breadth ratio, hulling and milling percentage and cooking parameter such as kernel length after cooking, kernel breadth after cooking, linear elongation ratio, breadth wise elongation ratio, water uptake and volume expansion ratio were estimated at post-harvest stage.

KDML 105 recorded higher kernel length of 7 mm under long size category. Jeeraga samba recorded kernel length of 4.00 mm under short catogary. The other varieties, Bhavani, White ponni ,Mappillai samba, CO 43, Red kavuni, IR 20, CO(R) 48, CO(R) 51, Kitchili samba and CB 05022 registered the kernel length ranging from 5.6-5.9 mm and they were classified as medium size category.The variety CO 43 variety recorded numerically higher kernel breadth of 2.1 mm.Other varieties evaluated registered kernel breadth ranging from 1.8 to 2.0 mm. KDML 105 recorded the higher L/B ratio of 3.89 and classified as slender grain shape group. The varieties like Kitchili samba, CO(R) 48, CO(R) 51, Mappillai samba and culture CB 05022 recorded L/B ratio ranging from 3.28 to 3.11 and comes under slender grain shape category. Remaining varieties Bhavani, White ponni, IR 20, CO 43, Red kavuni and Jeeraga samba classified as medium in grain shape.VarietyCO 43 obtained higher hulling percentage (88.4%) followed by KDML 105, White ponni, Jeeraga samba, Mappillai samba, IR 20, Bhavani, CO(R) 48, Red kavuni, Kitchili samba, CO(R) 51. Genotype CB 05022 registered lower hulling percentage (70.0%). The same trend was followed in milling percentage of various rice varieties evaluated under organic production.

Cooking characters (Table 7.2.15): KDML 105 recorded highest kernel length after cooking(10.3mm) while Kitchili samba and Jeeraga samba recorded 7.2 and 6.0 mm respectively. Other varieties CB 05022, Mappillai samba, White Ponni, CO(R) 48, IR 20, CO(R) 51, Red kavuni, Bhavani and CO 43 recorded values ranging from 8.3 to 8.9 mm of kernel length after cooking.The higher Kernel breadth after cooking value of 2.8 was registered in the Mappillai samba, CO 43 and Red kavuni,while lowest value of 2.0 was recorded in the Kitchilisamba. Maximum linear elongation ratio and breadth wise elongation ratio were recorded in the variety Mappillai samba 1.57 and 1.56 respectively followed by White ponni and CO(R) 48. Water uptake had a positive influence on grain elongation and volume expansion ratio. KDML 105 recorded higher water absorption ratio and volume expansion ratio of 3.81 and 3.40 respectively followed by CO(R) 48 3.52 and 3.00 respectively. The variety IR 20 recorded lowest water absorption ratio of 3.00. The lesser volume expansion was noticed in Kitchili samba 2.50.

Bio-chemical characters (Table 7.2.16): Amylose content can play a significant role in determining the overall cooking, eating and pasting properties of a rice variety. The variety Mappillai samba, Kitchili samba and IR 20 registered amylose content of 26.6, 26.5 and 24.3 per cent, respectively and grouped under high amylose content category. The varieties Bhavani, White ponni, CO 43, CO(R) 51, KDML105, Red kavuni and Jeeraga samba comes under intermediate amylose content category. Varieties CO(R) 48 and CB 05022 recorded lower amylose content category. Aroma is important character in rice and variety KDML 105 recorded higher aroma content of 4 and classified as good quality. Aroma content of Jeeraga samba is 3 and classified as moderate and rest of the varieties CO(R) 51, CB 05022, Red kavuni, Bhavani, White ponni, CO(R) 48, CO 43, IR 20, Kitchili samba and Mappillai samba were having lower aroma content of 2 and classified as poor.The gelatinization temperature of the endosperm starch, a useful test of cooking quality, refers to the cooking temperature at which water is absorbed and the starch granules well irreversibly in hot water with a simultaneous loss of crystallinity and birefringence. The time required for cooking is determined by the gelatinization temperature. Varieties IR 20 and CO(R) 51 recorded lower alkali digestion described as kernel not affected/swollen and comes under rating 2. The varieties Bhavani, White ponni and CO 43, Mappillai samba, CO(R) 48 and CB 05022 are grouped in the rating 3 based on the alkali digestion value. The variety KDML 105 has high alkali digestion value and grouped under 7th category describes kernel completely dispersed. Varieties Mappillai samba, Kitchili samba, IR 20, CO(R) 51, CB 05022, KDML 105 have higher length of gel consistency (>60 mm) and they were classified as soft rice. Bhavani, White ponni, CO 43, CO(R) 48, Red kavuni and Jeeraga samba have gel consistency lesser than 60 mm and were classified as flaky rice.

Table 7.2.16 Pests and natural enemies on different cultivars of rice grown under organic management at Coimbatore

Varieties/hybrids	Pest incidence					Natural enemies (Nos. hill^{-1})			
	Green Leaf hopper (Nos. hill^{-1})	Brown Plant hopper (Nos. hill^{-1})	Leaf folder (%)	Stem borer (%)		Spider	Rove Beetle	Mirid Bug	Lady Bird beetle
				Dead heart	White ear				
Bhavani	1.75*(2.57)	1.60(2.07)	3.37	4.77	1.18	1.27(1.10)	1.76(2.60)	1.08(0.67)	1.05(0.60)
White Ponni	1.97(3.40)	1.99(3.47)	3.72	4.50	1.88	1.39(1.43)	1.37(1.37)	1.11(0.73)	1.00(0.50)
Mappillai samba	1.84(2.90)	2.24(4.53)	5.72	7.11	3.33	1.28(1.13)	1.21(0.97)	1.13(0.77)	1.06(0.63)
Kitchili samba	1.82(2.80)	2.10(3.90)	2.54	5.57	2.25	1.38(1.40)	1.25(1.07)	1.08(0.67)	1.05(0.60)
IR 20	1.98(3.43)	1.68(2.33)	2.97	3.61	1.04	1.15(0.83)	1.41(1.50)	1.10(0.70)	1.11(0.73)
CO 43	1.80(2.73)	2.06(3.73)	4.36	8.23	3.06	1.33(1.27)	1.61(2.10)	1.17(0.87)	1.26(1.10)
CO(R) 48	1.89(3.07)	1.90(3.10)	3.13	4.27	1.87	1.33(1.27)	1.44(1.57)	1.09(0.70)	1.06(0.63)
CO(R) 51	2.37(5.10)	2.10(3.90)	4.36	8.15	3.75	1.42(1.53)	1.70(2.40)	1.06(0.63)	1.08(0.67)
CB 05022	1.84(2.90)	2.59(6.23)	3.46	6.22	2.32	1.30(1.20)	1.60(2.07)	1.33(1.27)	1.29(1.17)
KDML 105	1.91(3.13)	2.68(6.67)	2.92	5.66	2.36	1.21(0.97)	1.61(2.10)	1.29(1.17)	1.31(1.23)
Red kavuni	1.69(2.40)	2.22(4.43)	3.18	3.30	1.25	1.34(1.30)	1.39(1.43)	1.35(1.33)	1.18(0.90)
Jeeraga samba	1.90(3.10)	1.88(3.03)	4.33	5.49	2.41	1.37(1.37)	1.49(1.73)	1.21(0.97)	1.26(1.10)
SEd±	0.08	0.11	-	-	-	0.01	0.02	0.01	0.01
CD (P=0.05)	0.17	0.22	-	-	-	0.03	0.04	0.03	0.03

Figures in parenthesis are original values, * square root transformed values

Insect pests and natural enemies (Table 7.2.16 to 7.2.17): The major insect pests observed in the experimental field were the green leaf hopper, brown plant hopper, yellow stem borer and leaf folder under organic management conditions. The rice variety RedKavuni recorded lowest green leaf hopper population of 2.40 hill^{-1} which was on par with Bhavani, Mappillai samba, Kitchili samba,CO-43 and CB-05022. The higher green leaf hopper population of 5.10 hill^{-1} was found in CO(R) 51.The variety Bhavani recorded the lowest brown plant hopper population of 2.07 hill^{-1} which was statistically on par with IR 20. The highest brown plant hopper incidence of 6.67 per hill was observed in KDML 105. The leaf folder damage was lowest (2.54%) in Kitchili samba followed by KDML 105, IR 20 and Red kavuni 2.92, 2.97 and 3.18%, respectively. The higher leaf folder damage of 5.72% was observed in Mappillai samba.The symptoms at vegetative stages caused by yellow stem borers were lowest (3.30%) in Red Kavuni followed by IR 20 (3.61%) and White ponni (4.50%). The highest incidence was noticed in CO 43 (8.23%). The white ear symptoms observed during milking stage of the crops were lowest (1.25%) in Red kavuni,while higher in CO(R) 51 (3.75%).

Natural enemies: The natural enemies commonly observed are spiders, rove beetles, mirid bugs and lady bird beetles. The rove beetles population per hill was more irrespective of varieties evaluated followed by spiders and mirid bugs. The number of spider population over the varieties ranges from 0.83 to 1.53. The highest was statistically on par with each other. The rove beetle population was highest (2.40) in CO(R) 51. The lowest rove beetle numbers of 0.97 was observed in Mappillai samba and was on par with Kitchili samba. Red kavuni recorded the highest population of mirid bugs (1.33) which was on par with CB 05022. The lowest numbers (0.63) of mirid bugs were found in CO (R) 51 which was statistically on par with the Bhavani, White ponni ,Kitchili samba, IR 20 and CO(R) 48. The lady bird numbers were more (1.23) in KDML 105 and less in White ponni (0.50).

Economics (Table 7.2.17): The cost involved in the organic management practices ranged from ₹ 31,190 to ₹ 31,220/ha. The lower cost of cultivation of ₹ 31,190/ha was recorded in Bhavani, White ponni, IR 20, CO 43, CO(R) 48, CO(R) 51 and CB 05022. Among the different rice varieties evaluated under organic production systems, higher gross returns of ₹ 71,205/ha, net return of ₹ 40,015/ha and B:C ratio of 2.28 was recorded in the variety CB 05022 and it was followed by Kitchili samba Gross return ₹ 63,643/ha, net return ₹ 32423/ha and and B:C ratio of 2.28. The lower gross return of ₹ 34,929/ha, net return of ₹ 3739/ha and B:C ratio of 1.12 was recorded in the variety CO (R) 51.

Table 7.2.17. Economics of rice varieties under organic farming at Coimbatore

Varieties/hybrids	Cost of cultivation (₹ /ha)	Gross return (₹ /ha)	Net return (₹ /ha)	B:C ratio
Bhavani	31190	44968	13778	1.44
White Ponni	31190	48686	17496	1.56
Mappillai samba	31220	62518	31298	2.00
Kitchili samba	31220	63643	32423	2.04
IR 20	31190	36954	5764	1.18
CO 43	31190	36757	5567	1.18
CO(R) 48	31190	44947	13757	1.44
CO(R) 51	31190	34929	3739	1.12
CB 05022	31190	71205	40015	2.28
KDML 105	31220	53736	22516	1.72
Red kavuni	31220	59335	28115	1.90
Jeeraga samba	31220	62651	31431	2.01

Dharwad (Table 7.2.18 to 7.2.22)

Ten varieties of soybean,eleven varieties of groundnut, 320 varieties of cotton, nine varieties of wheat and eight varieties of chickpea were evaluated in cropping system mode.

Soybean (Table 7.2.18): Ten varieties of soybean were evaluated in *kharif* season in RBD design with three replications. Genotypes DSB 21 recorded maximum number of pods/plant (45.3) and 100 seed weight (12.8g) followed by JS 335 and DSB 16 (943.3 and 12.7 respectively). Genotypes DSB 22 and DSB19recorded lowest pod/plant and 100 seed weight. Cultivar DSB 16 recorded higher seed yield (2291 kg/ha)net return (Rs.50,089/ha) and B:C ratio (3.69) followed by DSB 21 and DSB 20. Cultivar KHSB 2 was the lower producer of grain yield, net return and B:Cratio. Cultivar DSB 21 and DSB 16 in organic production system were found more remunerative over other cultivars of JS 335 and KHSB 2.

Groundnut (Table 7.2.19): Eleven varieties of groundnut were studied for their performance under organic management during *kharif* 2013. Significantly higher dry pod weight (45.51g/plant),dry pod yield (3571 kg/ha), net return (Rs. 1,20,196/ha) and B:C ratio (6.32) was recorded with groundnut cultivar cv. TGLPS 3 followed by GPBD 4. Cultivation of TGLPS 3 under organic production system was found more remunerative in terms of net return. Groundnut cultivar Dh 200-1 recorded lowest dry pod yield, net return and B:C ratio.

Cotton (Table 7.2.20): Among the 320 varieties of cotton grown under similar organic nutrient source and doses, cultivars GHAM 82 produced 158, 113, 206 and 126 % higher seed cotton yield and GHAM 34 produced 193, 142, 246 and 156 % higher seed cotton yield over cultivars Sahana (794 kg/ha), MCV 5 (961 kg/ha), DS 28 (671 kg/ha) and Surabhi (908 kg/ha), respectively, under organic production system.

Wheat (Table 7.2.21): Among the variety of wheat grown under similar organic nutrient source and doses,DWR 162 out performed and recorded significantly higher tillers/m row length (113.71), total dry matter (126.65 g/plant), nos. of grains/spike (36.56), grain yield (1678 kg/ha),net return (Rs. 18091/ha)

Table 7.2.18. Response of varieties/hybrids for yield attributes, yield and economics of soybean at Dharwad

Soybean genotypes	Number of pods/plant	100 Seed weight (g)	Seed weight (g/plant)	Seed yield (kg/ha)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C Ratio
DSB-21	45.28	12.780	16.260	2207	18,631	66,204	47,573	3.55
DSB-20	41.13	12.430	15.540	2155	18,631	64,645	46,014	3.47
BDSB-18	40.20	12.230	15.290	2062	18,631	61,866	43,235	3.32
DSB-1	39.60	12.200	14.130	2079	18,631	62,360	43,729	3.35
DSB-22	32.47	11.330	16.080	2091	18,631	62,730	44,099	3.37
DSB-19	30.48	11.000	10.790	2078	18,631	62,342	43,711	3.35
DSB-16	43.05	12.630	17.280	2291	18,631	68,720	50,089	3.69
KHSB-2	41.60	12.500	15.610	1927	18,631	57,820	39,189	3.10
JS-335	43.33	12.760	16.130	2064	18,631	61,925	43,294	3.32
JS-9305	39.19	12.180	13.670	2059	18,631	61,764	43,133	3.32
SEm±	1.15	0.39	1.04	62	—	1856	1,856	0.10
CD (P=0.05)	3.41	NS	3.08	184	—	5515	5,515	0.30

Table 7.2.19. Yield attributes, yield and economics of groundnut at Dharwad

Groundnut genotypes	Number of pods/plant	Dry pod weight (g/plant)	100 Kernel weight (g)	Dry pod yield (kg/ha)	Net returns (Rs/ha)	B:C Ratio
Dh 4-3	34.000	38.490	36.990	3189	1,04,704	5.64
Dh 86	32.820	34.930	38.350	2965	95,996	5.25
Dh 200-1	27.650	34.500	39.070	2785	88,820	4.93
Dh 101	32.690	39.140	37.240	3388	1,12,936	6.00
Mutant III	31.450	35.830	35.290	3265	1,07,999	5.78
JL 24	30.690	39.190	39.470	3207	1,05,676	5.68
TMV 2	32.700	31.000	36.020	3025	98,420	5.36
TGLPS 3	34.920	45.510	37.980	3570	1,20,196	6.32
GPBD 4	35.820	40.610	42.210	3556	1,19,656	6.30
GPBD 5	34.580	40.180	37.760	3148	1,03,353	5.58
G-2-52	38.810	40.730	41.680	3214	1,10,549	5.90
SEm±	1.90	2.35	0.36	184	7,391	0.33
CD (P=0.05)	5.60	6.94	1.51	543	21,804	0.97

Table 7.2.20 Seed cotton yield at Dharwad

Sl. No.	Varieties/ hybrids	Seed cotton yield (kg/ha)	Sl. No.	Varieties/ hybrids	Seed cotton yield (kg/ha)	Sl. No.	Varieties/ hybrids	Seed cotton yield (kg / ha)
1	GHAM 1	1300	41	GHAM 41	1456	81	GHAM 81	1136
2	GHAM 2	1122	42	GHAM 42	1383	82	GHAM 82	2056
3	GHAM 3	767	43	GHAM 43	1500	83	GHAM 83	1078
4	GHAM 4	939	44	GHAM 44	1022	84	GHAM 84	1040
5	GHAM 5	1006	45	GHAM 45	1097	85	GHAM 85	978
6	GHAM 6	650	46	GHAM 46	1597	86	GHAM 86	1144
7	GHAM 7	1172	47	GHAM 47	750	87	GHAM 87	817
8	GHAM 8	619	48	GHAM 48	656	88	GHAM 88	875
9	GHAM 9	1344	49	GHAM 49	853	89	GHAM 89	1297
10	GHAM 10	575	50	GHAM 50	1303	90	GHAM 90	1118
11	GHAM 11	1365	51	GHAM 51	792	91	GHAM 91	743
12	GHAM 12	1450	52	GHAM 52	1108	92	GHAM 92	1092
13	GHAM 13	1293	53	GHAM 53	339	93	GHAM 93	606
14	GHAM 14	889	54	GHAM 54	892	94	GHAM 94	1192
15	GHAM 15	843	55	GHAM 55	1021	95	GHAM 95	868
16	GHAM 16	886	56	GHAM 56	1211	96	GHAM 96	961
17	GHAM 17	1283	57	GHAM 57	1367	97	GHAM 97	449
18	GHAM 18	386	58	GHAM 58	1011	98	GHAM 98	362
19	GHAM 19	1061	59	GHAM 59	743	99	GHAM 99	487
20	GHAM 20	736	60	GHAM 60	564	100	GHAM 100	556
21	GHAM 21	1894	61	GHAM 61	1953	101	GHAM 101	978
22	GHAM 22	1367	62	GHAM 62	1743	102	GHAM 102	756
23	GHAM 23	1633	63	GHAM 63	1719	103	GHAM 103	1208
24	GHAM 24	1201	64	GHAM 64	1199	104	GHAM 104	689
25	GHAM 25	1372	65	GHAM 65	962	105	GHAM 105	835
26	GHAM 26	1075	66	GHAM 66	393	106	GHAM 106	715

Sl. No.	Varieties/ hybrids	Seed cotton yield (kg/ha)	Sl. No.	Varieties/ hybrids	Seed cotton yield (kg/ha)	Sl. No.	Varieties/ hybrids	Seed cotton yield (kg / ha)
27	GHAM 27	160	67	GHAM 67	482	107	GHAM 107	1390
28	GHAM 28	328	68	GHAM 68	1293	108	GHAM 108	815
29	GHAM 29	1006	69	GHAM 69	768	109	GHAM 109	1349
30	GHAM 30	328	70	GHAM 70	1050	110	GHAM 110	1194
31	GHAM 31	1017	71	GHAM 71	1239	111	GHAM 111	729
32	GHAM 32	511	72	GHAM 72	708	112	GHAM 112	1094
33	GHAM 33	1024	73	GHAM 73	1046	113	GHAM 113	743
34	GHAM 34	2328	74	GHAM 74	1469	114	GHAM 114	868
35	GHAM 35	819	75	GHAM 75	1244	115	GHAM 115	469
36	GHAM 36	931	76	GHAM 76	475	116	GHAM 116	807
37	GHAM 37	1036	77	GHAM 77	903	117	GHAM 117	972
38	GHAM 38	1183	78	GHAM 78	926	118	GHAM 118	914
39	GHAM 39	615	79	GHAM 79	851	119	GHAM 119	487
40	GHAM 40	644	80	GHAM 80	969	120	GHAM 120	654
121	GHAM 121	886	161	GHAM 161	1067	201	GHAM 201	842
122	GHAM 122	900	162	GHAM 162	1010	202	GHAM 202	1322
123	GHAM 123	964	163	GHAM 163	889	203	GHAM 203	1339
124	GHAM 124	1737	164	GHAM 164	1012	204	GHAM 204	464
125	GHAM 125	1417	165	GHAM 165	1078	205	GHAM 205	590
126	GHAM 126	1442	166	GHAM 166	964	206	GHAM 206	1856
127	GHAM 127	854	167	GHAM 167	1008	207	GHAM 207	1267
128	GHAM 128	1146	168	GHAM 168	1217	208	GHAM 208	1581
129	GHAM 129	1033	169	GHAM 169	1049	209	GHAM 209	1233
130	GHAM 130	1171	170	GHAM 170	217	210	GHAM 210	1033
131	GHAM 131	694	171	GHAM 171	900	211	GHAM 211	1510
132	GHAM 132	744	172	GHAM 172	921	212	GHAM 212	731
133	GHAM 133	672	173	GHAM 173	654	213	GHAM 213	885
134	GHAM 134	1397	174	GHAM 174	1358	214	GHAM 214	793
135	GHAM 135	974	175	GHAM 175	690	215	GHAM 215	1057
136	GHAM 136	1329	176	GHAM 176	1174	216	GHAM 216	1136
137	GHAM 137	819	177	GHAM 177	1681	217	GHAM 217	1622
138	GHAM 138	999	178	GHAM 178	649	218	GHAM 218	1233
139	GHAM 139	547	179	GHAM 179	818	219	GHAM 219	1117
140	GHAM 140	997	180	GHAM 180	333	220	GHAM 220	1237
141	GHAM 141	717	181	GHAM 181	1485	221	GHAM 221	1204
142	GHAM 142	1669	182	GHAM 182	953	222	GHAM 222	683
143	GHAM 143	1472	183	GHAM 183	960	223	GHAM 223	797
144	GHAM 144	721	184	GHAM 184	926	224	GHAM 224	1064
145	GHAM 145	569	185	GHAM 185	1158	225	GHAM 225	800
146	GHAM 146	1418	186	GHAM 186	992	226	GHAM 226	1460
147	GHAM 147	1161	187	GHAM 187	1253	227	GHAM 227	1351
148	GHAM 148	843	188	GHAM 188	657	228	GHAM 228	703

Sl. No.	Varieties/ hybrids	Seed cotton yield (kg/ha)	Sl. No.	Varieties/ hybrids	Seed cotton yield (kg/ha)	Sl. No.	Varieties/ hybrids	Seed cotton yield (kg/ha)
149	GHAM 149	1068	189	GHAM 189	1071	229	GHAM 229	1008
150	GHAM 150	922	190	GHAM 190	1089	230	GHAM 230	1456
151	GHAM 151	681	191	GHAM 191	1625	231	GHAM 231	1167
152	GHAM 152	1492	192	GHAM 192	1331	232	GHAM 232	1244
153	GHAM 153	1549	193	GHAM 193	794	233	GHAM 233	1231
154	GHAM 154	925	194	GHAM 194	919	234	GHAM 234	847
155	GHAM 155	933	195	GHAM 195	1015	235	GHAM 235	1682
156	GHAM 156	1033	196	GHAM 196	661	236	GHAM 236	1311
157	GHAM 157	1033	197	GHAM 197	506	237	GHAM 237	1261
158	GHAM 158	647	198	GHAM 198	767	238	GHAM 238	1375
159	GHAM 159	874	199	GHAM 199	669	239	GHAM 239	579
160	GHAM 160	897	200	GHAM 200	732	240	GHAM 240	1060
241	GHAM 241	1292	268	GHAM 268	319	295	GHAM 295	619
242	GHAM 242	1603	269	GHAM 269	965	296	GHAM 296	868
243	GHAM 243	1092	270	GHAM 270	839	297	GHAM 297	908
244	GHAM 244	926	271	GHAM 271	1083	298	GHAM 298	1258
245	GHAM 245	1056	272	GHAM 272	611	299	GHAM 299	812
246	GHAM 246	807	273	GHAM 273	444	300	GHAM 300	361
247	GHAM 247	979	274	GHAM 274	893	301	GHAM 301	1014
248	GHAM 248	1156	275	GHAM 275	999	302	GHAM 302	1906
249	GHAM 249	814	276	GHAM 276	1417	303	GHAM 303	1686
250	GHAM 250	587	277	GHAM 277	640	304	GHAM 304	875
251	GHAM 251	797	278	GHAM 278	835	305	GHAM 305	894
252	GHAM 252	1067	279	GHAM 279	833	306	GHAM 306	708
253	GHAM 253	1372	280	GHAM 280	939	307	GHAM 307	703
254	GHAM 254	1561	281	GHAM 281	1204	308	GHAM 308	792
255	GHAM 255	1337	282	GHAM 282	658	309	GHAM 309	944
256	GHAM 256	1086	283	GHAM 283	1408	310	GHAM 310	786
257	GHAM 257	400	284	GHAM 284	714	311	GHAM 311	550
258	GHAM 258	1653	285	GHAM 285	1044	312	GHAM 312	872
259	GHAM 259	575	286	GHAM 286	907	313	MCU-5 (C)	961
260	GHAM 260	467	287	GHAM 287	869	314	Sahana (C)	794
261	GHAM 261	836	288	GHAM 288	414	315	DS-28 (C)	671
262	GHAM 262	1564	289	GHAM 289	658	316	Surabhi (C)	908
263	GHAM 263	1139	290	GHAM 290	600	317	GHAM 317	669
264	GHAM 264	683	291	GHAM 291	1019	318	GHAM 318	392
265	GHAM 265	600	292	GHAM 292	697	319	GHAM 319	1025
266	GHAM 266	1208	293	GHAM 293	467	320	ARBH-813	942
267	GHAM 267	1153	294	GHAM 294	487			
	CD (P=0.05)	812.8						

Table 7.2.21. Yield attributes, yield and economics of wheat at Dharwad

Varieties/ hybrids	Plant height (cm)	Number of tillers/ m row length	Total dry matter (g/plant)	Number of grains/spike	Grain yield (kg/ha)	Net returns (Rs/ha)	B:C ratio
UAS 185	59.82	97.47	118.77	31.31	1344	12,736	2.45
UAS 428	58.12	95.04	118.26	30.95	1313	12,240	2.40
GW 322	56.58	107.96	125.47	34.72	1634	17,387	2.98
DWR 162	54.68	113.71	126.65	36.56	1678	18,091	3.06
UAS 446	57.83	105.02	120.41	31.52	1383	13,360	2.52
UAS 304	56.46	108.10	123.72	34.36	1605	16,923	2.93
UAS 334	54.92	106.33	123.10	33.40	1505	15,323	2.75
MACS 622	53.02	103.77	120.68	32.51	1451	14,448	2.65
UAS 415	52.18	98.37	119.88	32.27	1352	12,951	2.48
SEm±	0.11	4.28	0.03	0.11	1.11	1110	0.01
CD (P=0.05)	0.33	NS	0.09	0.35	3.33	3331	0.03

and B:C ratio of 3.06. DWR 162 and UAS 304 also produced 21and 16% higher grain yield, respectively over UAS 446 (1383 kg/ha) under organic production system.

Chickpea (Table 7.2.22): Among the chickpea varieties, JAKI 9218, A1 and BGD 103 out performed in terms of all traits, MNK 1 was the lower performer in all the measured variables. Cultivars JAKI 9218, A1 and BGD 103 produced 23.41, 21.07 and 21.75 % higher seed yield, respectively over cultivar ICCV 2 (2097 kg/ha) under organic production system.

Table 7.2.22 Yield attributes, yield and economics of chickpea at Dharwad

Chickpea genotypes	Plant height (cm)	Number of branches/ plant	Dry matter production (g/plant)	Number of pods/plant	Seed weight (g/plant)	Seed yield (kg/ha)	Net returns (Rs/ha)	B:C Ratio
BGD 103	40.56	15.14	23.170	40.32	10.890	2553	50,808	2.64
GBM 2	39.82	14.09	22.010	39.21	10.590	2480	48,491	2.57
JG 11	40.05	14.93	21.760	40.9	11.040	2501	49,140	2.59
A1	36.90	15.20	23.970	41.23	11.130	2556	50,924	2.65
JAKI 9218	36.26	16.05	24.550	42.23	11.400	2588	51,945	2.68
MNK 1	39.82	14.22	21.960	38.53	10.400	2423	46,668	2.51
BG 1105	36.72	12.42	21.970	37.54	10.140	2182	38,929	2.26
ICCV 2	39.19	11.25	20.970	36.53	9.860	2097	36,212	2.17
SEm±	0.07	0.13	0.23	0.93	0.25	34	1,103	0.03
CD(P=0.05)	0.21	0.42	0.71	2.83	0.76	104	3,346	0.10

Jabalpur (Table 7.2.23 to 7.2.26)

Rice (Table 7.2.23): Each twelve varieties of rice and wheat was evaluated in rice-wheat system. Significant difference among the varieties for plant height, panicle length, grains/panicle and grain yield were recorded with PS3 (77.2 cm, 26.2 cm, 138.7 and 3410 kg/ha respectively) and it was statistically at par with Dhanteshwari, PS 5 and Madhuri.BVD 109 achieved lower height, panicle length, grains/panicle and grain yield.

Table 7.2.23. Yield attributes, yield and harvest index of rice under organic management practices at Jabalpur

Rice varieties/ hybrids	Plant height (cm)	Panicle length (cm)	No. of effective tillers /m²	No. of grain/ panicle	1000 grain wt. (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest Index
PS 5	75.2	25.7	440.0	136.2	25.2	3349	5160	0.39
Shehdri	60.1	21.8	283.3	114.3	22.7	2810	4775	0.37
PS 4	64.8	23.7	336.5	122.8	25.5	3020	4925	0.38
BVD 109	58.1	20.5	258.3	102.8	25.0	2529	4610	0.35
JR-201	61.1	22.5	301.5	117.5	25.6	2889	4840	0.37
Dhanteshwari	76.3	25.9	468.3	137.5	23.2	3382	5200	0.39
Madhuri	73.2	25.1	411.5	134.5	25.5	3309	5112	0.39
IR 36	69.7	24.6	381.5	132.2	22.8	3251	5005	0.39
MTU 1010	67.8	24.4	366.5	129.4	22.9	3183	4967	0.39
IR 64	63.1	23.2	325.0	119.6	23.0	2941	4885	0.38
Pusa 1	59.1	20.5	261.5	107.5	25.5	2643	4680	0.36
PS 3	77.2	26.5	475.0	138.7	25.0	3410	5240	0.39
CD (p=0.05)								

Table 7.2.24. Yield attributes, yield and harvest index of wheat at Jabalpur

Wheat varieties/ hybrids	Plant height (cm)	Panicle length (cm)	No. of effective tillers /m²	No. of grain/ panicle	1000 grain wt. (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest Index
JW 17	73.6	10.4	139.1	42.3	42.0	3327	5656	0.38
JW 3020	72.2	9.3	138.1	40.3	41.5	3331	5663	0.38
JW 3173	72.9	10.0	139.5	45.0	42.2	4063	6906	0.38
JW 3269	73.0	10.0	140.3	46.7	41.8	3290	5594	0.38
JW 3288	73.1	10.3	139.1	41.3	41.6	3453	5869	0.38
HI 1531	72.7	9.4	138.2	41.3	41.8	3107	3728	0.40
HI 1500	74.0	11.0	141.3	47.6	41.3	2841	3409	0.40
C 306	72.9	9.0	138.9	38.3	42.3	3455	4146	0.40
HW 2004	73.4	10.0	139.7	42.1	41.7	3453	4144	0.41
HI 2987	71.9	8.1	138.0	37.3	42.0	2592	3110	0.40
HD 4672	73.9	10.9	138.2	46.0	42.0	3576	4291	0.41
HI 1418	72.7	9.4	138.2	41.3	42.4	2838	3406	0.40
CD (p=0.05)								

Wheat (Table 7.2.24): Not much variation was recorded in plant height, among different.Though maximum spike length and grains/spike were recorded by HI-1500 (11.0 and 47.6 cm) respectively it was statistically at par with JW-3269 and HD-4672. Wheat variety JW-3173 gave the significantly higher yield (4063 kg/ha) than all the other varieties. The lowest grain yield was recorded by HI-2987 (2592 kg/ha). Straw yield also followed trend.

Soil physical and chemical properties (Table 7.2.25): The difference among the varieties in respect of physical and chemical properties was non-significant. Maximum organic carbon content (7.17%) in the soil was found to be with rice (JR-201)-wheat (JW-3288) systemand it was closely followed by varieties of both crops in rice-wheat system. Maximum available N (277 kg/ha) was found to be with rice (JR-201) and wheat (JW-3288) system and minimum was with rice (Shehdri)-wheat(JW-3020) system 266 kg/ha. VarietyPS-5 of rice in *kharif* and JW-17 of wheat in *rabi* recorded higher available P (14.4 kg/ha) while minimum (12.8 kg/ha) was with Madhuri in *kharif* and HI-1500 in *rabi*.

Table 7.2.25. Chemical properties of soil at the end of cropping cycle at Jabalpur

Rice	Wheat	pH	EC (dSm^{-1})	OC (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
PS 5	JW 17	7.25	0.32	7.07	275	14.4	296
Shehdri	JW 3020	7.43	0.33	6.67	266	12.9	287
PS 4	JW 3173	7.33	0.31	7.07	272	14.0	295
BVD 109	JW 3269	7.31	0.33	6.92	270	13.5	292
JR-201	JW 3288	7.15	0.33	7.17	277	14.0	300
Dhanteshwari	HI 1531	7.13	0.35	6.75	269	13.2	296
Madhuri	HI 1500	7.31	0.36	7.06	269	12.8	293
IR 36	C 306	7.31	0.34	6.97	270	13.0	295
MTU 1010	HW 2004	7.22	0.34	6.72	268	13.3	291
IR 64	HI 2987	7.23	0.33	6.97	276	13.8	299
Pusa 1	HD 4672	7.20	0.34	6.92	272	13.5	296
PS 3	HI 1418	7.16	0.36	6.72	267	13.3	291
CD (p=0.05)							

Table 7.2.26. Microbial changes in soil at the end of cropping cycle at Jabalpur

Kharif (Rice)	*Rabi* (Wheat)	Fungi ($x10^6$ CFU/g)	Bacteria ($x10^6$ CFU/g)	Azatobacter ($x10^6$ CFU/g)	PSB ($x10^6$ CFU/g)	Actinomycets ($x10^6$ CFU/g)
PS 5	JW 17	35.2	48.3	26.30	16.1	15.1
Shehdri	JW 3020	34.5	45.5	24.65	15.4	14.2
PS 4	JW 3173	34.7	46.8	25.80	16.0	14.8
BVD 109	JW 3269	34.9	47.7	25.53	15.4	15.8
JR-201	JW 3288	36.1	46.1	26.71	16.0	15.0
Dhanteshwari	HI 1531	35.2	45.5	25.55	15.6	14.7
Madhuri	HI 1500	35.6	47.1	25.55	14.9	14.7
IR 36	C 306	35.6	45.6	26.05	15.5	14.8
MTU 1010	HW 2004	34.6	45.6	25.35	14.6	20.5
IR 64	HI 2987	36.0	45.9	26.50	15.6	15.0
Pusa 1	HD 4672	35.5	45.6	26.05	15.5	14.8
PS 3	HI 1418	34.7	45.1	25.45	15.0	14.6
CD (p=0.05)						

Performance of wheat varieties under organic management at Jabalpur

Microbial changes in soil (Table 7.2.26): Among the varieties grown in *kharif* and *rabi* in system mode, no much variation was found except *Actinomycets*. Maximum fungi ($36.1x10^4$ CFU/g) and *azatobacter* ($26.7x10^6$ CFU/g) was recorded in rice (JR-201)-wheat (JW-3288). Bacteria and PSB was found to be higher in rice (PS-5)-wheat (JW 17) (48.3 to 16.110^6 CFU/g). System rice (MTU-1010)-wheat (HW-2004) retained significantly higher *Actinomycets* $20.5x10^6$ CFU/g while lower was with rice (Shehdri)-wheat (JW 3020) system ($14.2x10^6$ CFU/g).

Karjat (Table 7.2.27 to 7.2.29)

During *kharif* season 15 varieties of rice were grown and after harvest of rice crop, 15 groundnuts varieties were also tested during *rabi* season in the system mode under organic management.

Rice (Table 7.2.27): Higher grain and straw yield was recorded by sahyadri-5 (4710 and 5510 kg/ha) in comparison to rest of rice varieties except sahyadri-4 and sahyadri-3 hybrids. Lowest grain yield was

Table 7.2.27. Performance of different rice varieties under organic management practices at Karjat

Rice varieties/ hybrids	Plant Height (cm)	No. of tillers/ hill	Effective tillers/ hill	Panicle Length (cm)	Grain Yield (kg/ha)	Straw Yield (kg/ha)
Karjat - 4	77.2	18.3	16.3	20.6	2810	3290
Karjat-7	97.4	22.8	21.2	21.4	3530	4130
Ratnagiri-1	103.7	15.3	14.1	22.2	3970	4650
Sahyadri-4	104.5	15.7	14.1	28.2	4630	5410
Karjat-5	113.0	15.4	13.5	26.2	3590	4200
Karjat-6	98.1	16.2	14.4	19.6	3410	3990
Palghar-1	88.2	14.1	12.3	26.5	3620	4230
Sahyadri-3	118.0	18.8	16.3	27.7	4690	5480
Ratnagiri-2	107.4	14.4	12.9	25.3	3610	4220
Ratnagiri-3	102.9	15.6	13.8	23.1	3620	4240
Karjat-8	113.3	18.3	16.6	22.6	3520	4120
Sahyadri-5	102.4	21.8	20.1	27.3	4710	5510
Karjat-3	98.1	19.9	18.2	23.5	3980	4660
Jaya	106.4	14.6	13.1	20.5	3990	4670
Karjat-2	98.5	15.7	14.1	20.9	3610	4220
SEm ±	0.83	0.53	0.53	0.40	70	81
CD(p=0.05)	2.59	1.65	1.66	1.26	217	253

Table 7.2.28. Performance of different groundnut varieties under organic management practices at Karjat

Groundnut varieties/hybrids	Plant height(cm)	Dry pods yield (kg/ ha)	Haulm yield (kg/ ha)
Phule-6021	39.0	1892	3027
SB XI	36.4	1612	2580
Western-44	38.0	1624	2598
Western-66	42.3	1754	2806
TAG-24	30.8	1886	3017
TKG-Bold	41.0	2211	3538
Kopergaon-1	36.4	1883	3013
PhulePragati (JL-24)	27.8	1922	3075
JL-220	46.2	2187	3499
JL-776	45.4	2229	3566
JL-501	35.1	1680	2688
TG-37 A	43.7	1955	3129
TG-26	35.2	2296	3673
KonkanGaurav	35.1	2274	3638
RHRG-6083	47.0	2320	3713
SEm ±	0.68	26	41
CD(p=0.05)	2.13	80	127

Table 7.2.29. Rice equivalent yield in term of system equivalent yield and economics of rice-ground system under organic management at Karjat

Rice	Groundnut	SEY (kg/ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	NRPRI* ratio
Karjat - 4	Phule-6021	15190	205047	47682	1.30
Karjat-7	SB XI	14620	197328	39963	1.25
Ratnagiri-1	Western-44	15330	206968	49603	1.32
Sahyadri-4	Western-66	17050	230141	72776	1.46
Karjat-5	TAG-24	16300	220050	62685	1.40
Karjat-6	TKG-Bold	17940	242187	84822	1.54
Palghar-1	Kopergaon-1	16320	220360	62995	1.40
Sahyadri-3	PhulePragati (JL-24)	18120	244575	87210	1.55
Ratnagiri-2	JL-220	18090	244225	86860	1.55
Ratnagiri-3	JL-776	18350	247767	90402	1.57
Karjat-8	JL-501	14990	202376	45011	1.29
Sahyadri-5	TG-37 A	18350	247729	90364	1.57
Karjat-3	TG-26	19270	260162	102797	1.65
Jaya	KonkanGaurav	19160	258622	101257	1.64
Karjat-2	RHRG-6083	18870	254784	97419	1.62
SEm ±		200	2640	2640	0.02
CD(p=0.05)		610	8213	8213	0.05

* Net return per rupees invested

recorded by Karjat-4 (2810 kg/ha). Significantly higher panicle length (28.2 cm) was recorded with Sahyadri-4 while maximum plant height of 118.0 cm was observed with Sahyadri-3.

Ground nut (Table 7.2.28): Groundnut variety,RHRG-6083 produced maximum and significantly higher plant height (47cm), dry pods yield (2320 kg/ha) and haulm weight (3713 kg/ha) over rest of the varieties except TG-26 and Konkangaurav. Lowest plant height was observed in PhulePragati (JL-24) of 27.8 cm and dry pod yield in Western-44 (1612 kg/ha).

Performance of groundnut varieties under organic management at Karjat

System equivalent yield and economics (Table 7.2.29): Rice variety Karjat–3 grown during *kharif* and groundnut variety TG-26 grown after harvest of karjat–3 recorded maximum and significantly higher system equivalent yield (REY 19270 kg/ha), net return (Rs. 102797/ha) and net return per Rs. invested (1.65) compared to other varieties evaluated in the system. Lowest system equivalent yield was recorded by rice (Karjat-7)-groundnut (SBXI) of (14620 kg/ha).

Ludhiana (Table 7.2.30 to 7.2.31)

Ten genotypes of rice and twelve genotypes of wheat were studied in RBD design with three replications for rice-wheat system. All the varieties of rice and wheat were grown under similar nutrient source and doses.

Basmati rice (Table 7.2.30): Basmati rice variety Punjab basmati 2 achieved significantly higher plant height (149.1 cm) followed by UPR 3560 (134.0 cm) which was significantly higher than all the other varieties.Lowest plant height was recorded by Pusa Punjab Basmati 1509 (90.1 cm). Among the rice varieties maximum panicle length was recorded in UPR 3560 27.7 cm and lowest was in Ent 6001 (21.4

Evaluation of rice varieties under organic management at Ludhiana

Performance of wheat varieties under organic management at Ludhiana

Table 7.2.30. Yield attributes, yield and harvest index of basmati rice at Ludhiana

Rice varieties/ hybrids	Plant height (cm)	Panicle length (cm)	No. of effective tillers /m²	No. of grain/ panicle	1000 grain wt. (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest Index
Punjab Basmati 2	149.1	25.1	261	59.1	24.7	3307	5833	0.36
Pusa Punjab Basmati 1509	90.1	24.7	168	62.1	29.8	2307	5470	0.30
Pusa Basmati 1121	121.2	22.9	283	55.2	27.8	4593	6540	0.41
Pusa 1592	104.6	23.8	287	87.4	25.9	5217	6930	0.43
Pusa 1612	113.4	27.1	270	87.8	28.8	5367	7960	0.40
CR-2007	118.7	25.3	281	68.0	29.3	4773	5410	0.47
Ent 6001	116.3	21.4	303	52.0	26.9	3720	5830	0.39
Ent 6002	116.4	22.4	321	61.4	24.8	4090	4550	0.47
UPR 3560	134.0	27.7	273	87.1	24.9	5007	6077	0.45
Punjab Basmati 3	120.3	23.6	260	61.6	22.5	3227	5293	0.38
CD (P=0.05)	5.9	2.0	52.0	18.0	NS	1020	1980	

Table 7.2.31. Yield attributes, yield and harvest index of wheat at Ludhiana

Wheat varieties/ hybrids	Plant height (cm)	Panicle length (cm)	No. of effective tillers /m²	No. of grain/ panicle	1000 grain wt. (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest Index
PBW 702	91.4	6.7	26.4	346.0	39.5	3487	4180	0.46
PBW 706	90.8	7.9	32.6	289.9	43.8	3800	4420	0.46
PBW 621	89.3	7.2	34.5	323.3	39.5	4317	5183	0.45
PBW 644	90.5	8.7	33.4	272.2	42.8	3620	4243	0.46
PBW 175	96.3	6.7	20.7	351.1	42.3	3160	3957	0.44
BWL-1761	107.1	7.4	21.1	358.0	35.9	2410	4033	0.37
BWL -0134	95.7	7.8	36.1	360.0	44.5	4773	5230	0.48
BWL-1940	88.5	7.8	34.9	296.6	42.2	4477	5300	0.46
BWL-2756	84.5	8.9	34.1	244.4	47.0	3797	4800	0.44
BWL- 720	96.8	7.7	36.7	314.4	39.8	4417	5207	0.46
C 306	113.1	7.1	27.9	277.8	42.9	3047	4510	0.40
PBW 660	95.7	7.1	36.4	287.7	41.1	4023	4977	0.45
CD (P=0.05)	6.8	NS	1.1	9.3	NS	7.8	NS	NS

cm).The maximum nos. of grain/panicle was recorded with Pusa 1612 (87.8) whereas Pusa Punjab Basmati 1509 recorded highest 1000 grains weight (29.8 g). Grain yield of rice varied from 2310-5370 kg/ha with a maximum variation of 113%. Basmati rice variety Pusa 1612 out performed and observed significantly higher grain yield of 5367 kg/ha closely followed by Pusa-1592 (5247 kg/ha) while, Pusa Punjab Basmati-1509 recorded lowest grain yield (2307 kg/ha). Straw yield also follow similar trend.

Wheat (Table 7.2.31): Higher plant height of wheat (113.1 cm) was observed in C 306 which was significantly higher than all the other wheat varieties except BWL-1761 which was statistically at par. Lowest plant height was in BWL-2756 (84.5 cm). Thousand grains weight, straw yield and harvest index did not differ significantly among the different varieties. Wheat grain yield varied from 2410-4770 kg/ha among different varieties. The highest grain yield (4770 kg/ha) was observed in BWL -0134 and it was significantly higher than the other varieties of wheat except BWL-1940, BWL- 720, PBW 621 and PBW 660 which were statistically at par. The lowest grain yield was recorded with BWL-1761 (2410 kg/ha).

Modipuram (Table 7.2.32 to 7.2.33)

Twelve promising varieties of maize and mustard were evaluated underorganic management in a randomized block design (RBD) during kharif and rabi season of 2013-14 in system mode grown under similar nutrient source and doses.

Varietal evaluation of maize under organic management at Modipuram

Maize (Table 7.2.32): Significant differences among the varieties for the entire traits was observed except cobs/plant and harvest index. Though the variety Bio-9637 recorded the highest plant height (245 cm), it was found to be statistically at par with PMH-4 (243 cm). Among the varieties, cob length of maize varied from 14.0 – 19.0 cm in which,PMH -5 recorded maximum and Vivek hybrid- 9 recorded minimum. Grain yield, straw yield, gross return, net returns and net return per rupee invested (6170, 8680 kg/ha, Rs.115977/ha, Rs.76552/ha and1.94 respectively) was recorded significantly higher with PMH-3 than all the other varieties except PMH-4 which was statistically at par.The lowest grain yield, straw yield, gross return, net returns and net return per rupee invested was given by Vivek QPM- 9 (3330, 5040kg/ha, Rs.62623/ha, Rs.23198/ha and 0.59 respectively).

Mustard (Table 7.2.33): The differences for all measured variable among the wheat varieties was observed to be significant for mustard. Among the varieties maximum plant height was recorded with RGN-48 but statistically at par with RH- 0406, RGN- 229 and Urvashi. Maximum branches/plant was observed with Pusa Mustard-25 (5.5) while nos. of sympodia was higher with NRCHB- 506 (21.4). Nos. of siliqua/plant and grains/siliqua was found to be significantly higher with Pusa Mustard-25 (299 and 17.4 respectively). Among the mustard varieties significantly higher grain yield was recorded with RGN-48 (1970 kg/ha) and it was statistically at par with RH- 0406, Pusa Bold and Pusa Mustard-26 (1950, 1910 and 1910 kg/ha respectively). Variety Pusa Mustard-25 gave minimum yield of 1530 kg/ha. Maximum gross return net return and net return per rupee invested was recorded by Urvashi (Rs./ha 73800, 38930 and 1.12). DRMRIJ-31, NRCHB- 101 and Pusa Mustard-26 also gave good returns and net return per rupee invested than the rest of other varieties.

Pantnagar (Table 7.2.34 to 7.2.35)

Seven coarse varieties of rice and seven basmati rice varieties (total 14) were evaluated during *kharif* and fourteen varieties of wheat in *rabi* were grown under similar organic nutrient source and doses for their performance under organic management.

Table 7.2.32 Yield attributes, yield and harvest index and economics of maize of maize varieties under organic management at Modipuram.

Maize varieties/ hybrids	Plant height (cm)	No. of cobs/ plant	Cob length (cm)	1000 grain weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest Index	Gross return (Rs/ha)	Cost of cultivation (Rs/ha)	Net Returns (Rs/ha)	Net return per rupee invested
Prakash	183	1.4	15.8	244.5	5170	7930	0.40	97177	39425	57752	1.46
Seed tech- 2324	217	1.2	17.0	348.4	5330	8140	0.40	100260	39425	60835	1.54
PMH -1	237	1.2	17.4	266.2	5010	7390	0.40	94194	39425	54769	1.39
PMH -3	194	1.6	17.6	243.3	**6170**	8680	0.42	**115977**	39425	**76552**	**1.94**
PMH -4	243	1.4	18.0	307.5	6000	8470	0.42	112819	39425	73394	1.86
PMH -5	205	1.4	**19.0**	263.5	5330	8190	0.39	100260	39425	60835	1.54
HQPM-5	225	1.2	15.6	291.7	4330	6710	0.39	81460	39425	42035	1.07
HQPM-1	215	1.4	16.2	229.2	4170	6470	0.39	78340	39425	38915	0.99
Bio- 9681	240	1.6	16.0	259.4	5170	7550	0.41	97177	39425	57752	1.46
Bio- 9637	**245**	1.4	17.2	301.6	4830	6670	0.42	90823	39425	51398	1.30
Vivek hybrid- 9	196	1.2	14.0	242.0	4330	6740	0.39	81423	39425	41998	1.07
Vivek QPM- 9	192	1.2	15.6	237.0	3330	5040	0.40	62623	39425	23198	0.59
CD (p=0.05)											

Table 7.2.33. Yield attributes, yield and harvest index economics of mustard varieties under organic management at Modipuram

Mustard varieties/ hybrids	Plant height (cm)	Branches/ plant	No. of sympodia/ plant	No. of siliqua/ plant	No. of grains/ siliqua	1000 grain wt. (g)	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest Index	Gross return (Rs/ha)	Cost of cultivation (Rs/ha)	Net Returns (Rs/ha)	B:C ratio
DRMRIJ- 31	146	3.8	10.5	181	17.4	6.9	1530	6550	18.9	57425	34870	22555	0.65
NRCDR- 02	143	3.4	15.0	245	13.6	5.9	1750	6000	22.6	65663	34870	30793	0.88
NRCHB- 101	144	4.1	14.0	283	13.0	5.3	1650	5540	22.9	61888	34870	27018	0.77
NRCHB- 506	153	4.8	18.4	270	14.0	5.1	1910	7170	21.0	71500	34870	36630	1.05
Pusa Mustard-25 (NPJ-112)	133	5.8	21.4	227	15.4	4.2	1650	5460	23.2	61913	34870	27043	0.78
Pusa Mustard-26 (NPJ-113)	143	5.8	16.8	236	15.2	4.8	1670	5520	23.2	62550	34870	27680	0.79
PusaTarak	144	4.2	20.8	228	12.4	5.8	1570	5850	21.2	58875	34870	24005	0.69
RH- 0406	167	4.8	14.8	212	17.0	5.6	1950	6800	22.3	73138	34870	38268	1.10
RGN- 229	164	4.8	20.6	273	15.2	5.2	1970	7370	21.1	73800	34870	38930	1.12
RGN- 48	171	5.0	18.2	232	14.8	6.0	1830	6840	21.1	68675	34870	33805	0.97
Urvashi	162	4.6	17.2	253	14.8	5.5	1910	7340	20.6	71563	34870	36693	1.05
Pusa Bold	157	5.6	18.2	299	17.2	6.4	1870	7800	19.3	70050	34870	35180	1.01
CD (p=0.05)													

Performance of PUSA-1121 under organic management

Performance of PUSA BASMATI-1 under organic management

Wheat performance UP-2784 under organic management at Pantnagar

Performance of PANT DHAN-18 under organic management at Pantnagar

Rice (Table 7.2.34): Plant height at harvest, effective tillers/m^2, number of grains/panicle and weight of grains per panicle showed significant variation among different rice varieties. Plant height at harvest of different coarse rice varieties ranged from 112 to 131 cm and that of fine rice varieties ranged from 119 to 141 cm. Tallest varieties reported among coarse were PD-18 and UPR-3425-1j-1-1 and fine in grain Taraori and Type-3 varieties. Number of effective tillers/m^2 of coarse grain varieties ranged from 277 to 337 and that of fine grain varieties from 224 to 314. Significantly higher effective tillers/m^2 were observed in NDR-359 and it was at par with all other varieties except PD-4, IR-64 (coarse grain) and Taraori, Type-3, Pusa basmati-1 and Pusa-1121(fine grain).

Among fine grain rice varieties, significantly higher numbers of grains/panicle were observed in Pant DRR Basmati -1(129) being *at par* with UPR-3488621(118) and UPR-3506-7-1-1(111). Among coarse grain rice varieties, significantly higher grain weight /panicle was recorded in NDR-359 (3.65 g) and among fine grain rice varieties, significantly higher grain weight/panicle was recorded in UPR-3488621(1.90 g) which was at par with Pant DRR Basmati-1(1.90 g).

Table 7.2.34. Yield attributes, yield, harvest index and NPK uptake of rice varieties influenced by organic management

Rice varieties/ hybrids	Plant height (cm)	No. of effective tillers/m²	Grains / panicle	Grain weight / panicle (g)	1000 grain weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest Index	Total N uptake (kg/ha)	Total P uptake (kg/ha)	Total K uptake (kg/ha)	Total S uptake (kg/ha)
Coarse grain												
PD-4	112	277	93	1.92	25.1	5133	5708	0.47	96.5	23.2	118.0	19.7
IR-64	121	296	93	2.22	28.9	5262	5896	0.47	89.6	23.6	106.7	9.2
PUSA-44	117	334	153	2.93	32.1	5845	5889	0.50	89.7	29.6	119.9	17.4
PD-18	131	331	139	2.54	31.4	5763	5794	0.50	101.8	24.8	125.8	14.6
PD-19	115	317	118	2.60	31.5	5388	6015	0.47	98.8	26.3	120.5	18.3
NDR-359	118	337	151	3.65	33.2	6174	6398	0.49	105.2	24.9	158.1	17.4
UPR-3425-11-1-1	131	328	96	2.24	29.9	5327	5927	0.47	99.0	24.6	128.7	13.6
Fine grain												
Taraori	141	224	75	1.25	22.8	2510	5310	0.32	54.0	15.4	86.8	15.4
Type-3	141	263	90	1.31	24.7	2799	5693	0.33	64.2	15.9	95.5	12.5
Pusa Basmati-1	121	277	92	1.37	25.6	3300	5623	0.37	67.5	26.3	98.8	11.4
Pusa-1121	127	276	103	1.50	25.8	3563	5283	0.40	74.9	18.2	103.4	10.0
Pant DRR Basmati-1	126	313	129	1.70	29.5	4165	5356	0.44	87.3	17.5	117.3	17.5
UPR-3488621	119	314	118	1.90	30.3	4185	5152	0.44	85.1	17.9	112.4	15.0
UPR-3506-7-1-1	137	309	111	1.50	26.6	3933	5124	0.43	74.9	24.4	97.9	13.4
CD (P=0.05)												

Table 7.2.35. Yield attributes, yield, harvest index and NPK uptake of wheat varieties influenced by organic management

Wheat varieties/ hybrids	Plant height (cm)	No. of spikes/ m²	No. of grains/ spike	1000 grain weight (g)	Grain yield (kg/ha)	Straw Yield (kg/ha)	Harvest Index	N Uptake (kg/ha)	P uptake (kg/ha)	K uptake (kg/ha)	S uptake (kg/ha)
UPD-94	97	277	48.5	41.2	3727	5859	0.39	97.9	11.3	91.1	9.3
PBW-550	86	276	48.2	42.6	3576	4840	0.43	88.9	8.7	88.7	10.1
UP-2628	87	253	46.1	40.4	3374	5404	0.38	89.4	7.9	79.3	9.8
UP-1109	97	311	51.5	42.7	4101	5298	0.44	96.6	10.4	96.2	10.0
UP-2748	91	329	53.9	43.0	3348	5712	0.37	89.2	10.0	87.6	12.2
UP-2843	91	359	54.0	44.2	3778	4963	0.43	93.5	9.6	87.4	11.6
UP-2841	99	279	48.8	40.2	3727	5455	0.41	98.0	9.1	92.3	9.3
UP-2572	99	291	49.8	39.6	3728	6034	0.38	100.9	13.3	111.9	8.2
DPW-62150	94	233	44.4	37.6	3373	5803	0.37	94.1	9.5	96.0	12.3
UP-2565	98	224	43.5	38.9	4045	5141	0.44	106.3	8.3	85.8	11.6
HD-2967	109	267	48.2	38.8	3550	5299	0.40	84.9	10.6	98.6	10.2
UP-2684	100	326	52.3	39.4	3804	5651	0.40	91.5	11.5	94.6	10.0
DPW-17	94	254	47.1	41.1	3499	6007	0.37	101.7	10.8	111.4	11.5
UP-2784	102	301	50.4	41.7	3738	5626	0.40	104.7	9.3	103.9	9.6
CD (P=0.05)											

Test weight of different coarse and fine grain rice varieties ranged from 25.1 to 33.2 g and from 22.8 to 30.3 g respectively. Significantly higher test weight of coarse grain rice varieties was found in NDR-359 (33.2 g) which was at par with Pusa-44 (32.1 g) and that of fine grain rice varieties, test weight was significantly higher in UPR-3488621 (30.3g) and it was at par with Pant DRR Basmati-1 (29.5g). Grain yield of coarse and fine grain varieties ranged from 5133 to 6174 kg/ha and from 2510 to 4185 kg/ha respectively. Significantly higher grain yield were observed in NDR-359 (6174 kg/ha) which was at par with all other varieties except PD-4, IR-64 (coarse grain) and Taraori, Type-3, Pusa basmati-1 and Pusa-1121(fine grain). Straw yield of coarse grain rice ranged from 5708 to 6398 kg/ha, while fine grain rice varieties ranged from 5124 to 5693 kg/ha. Non-significant differences in harvest index were observed among different coarse grain varieties as well as fine grain rice varieties.

Nitrogen uptake in coarse grain rice varieties was found to be significantly higher in NDR-359 (105.2 kg/ha) and it was at par with all the varieties except IR-64 and Pusa-44, while N uptake among fine grain rice varieties was significantly higher in Pant DRR Basmati-1(87.3 kg/ha) and at par with all other varieties except Taroari, Type-3 and Pusa Basmati-1. Phosphorus uptake by coarse grain rice varieties was found to be significantly higher in Pusa-44 (29.6 kg/ha). Potassium uptake by coarse grain rice varieties was found to be significantly higher in NDR-359 (158.1kg/ha) as compared to all other varieties, while potassium uptake among fine grain rice varieties was found to be significantly higher in Pant DRR Basmati-1 (117.3 kg/ha).

Wheat (Table 7.2.35): Plant height at harvest of different wheat varieties ranged from 85.7 to 109.3 cm, tallest variety reported was HD-2967 (109.3cm) followed by UP-2784 (102.3 cm). Significant differences in spikes/m^2 were observed and it ranged from 224 to 359. Number of grains/spike ranged from 43.5 to 54.0 among the different wheat varieties and significantly higher number of grains/spike were observed in UP-2843(54 nos.) being at par with 2748 (53.9), UP-1109 (51.5), UP-2684 (52.3). Grain weight/spike was found non-significant among different wheat varieties.

Significantly higher test weight of wheat varieties was found in UP-2843 (44.2g) which was at par with UP-2748 (43.0 g), UP-1109 (42.7g), PBW-550 (42.6g) and UP-2784(41.7g). Non-significant differences in grain yield among different wheat varieties were observed, although numerically higher grain yield were observed in UP-1109 (4101 kg/ha). Higher straw yield of wheat was recorded in UP-2572and it was at par with DPW-17, DPW-62150 and UPD-94.

Nitrogen uptake was found to be significantly higher in UP-2565 (106.4 kg/ha) and it was at par with all the varieties except PBW-550 and UP-2628 and UP-2748hoever,phosphorus uptake was found to be significantly higher in UP-2572 (13.3 kg/ha) and it was at par with UPD-94 and UP-2684. Potassium uptake was found to be significantly higher in UP-2572 (111.9 kg/ha) closely followed by DPW-62150 (12.3 kg/ha). Sulphur uptake was found to be significantly higher with PD-4 (12.3 kg/ha).

Raipur (Table 7.2.36)

Among the rice varieties grown under organic management, maximum plant height was observed in rice variety Jeeraphool (183.6 cm) while lowest was with the CR Sugandha Dhan 907 (103.3 cm). The rice variety Badshahbhog recorded the highergrain yield (3854 kg/ha) compared with rest varieties. Jaygundi,Bisni,Vishnubhog and Kubrimohar recorded yield ranging from 3636 to 3730 kg/ha. No much variation was recorded in available phosphorus in the soil whereas, maximum available N was recorded

Table 7.2.36. Response of different traditional and improved scented rice varieties under organic farming at Raipur

Rice varieties/ hybrids	Growth and yield attributes					Yield (kg/ha)	Chemical properties of soil			
	Plant height (cm)	No. of tillers /hill	No. of filled grains/panicle	Panicle length (cm)	1000 grains weight (g)		Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)	OC (%)
Badshahbhog	169.3	13.3	188.7	30.1	15.0	3854	235.6	14.1	312.3	0.63
Gopalbhog	143.6	15.0	156.7	30.8	19.2	3344	264.9	14.5	363.3	0.79
Vishnubhog	125.3	19.7	187.3	27.2	14.5	3646	271.6	14.3	364.5	0.75
Bisni	163.5	13.7	156.7	25.3	14.5	3708	259.4	13.5	389.9	0.69
Shyamajeera	175.9	18.7	147.3	31.0	13.3	1854	260.4	14.4	430.4	0.73
Jeeraphool	183.6	21.7	206.0	27.8	16.3	2948	285.4	13.5	377.0	0.75
KubriMohar	150.7	14.0	174.3	29.3	20.5	3636	228.8	14.3	457.7	0.65
TulsiManjari	141.9	14.3	150.0	29.2	13.7	2562	260.0	14.8	370.6	0.67
Jaygundi	177.1	15.7	266.0	30.4	15.8	3730	249.9	14.3	403.8	0.67
Gagabaru	181.7	19.7	156.7	29.3	15.0	2604	286.0	12.6	334.2	0.77
Sugandhmati	145.4	19.3	167.3	26.7	20.0	2583	242.8	13.3	317.8	0.62
Lalu 14	126.4	16.7	159.7	23.1	19.6	2271	260.4	14.0	450.2	0.73
Dujai	149.1	12.7	161.3	23.4	18.0	2396	260.4	13.5	315.8	0.67
Dubraj	142.9	14.0	139.0	22.0	19.5	3500	242.3	13.7	430.2	0.62
CR Sugandha Dhan 907	103.3	14.7	168.0	25.5	19.9	3250	254.1	13.6	391.7	0.60

Performance of rice varieties Badshah Bhog under organic management at Raipur

Performance of rice varieties Jeera Phool under organic management at Raipur

with Kubrimohar (228.8 kg/ha) while K was higher with (Lalu-14) rice variety. Organic carbon was observed to be higher in Gopalbhog.Since majority of traditional scented rice cultivars are long duration (up to 145 days), next cropchilliwhich was planted late failed. Hence chilli is not recommended after long duration rice.

Ranchi (Table 7.2.37 to 7.2.43)

Yield attributing characters of rice (Table 7.2.37): The rice variety Lalat recorded the maximum straw yield, effective tillers/m^2, panicle length, number of filled grains/panicle and straw yield. The maximum plant height was observed with rice variety Birsamati (10.60cm) compared to other varieties. However, Anjli registered highest 1000 grain weight (24.93) while, lowest test weight (20.88) was observed with Birsa vikas sugandha 1.

Yields attributing characters of wheat (Table 7.2.38): Yield attributing characters and straw yield of wheat was recorded higher with wheat variety K0307 which recorded straw yield (4816 kg/ha), effective tillers/m^2 of 333, spike length 10.13 cm and number of grains/spike 33.30. The maximum plant height & test weight were observed with wheat variety K9207 (101.82 cm) & WR544 (50.12 g).

Grain yield of rice, wheat and system (Table 7.2.39): The maximum grain yield of rice (3722 kg/ha) was obtained with rice variety Lalat which was significantly superior over all the other rice varieties except Birsa vikas dhan-203 (3622 kg/ha), Birsadhan-201 (3567 kg/ha) and Naveen (3404 kg/ha). The wheat variety K0307 recorded the higher wheat yield (3378 kg/ha) and rice equivalent yield of wheat crop (3942 kg/ha) which was statistically similar to Raj-4229 (3222 kg/ha), K-9107 (3156 kg/ha), GW-366 (3044 kg/ha), DBW-39 (3000 kg/ha) and BG-3 (2967 kg/ha) but shows its significant superiority over rest of the varieties. In terms of system yield of rice with, Birsadhan 201- wheat with GW-366 gave significantly higher system yield (7119 kg/ha) than rice (Birsa vikas sugandha 1) -wheat (NW 2036), rice (Birsamati) – wheat (HI 1563), rice (Akhchhai) – wheat (BG 3) and rice (Pusa sugandha) –wheat (HD 2733).

Weed dynamics (Table7.2.40): Dry matter accumulation of weeds per unit area was minimum in rice (Lalat) – wheat (DBW 14) sequence during *kharif* at 25 & 40 DAT/ DAS, while in *rabi* minimum dry matter accumulation of weeds was recorded with rice (B.V.D110) – wheat (K0307) at 25 & 40 DAT/ DAS. The

Table 7.2.37. Yield attributing characters and straw yield of rice varieties under organic management at Ranchi

Cropping System	Effective tillers/m²	Plant height (cm)	Panicle length (cm)	Filled grain /panicle	1000 grain weight (g)	Straw yield (q/ha)
Rice (Birsavikasdhan 203)	275.67	87.67	23.53	86.93	22.72	5814
Rice (Birsadhan 201)	274.00	80.13	21.77	83.87	23.50	5570
Rice (Birsavikassugandha 1)	247.67	103.90	20.47	76.20	20.88	5264
Rice (B.V.D110)	251.33	102.63	20.70	78.93	21.59	5399
Rice (Sahbhagi)	260.33	92.17	21.27	83.73	23.07	5604
Rice (Birsamati)	260.67	104.60	21.83	83.93	20.93	5704
Rice (Anjli)	239.33	82.33	19.83	70.93	24.93	5347
Rice (Lalat)	287.00	97.53	25.53	88.07	22.31	6161
Rice (M.T.U 10)	258.00	84.90	23.43	84.73	22.03	5378
Rice (Akhchhai)	251.00	101.60	20.17	75.40	22.43	5440
Rice (Pusasugandha)	266.33	100.37	20.90	83.67	21.02	5665
Rice (Navin)	268.67	99.23	23.43	86.07	22.23	5885
SEm±	12.19	3.73	0.93	4.14	0.60	195
CD (P=0.05)	35.76	10.95	2.73	12.14	1.77	573

Table 7.2.38. Yields attributing characters and straw yield of wheat under organic management at Ranchi

Cropping System	Number of spikes/m²	Plant height (cm)	Spike length (cm)	No. of grains/ spike	1000 grain weight (g)	Straw yield (q/ha)
Wheat (Raj 4250)	280	91.09	7.63	31.07	44.01	4154
Wheat (GW 366)	318	87.82	9.21	32.60	41.27	4376
Wheat (NW 2036)	295	87.09	8.33	31.80	43.43	4250
Wheat (K0307)	333	92.19	10.13	33.30	42.71	4816
Wheat (K9107)	323	101.82	8.41	31.97	42.62	4582
Wheat (HI 1563)	282	91.74	7.99	31.53	45.12	4252
Wheat (Raj 4229)	310	82.62	9.88	32.63	44.54	4478
Wheat (DBW 14)	285	70.05	8.14	31.60	43.05	4234
Wheat (WR 544)	273	95.43	8.03	28.57	50.12	4299
Wheat (BG 3)	293	86.43	9.03	30.03	47.24	4458
Wheat (HD 2733)	280	78.10	7.05	29.82	44.84	4194
Wheat (DBW 39)	300	83.11	9.15	32.30	45.76	4302
SEm±	13.77	3.14	0.55	0.93	1.54	185
CD (P=0.05)	40.39	9.20	1.61	2.74	4.53	543

Table 7.2.39. Grain yield of rice, wheat and system under organic management at Ranchi

Treatments	Rice(kg/ha)	Wheat (kg/ha)	Rice equivalent system yield(kg/ha)
Rice (Birsavikasdhan 203) - wheat (Raj 4250)	3622	2733	6811
Rice (Birsadhan 201) – wheat (GW 366)	3567	3044	7119
Rice(Birsavikassugandha 1) -wheat (NW 2036)	2667	2889	6037
Rice (B.V.D110) – wheat (K0307)	2833	3378	6774
Rice (Sahbhagi) – wheat (K9107)	3300	3156	6981
Rice (Birsamati) – wheat (HI 1563)	3089	2822	6381
Rice (Anjli) – wheat (Raj 4229)	2856	3222	6615
Rice (Lalat) – wheat (DBW 14)	3722	2756	6937
Rice (M.T.U 10) – wheat (WR 544)	3256	2844	6574
Rice (Akhchhai) – wheat (BG 3)	2900	2967	6361
Rice (Pusasugandha) –wheat (HD 2733)	3156	2733	6344
Rice (Naveen) – wheat (DBW 39)	3404	3000	6904
SEm±	144	146	219
CD (P=0.05)	422	430	642

Selling price of organic produce i.e. rice and wheat are Rs 15.00, Rs.17.50/kg respectively

Table 7.2.40. Dry matter accumulation of weeds (g/m²) in rice – wheat cropping system under organic management at Ranchi

Varieties in rice-wheat cropping system	*Kharif*		*Rabi*	
	Weed dry weight (g/m²) 25 DAT	Weed dry weight (g/m²) 40 DAT	Weed dry weight (g/m²) 25 DAS	Weed dry weight (g/m²) 40 DAS
Rice (Birsavikasdhan 203) - wheat (Raj 4250)	20.85	32.00	15.64	24.88
Rice (Birsadhan 201) – wheat (GW 366)	22.69	33.10	11.26	20.41
Rice (Birsavikassugandha 1) – wheat (NW 2036)	30.32	40.48	13.62	24.18
Rice (B.V.D110) – wheat (K0307)	29.88	39.88	9.25	16.40
Rice (Sahbhagi) – wheat (K9107)	24.45	34.78	13.31	22.31
Rice (Birsamati) – wheat (HI 1563)	25.21	35.28	14.55	24.84
Rice (Anjli) – wheat (Raj 4229)	27.69	39.48	10.67	19.23
Rice (Lalat) – wheat (DBW 14)	20.22	30.08	14.14	24.39
Rice (M.T.U 10) – wheat (WR 544)	24.89	34.94	14.41	24.52
Rice (Akhchhai) – wheat (BG 3)	27.09	38.14	12.20	21.02
Rice (Pusasugandha) – wheat (HD 2733)	25.51	36.61	18.66	25.15
Rice (Navin) – wheat (DBW 39)	24.01	33.78	11.59	20.99
SEm±	1.59	2.01	1.01	1.58
CD (P=0.05)	4.66	5.90	2.95	4.64

highest dry matter accumulation was recorded with rice (Birsavikassugandha 1) – wheat (NW 2036) during both the season at 25 & 40 DAT/ DAS.

Soil nutrient status (Table 7.2.41): There was improvement in soil pH, organic carbon, soil N, P & K in rice-wheat cropping system compared to initial value. Among cropping system,rice (Birsa vikas sugandha 1) – wheat (NW 2036) recorded higher available N, P & K at end of rice-wheat system cropping cycle.

Table 7.2.41. Soil nutrient status under different varieties of crop for organic management practices

Practices in rice-wheat cropping system	End of cropping cycle				
	pH	OC%	Avail. N	Avail. P	Avail.K
Rice (Birsavikasdhan 203) - wheat (Raj 4250)	6.20	0.62	249.00	37.18	200.85
Rice (Birsadhan 201) – wheat (GW 366)	6.17	0.63	249.32	37.81	200.98
Rice (Birsavikassugandha 1) – wheat (NW 2036)	6.05	0.67	262.21	42.71	220.20
Rice (B.V.D110) – wheat (K0307)	5.98	0.67	260.74	40.81	216.02
Rice (Sahbhagi) – wheat (K9107)	6.17	0.64	253.68	39.11	203.37
Rice (Birsamati) – wheat (HI 1563)	6.03	0.65	254.84	42.05	212.22
Rice (Anjli) – wheat (Raj 4229)	5.90	0.67	260.01	40.57	215.13
Rice (Lalat) – wheat (DBW 14)	6.05	0.62	247.80	36.75	199.26
Rice (M.T.U 10) – wheat (WR 544)	6.07	0.65	254.70	39.29	203.72
Rice (Akhchhai) – wheat (BG 3)	5.94	0.67	258.72	40.15	213.35
Rice (Pusasugandha) – wheat (HD 2733)	5.77	0.66	254.92	39.93	211.19
Rice (Navin) – wheat (DBW 39)	5.81	0.63	251.38	38.73	202.85
SEm±	0.13	0.03	6.89	1.60	8.40
CD (P=0.05)	0.38	0.10	20.22	4.70	24.65
Initial	5.5	0.42	230	32.25	162

Nutrient uptake (Table 7.2.42): Among rice varieties, Lalat recorded the highest N (98.94 kg/ha), P (22.04 kg/ha) and K (76.21 kg/ha) uptake, while in *rabi*, wheat variety K0307 registered the maximum N (74.07 kg/ha), P (15.98 kg/ha), K (69.72 kg/ha) uptake. As a sequence, Rice (B.V.D110) – wheat (K0307) registered the highest N (164.58 kg/ha) uptake as well as total NPK uptake (337.25kg/ha) of the system. The cropping sequence Rice (Birsadhan 201) – wheat (GW 366) recorded the maximum P (36.38kg/ha) uptake,while, maximum K uptake (138.58kg/ha) was observed with Rice (Lalat) – wheat (DBW 14)system.

Economics (Table 7.2.43): Rice variety Lalat resulted in significantly higher net returns (Rs. 35211/ha) & net return per rupee invested (1.32) over other varieties but it remained at par with Pusa sugandha (Rs. 34777/ha), Birsamati (33875 Rs/ha), Birsa vikas dhan 203 (33095 Rs/ha), Birsadhan 201 (Rs 31790/ ha),Navin (Rs. 30551/ha) and Sahbhagi (Rs. 28542/ha). In *rabi*, wheat variety KO307 variety registered significantly more net returns (Rs. 40526/ha) & net return per rupee invested (1.11) then rest of the varieties, but remains statistically at par with Raj 4229 (Rs. 36537/ha), K9107 (Rs. 35760/ha), GW366 (33045 Rs/ ha), BG3 (31990 Rs/ha) and DBW (319889 Rs/ha). In terms of system economics of rice-wheat cropping sequence Birsadhan 201 GW366 gave highest system net return (Rs. 64835/ha) & system net return per rupee invested (1.02) while, the lowest system net return (Rs. 55122/ha) & net return per rupee invested (0.87) was obtained in rice (Akhchhai) – wheat (BG 3) cropping sequence.

Table 7.2.42. Effect of organic management practices on nutrient uptake in rice-wheat system with different varieties at Ranchi

Practices in rice-wheat cropping system	*Kharif* (Rice)			*Rabi* (Wheat)			System			Total
	Total N uptake (kg/ha)	Total P uptake (kg/ha)	Total K uptake (kg/ha)	Total N uptake (kg/ha)	Total P uptake (kg/ha)	Total K uptake (kg/ha)	Total N uptake (kg/ha)	Total P uptake (kg/ha)	Total K uptake (kg/ha)	NPK uptake (kg/ha)
Rice (Birsavikasdhan 203) - wheat (Raj 4250)	96.15	21.73	72.89	63.03	13.72	61.20	159.19	35.45	134.09	328.73
Rice (Birsadhan 201) – wheat (GW 366)	96.42	21.61	70.46	68.01	14.77	64.99	164.43	36.38	135.45	336.26
Rice (Birsavikassugandha 1) – wheat (NW 2036)	84.02	18.61	65.49	65.19	14.15	62.73	149.20	32.77	128.22	310.19
Rice (B.V.D110) – wheat (K0307)	90.50	19.71	67.27	74.07	15.98	69.72	164.58	35.69	136.99	337.25
Rice (Sahbhagi) – wheat (K9107)	91.90	20.90	70.32	70.69	15.15	66.88	162.59	36.05	137.20	335.85
Rice (Birsamati) – wheat (HI 1563)	93.27	20.48	70.74	64.12	13.38	62.14	157.38	33.86	132.88	324.13
Rice (Anjli) – wheat (Raj 4229)	89.77	19.80	66.96	71.40	15.12	66.48	161.17	34.93	133.44	329.54
Rice (Lalat) – wheat (DBW 14)	98.94	22.04	76.21	64.20	13.40	62.37	163.14	35.45	138.58	337.17
Rice (M.T.U 10) – wheat (WR 544)	92.02	20.91	68.27	65.45	13.93	63.38	157.47	34.84	131.66	323.97
Rice (Akhchhai) – wheat (BG 3)	91.93	20.16	68.20	67.81	14.35	65.33	159.73	34.51	133.53	327.77
Rice (Pusasugandha) – wheat (HD 2733)	93.87	20.84	70.66	63.30	13.20	61.19	157.17	34.04	131.85	323.06
Rice (Navin) – wheat (DBW 39)	96.91	21.20	72.85	67.20	14.36	64.09	164.11	35.56	136.94	336.61
SEm±	3.51	0.56	2.04	2.38	0.53	1.94	4.23	0.79	2.98	6.93
CD (P=0.05)	10.31	1.65	5.99	6.98	1.56	5.70	12.40	2.32	8.73	20.32

Table 7.2.43. Net returns and net return per rupee invested of different varieties of rice-wheat system under organic management at Ranchi

Practices in rice-wheat cropping system	*Kharif*		*Rabi*		System	
	Net Returns (Rs/ha)	NRPRI	Net Returns (Rs/ha)	NRPRI	Net Returns (Rs/ha)	NRPRI
Rice (Birsa vikas dhan 203) - wheat (Raj 4250)	33095	1.24	26769	0.73	59864	0.94
Rice (Birsadhan 201) – wheat (GW 366)	31791	1.19	33045	0.90	64836	1.02
Rice (Birsa vikas sugandha 1) – wheat (NW 2036)	26443	0.99	29851	0.81	56294	0.89
Rice (B.V.D110) – wheat (K0307)	22197	0.83	40527	1.11	62724	0.99
Rice (Sahbhagi) – wheat (K9107)	28543	1.07	35761	0.98	64304	1.01
Rice (Birsamati) – wheat (HI 1563)	33876	1.27	28693	0.78	62568	0.99
Rice (Anjli) – wheat (Raj 4229)	22345	0.84	36538	1.00	58883	0.93
Rice (Lalat) – wheat (DBW 14)	35212	1.32	27458	0.75	62669	0.99
Rice (M.T.U 10) – wheat (WR 544)	27422	1.03	29255	0.80	56677	0.89
Rice (Akhchhai) – wheat (BG 3)	23133	0.87	31990	0.87	55123	0.87
Rice (Pusa sugandha) – wheat (HD 2733)	34778	1.30	26917	0.73	61695	0.97
Rice (Navin) – wheat (DBW 39)	30551	1.14	31989	0.87	62540	0.99
SEm±	2324	0.09	2965	0.08	3681	0.06
CD (P=0.05)	6817	0.26	8696	0.24	10796	0.17

***** Net return per rupee invested

Umiam (Table 7.2.44 to 7.2.45)

Eleven varieties of maize were screened among which eight were composites, one hybrid and two were local varieties grown mostly in the region and ten varieties of frenchbean were evaluated in which 8 were improved and 2 were local varieties.

Screening of maize varieties under organic management at Umiam

Performance of tomato varieties under organic management at Umiam

Growth parameters maize and french bean (Table 7.2.44): Plant growth parameters such as plant height, cob length, cob weight were recorded. Among the varieties of Maize, plant height was highest in Local white (296.3 cm) followed by RCM 1-3 (268 cm) and RCM 75 (267 cm) whereas, QPM 9 (184 cm) recorded the shortest plants followed by DA 61-A (232.3 cm) and RCM 1-2 (243.8cm). The longest cob length was recorded in RCM 1-1 (15.3 cm) followed by DA 61-A (15.00 cm) and Vijay Composite (14.67 cm). The shortest cob length was observed in Local white (8.7 cm) followed by RCM 1-2 (10.7 cm) and Hemant which was at par with RCM 76 (12.00 cm). Cob weight was recorded the highest in DA 61-A (275.4 g) closely followed by RCM 1-3 (271.5 g) and RCM 1-2 (230.8 g) while local yellow recorded the lowest with the value of 105.8 g followed by QPM-9 (164.2 g) and Local white (167.9 g).

Table 7.2.44.Response of different varieties of maize under organic management at Umiam

Variety	Plant height (cm)	Cob Length (cm)	Cob weight (g)	Green cob yield (kg/ha)	Seed yield (kg/ha)	Stover yield (kg/ha)
RCM-1-1	246.0	15.33	212.5	5790	2730	9700
RCM 1-2	243.0	10.7	230.8	3610	2490	9850
RCM-1-3	268.3	13.0	271.5	6400	3120	9750
RCM 75	267.0	14.7	202.1	6030	3290	9500
RCM 76	238.3	12.0	230.0	5120	1220	9540
Vijay composite	249.3	14.7	197.5	4700	3260	9450
Hemant	241.3	14.3	137.5	5480	2730	8810
DA 61 A	232.3	15.0	275.4	5950	3610	9760
QPM 9	184.0	12.0	164.2	4580	2230	5720
Local Yellow	245.7	13.0	105.8	3320	2420	7280
Local White	296.3	8.7	167.9	4020	2120	10210
SEm (±)	11.3	1.3	15.09	580	420	440
CD *(P=0.05)*	33.5	3.7	44.51	1710	1240	1300

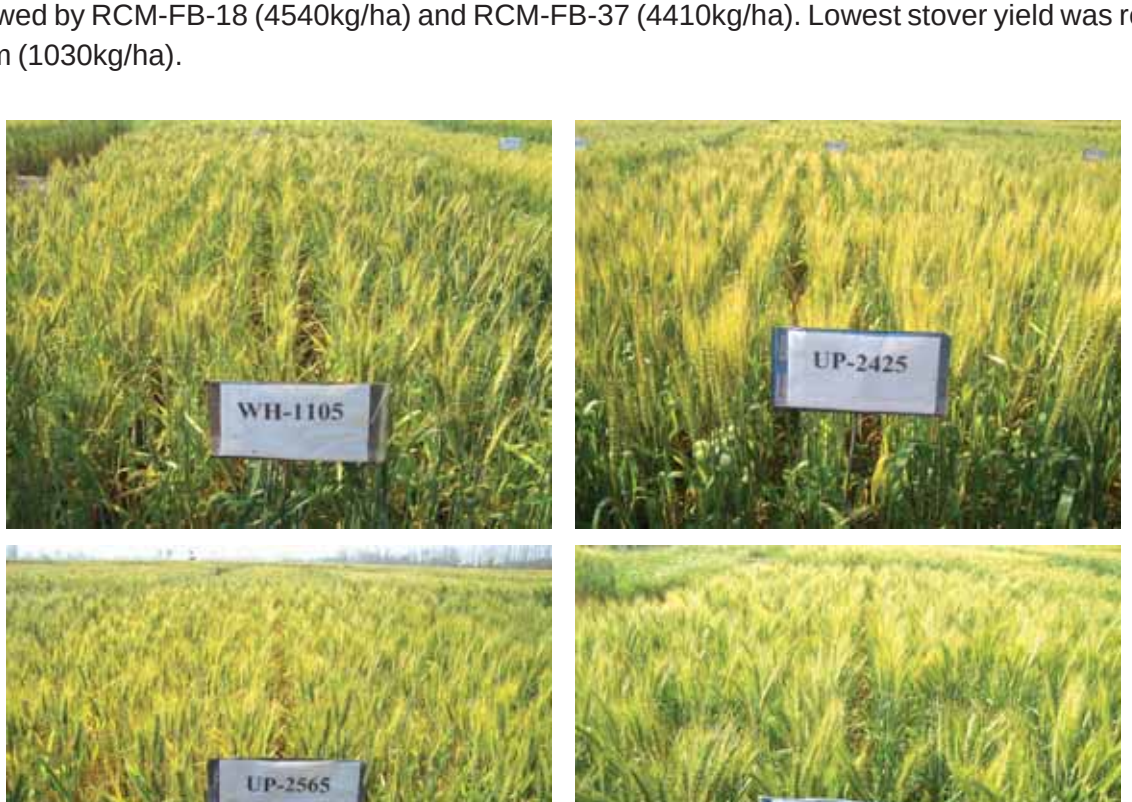
Table 7.2.45. Evaluation of different varieties of frenchbean under organic management at Umiam

Variety	Plant height (cm)	Pod Length (cm)	Average Pod weight (g)	Green cob yield (kg/ha)	Seed yield (kg/ha)	Stover yield (kg/ha)
RCM FB 18	254.3	15.63	7.68	4110	2210	4540
RCM FB-19	180.7	13.07	6.46	3930	2280	4390
RCM FB-37	247.0	14.21	8.71	2840	1550	4410
RCM FB 61	156.0	15.08	6.93	2140	1080	4360
RCM FB-62	244.0	12.28	6.45	2240	1150	3960
RCM FB-80	230.0	14.60	8.55	3430	2020	4140
Local 1	206.3	11.88	6.19	1530	420	4160
Local 2	146.0	16.19	7.55	2550	1400	3880
Maram	48.0	12.45	5.64	770	410	1030
Naga local	256.7	16.39	10.06	4360	2400	5220
SEm (+)	5.17	0.21	0.18	360	180	110
CD (P=0.05)	15.35	0.62	0.55	1080	530	330

In French bean, taller plant were observed with Naga Local (256.7cm) followed by RCM-FB-18 (254.3 cm) and RCM-FB-37 (247 cm). Lowest plant height was recorded in Maram (48 cm) followed by Local 3 (146 cm) and RCM-FB-61 (156 cm). In terms of pod length of different varieties, Naga local (16.39 cm) recorded the highest followed by Local-2 (16.19 cm) and RCM-FB-18 (15.63 cm) while lowest pod length was recorded in Local-1 (11.88 cm) followed by RCM-FB-62 (12.28 cm) which was closely at par with Maram (12.45 cm). Average pod weight was highest in Naga local (10.06 g) followed by RCM-FB-37 (8.71 g) and RCM-FB-80 (8.55g) while lowest average pod weight was recorded in Maram (5.64 g) followed by Local 1 (6.19 g) and RCM-FB-62 (6.45 cm) which was at par with RCM-FB-19 (6.46 cm).

Yield of maize and frenchbean (Table 7.2.45): In maize, green cob yield was highest in RCM 1-3 (6400kg/ha) followed by RCM 75 (6030kg/ha) and DA 61-A (5950kg/ha) while the lowest was recorded in the local varieties such as local yellow (3320kg/ha) and local white (4020kg/ha) and in composites, RCM 1-2 recorded the lowest seed yield (3610kg/ha). Highest stover yield was recorded in Local white (10210kg/ha) followed by RCM 1-2 (9850kg/ha) and DA-61-A (9760kg/ha) which was at par with RCM-1-3 (9750kg/ha) whereas, lowest was recorded in QPM-9 (5720kg/ha) followed by Hemant (8810kg/ha).

In frenchbean, highest green pod yield was recorded in Naga local (4360kg/ha) followed by RCM-FB-18 (4110kg/ha) and RCM-FB-19 (3930kg/ha). Lowest green yield was recorded in Maram (770kg/ha). Seed yield also shown the similar trend as in green pod which had recorded highest in Naga local (2400kg/ha) and lowest in Maram (410kg/ha). On the other hand, stover yield was highest in Naga local (5220kg/ha) followed by RCM-FB-18 (4540kg/ha) and RCM-FB-37 (4410kg/ha). Lowest stover yield was recorded in Maram (1030kg/ha).



Wheat varieties evaluated under organic managament at Pantnagar

7.3 Evaluation of Bio-intensive Complimentary Cropping Systems under Organic Production Systems

Objectives

- To evaluate the various land configuration and intercropping options for managing the soil nutrient and pests under organic production system
- To assess the infestation level of insect, disease and weeds under bio-intensive complimentary systems

Treatments: Four number of land configuration a method was taken up in main plot.

Land Configuration: Conventional, Furrow Irrigated Raised Bed (FIRB), Broad Bed & Furrow (BBF) and Raised & Sunken Bed (RSB)

Cropping system: Four location specific complimentary bio-intensive cropping systems were taken in Sub Plots**.** Experiment was conducted at Dharwad, Pantnagar and Umiam centres with 3 replications in split plot design.

Year of start: 2013-14

Results: Dharwad (Table 7.1-7.6)

Yield of economics (Table 7.3.1 and 7.3.2)

Four systems namely soybean-wheat, groundnut +cotton (2:1), green gram -sorghum and soybean + pigeon pea (2:1) were evaluated with four land geometry. Yield of all crops in cropping systems were found to be higher under broad bed and furrow with crop residue followed by broad bed and furrow method land configuration.Broad bed and furrow (BBF) method of planting and conventional flat bed (FB) method of planting with crop residue produced higher net monetary returns and higher B:C ratio (Rs. 65,212 to 69,255/ha and 3.51 to 3.59, respectively) compared to broad bed and furrow (BBF) method of planting and conventional flat bed (FB) method of planting without crop residues (Rs. 60,758 to 66,200/ha and 3.41 to 3.52, respectively). Broad bed and furrow (BBF) method of planting with or without the crop residues was found beneficial for different cropping systems (either sequence or intercropping systems) over conventional flat bed (FB) method of planting with or without crop residues. The use of crop residues as a mulch for existing crop in different cropping systems and as incorporation for succeeding crop found more beneficial under both conventional flat bed (FB) method of planting and broad bed and furrow (BBF) method of planting. Groundnut (GPBD 4) + cotton (Sahana) (2:1) intercropping system produced highest net monetary returns (Rs. 88,898/ha) compared to Greengram (DGGV 2)-sorghum (cv. M 35-1) sequence cropping system (Rs.74,230/ha), soybean (DSB 21) + pigeonpea (TS 3R) (2:1) (Rs. 50.042/ha) and soybean (cv. DSB 21)-wheat (cv. DWR 2006) sequence cropping system (Rs. 48,254/ha). Groundnut (GPBD 4) + cotton (Sahana) (2:1) intercropping system was found more beneficial and more remunerative cropping system under organic production system.

Table 7.3.1 Yield and equivalent yield of various crops in cropping system as influenced by land configuration and crop residue management under organic conditions (Dharwad)

Cropping systems	First crop yield (kg/ha)					Second crop yield (kg/ha)					Soybean equivalent yield (kg/ha)				
	Broad bed and furrow with crop residues	Flat bed with bed crop residues	Broad and bed furrow	Flat	Mean	Broad bed and furrow with crop residues	Flat bed with bed crop residues	Broad and bed furrow	Flat	Mean	Broad bed and furrow with crop residues	Flat bed with bed crop residues	Broad and bed furrow	Flat	Mean
Soybean-wheat	1953	1841	1863	1736	1848	1711	1655	1619	1482	1617	3120	2970	2967	2746	2951
Groundnut +cotton (2:1)	4257	4132	4151	3894	4109	1582	1517	1520	1376	1499	3710	3583	3596	3324	3553
Green gram -sorghum	1313	1188	1281	1167	1237	4882	4622	4648	4417	4642	6387	6020	6076	5723	6052
Soybean + pigeon pea (2:1)	1331	1227	1261	1199	1255	1917	1793	1884	1741	1834	2445	2280	2385	2216	2332
Mean	2214	2097	2139	1999		2523	2397	2418	2254		3916	3713	3756	3502	

Table 7.3.2. Economics of different cropping systems as influenced by land configuration and crop residue management (Dharwad)

Cropping systems	Gross return (Rs./ha)					Cost of cultivation (Rs./ha)					Net return (Rs./ha)					B:C ratio				
	Broad bed and furrow with crop residues	Flat bed with crop residues	Broad bed and furrow	Flat bed	Mean	Broad bed and furrow with crop residues	Flat bed with crop residues	Broad bed and furrow	Flat bed	Mean	Broad bed and furrow with crop residues	Flat bed with crop residues	Broad bed and furrow	Flat bed	Mean	Broad bed and furrow with crop residues	Flat bed with crop resi-dues	Broad bed and furrow	Flat bed	Mean
Soybean-wheat	68,639	65,339	65,264	60,423	64,916	17,080	16,721	16,955	15,893	16,662	51,559	48,619	48,308	44,530	48,254	4.02	3.91	3.85	3.80	3.90
Groundnut +cotton (2:1)	1,29,859	1,25,398	1,25,847	1,16,323	124357	36,759	35,634	35,805	33,639	35,459	93,100	89,765	90,042	82,684	88,898	3.53	3.52	3.51	3.46	3.51
Green gram -sorghum	1,08,575	1,02,335	1,03,298	97,298	97298	29,252	28,489	28,010	28,836	28,647	79,323	73,846	75,289	68,462	74,230	3.71	3.59	3.69	3.37	3.59
Soybean + pigeon pea (2:1)	78,247	72,961	76,305	70,921	74,609	25,210	24,345	25,145	23,565	24,566	53,037	48,616	51,160	47,356	50,042	3.10	3.00	3.03	3.01	3.04
Mean	96,330	91,508	92,679	86,241		27,075	26,297	26,479	25,483		69,255	65,212	66,200	60,758		3.59	3.51	3.52	3.41	

Physical and chemical properties of soil (Table 7.3.3 to 7.3.4)

Soil physical (bulk density and maximum water holding capacity) and chemical (pH, Electrical conductivity and organic carbon content) properties were not significantly influenced by different cropping systems under various land configuration and residues management .Similarly, forms of nitrogen (ammonical, nitrate and available) phosphorus (saloid-P, aluminium-P, iron-P, calcium-P occluded-P and total-P) and available potassium and DTPA-extractable micronutrients content of soil were also not influenced significantly due to various cropping systems under different land configuration and residues management practices. The reduction in bulk density (1.20 mg/m^3) was found in broad bed and furrow method of planting with crop residues and maximum water holding capacity (64.42 %) was higher in conventional flat bed method of planting in addition to crop residues. Organic carbon content in the soil was found highest in conventional flat bed method of planting with crop residues (.64%). Residual nutrient of N, P and K (280, 31 and 354 kg/ha respectively) were more in broad bed and furrow method of planting with residues at time of harvest of *kharif* crops. DTPA extractable micronutrient status such as copper (1.59 mg/kg), Iron (10.07 mg/kg), Manganese (11.59 mg/kg) and Zinc (0.95 mg/kg) were found highest in broad bed and furrow method of planting. In case of total carbon content and nitrogen fractions, ammonical-N, nitrite-N and total-N were maximum in broad bed and furrow method of planting. Whereas, phosphorous fractions such as Saloid-P, Al-P, Ca-P, Fe-P, Occluded-P and total P did not vary significantly due to the different land configuration and cropping systems.

Natural enemies and incidence of insects (Table7.3.5)

Significantly lower pod borer incidence and higher natural enemies and spider population were recordedin broad bed and furrow method of planting with crop residues followed by conventional flatbed (FB) method of planting with crop residues. Non-significant differences were noticed with respect to gall weevil incidence in soybean + pigeonpea (2:1). Significantly higher incidence of defoliators and pod borers were noticed in broad bed and furrow method of planting with crop residues. Significantly higher incidence of cadavars, *coccinellids* and spider population was recorded in broad bed and furrow method of planting with crop residues followed by conventional flat bed (FB) method of planting with crop residues.

Beneficial microorganism (Table 7.3.6)

Significantly higher microbial populations were observed in all the cropping systems under broad bed and furrow method of planting with crop residues. Similar trend was also observed with respect of nodule number and nodule weight. Higher microbial activity was also seen in conventional flat bed method of planting in with crop residues compared to the same method without crop residues.

Incidence of diseases (Table 7.3.7)

In soybean-wheat sequence cropping and soybean + pigeonpea (2:1) intercropping systems, lowest soybean rust incidence was noticed in conventional flat bed method of planting without crop residues and broad bed and furrow method of planting with crop residues, respectively. In greengram-sorghum system, lowest incidence of *Cercospora* leaf spot of greengram and powdery mildew were noticed in broad bed and furrow method of planting in addition to crop residues and conventional flat bed method of planting without crop residues, respectively.

Table 7.3.3 Soil physical and chemical properties as influenced by land configuration and crop residue management (Dharwad)

Cropping systems	Bulk density (g/cc)					pH					Electrical conductivity (dS/m)					Organic carbon (%)				
	Broad bed and furrow with crop residues	Flat bed with crop residues	Broad bed and furrow	Flat bed	Mean	Broad bed and furrow with crop residues	Flat bed with crop residues	Broad bed and furrow	Flat bed	Mean	Broad bed and furrow with crop residues	Flat bed with crop residues	Broad bed and furrow	Flat bed	Mean	Broad bed and furrow with crop residues	Flat bed with crop residues	Broad bed and furrow	Flat bed	Mean
Soybean-wheat	1.26	1.26	1.21	1.18	1.23	7.55	7.46	7.32	7.46	7.45	0.11	0.12	0.12	0.07	0.11	0.59	0.55	0.60	0.63	0.59
Groundnut +cotton (2:1)	1.22	1.21	1.20	1.26	1.22	7.41	7.54	7.38	7.44	7.44	0.07	0.18	0.21	0.10	0.14	0.52	0.59	0.59	0.60	0.57
Green gram -sorghum	1.27	1.29	1.23	1.22	1.25	7.43	7.52	7.39	7.56	7.48	0.08	0.15	0.08	0.11	0.11	0.56	0.60	0.58	0.58	0.58
Soybean + pigeon pea (2:1)	1.30	1.26	1.27	1.20	1.26	7.36	7.43	7.48	7.47	7.44	0.11	0.15	0.07	0.12	0.11	0.54	0.51	0.59	0.62	0.57
Mean	1.26	1.26	1.23	1.22		7.44	7.49	7.39	7.48		0.09	0.15	0.12	0.10		0.55	0.56	0.59	0.61	
	S.Em±	CD (P=0.05)				S.Em±	CD (P=0.05)				S.Em±	CD (P=0.05)				S.Em±	CD (P=0.05)			
LCRM	0.01	NS				0.06	NS				0.03	NS				0.13	NS			
CS	0.01	NS				0.04	NS				0.02	NS				0.13	NS			
LCRM x CS	0.10	NS				0.19	NS				0.63	NS				0.46	NS			

Table 7.3.4. Available N, P and K at the end of cropping cycle as influenced by land configuration and crop residue management (Dharwad)

Cropping systems	Available N (kg/ha)					Available P (kg/ha)					Available K (kg/ha)				
	Broad bed and furrow with crop residues	Flat bed with bed crop residues	Broad and bed furrow	Flat bed	Mean	Broad bed and furrow with crop residues	Flat bed with bed crop residues	Broad and bed furrow	Flat bed	Mean	Broad bed and furrow with crop residues	Flat bed with bed crop residues	Broad and bed furrow	Flat bed	Mean
Soybean-wheat	260.0	256.7	273.3	261.3	262.8	26.1	26.8	27.0	29.3	27.3	315.7	314.0	350.7	343.3	330.9
Groundnut +cotton (2:1)	238.0	269.0	273.7	271.3	263.0	25.1	28.2	28.3	30.8	28.1	312.7	314.7	370.0	351.3	337.2
Green gram -sorghum	256.7	250.3	252.7	275.7	258.9	25.6	25.5	28.1	31.9	27.8	318.0	328.0	336.7	354.0	334.2
Soybean + pigeon pea (2:1)	237.3	256.7	255.3	275.7	256.3	25.0	25.3	32.1	30.2	28.1	313.3	333.7	324.0	360.0	332.8
Mean	248.0	258.2	263.8	271.0		25.4	26.5	28.9	30.6		314.9	322.6	345.4	352.2	
	S.Em±	CD (P=0.05)				S.Em±	CD (P=0.05)				S.Em±	CD (P=0.05)			
LCRM	9.09	NS				1.06	NS				9.96	NS			
CS	4.79	NS				0.85	NS				8.14	NS			
LCRM x CS	4.48	NS				1.66	NS				4.49	NS			

Table 7.3.5. Microbial activity in soil at grand growth periods of crops influenced by land configuration and residue management (Dharwad)

Cropping systems	Bacterial population (CFU x 10^6)					Fungal population (CFU x 10^4)					Actinomycetes (CFU x 10^3)					Phosphate Solubilizing Microorganisms (CFU x 10^5)				
	Broad bed and furrow with crop residues	Flat bed with crop residues	Broad bed and furrow	Flat bed	Mean	Broad bed and furrow with crop residues	Flat bed with crop residues	Broad bed and furrow	Flat bed	Mean	Broad bed and furrow with crop residues	Flat bed with crop residues	Broad bed and furrow	Flat bed	Mean	Broad bed and furrow with crop residues	Flat bed with crop residues	Broad bed and furrow	Flat bed	Mean
Soybean-wheat	8.02	7.92	7.48	7.08	7.63	5.03	4.98	4.97	4.95	4.98	4.74	4.68	4.42	3.92	4.44	6.46	6.23	6.29	5.92	6.23
Groundnut +cotton (2:1)	8.15	7.70	7.41	7.02	7.57	5.10	4.95	4.87	4.82	4.94	4.78	4.57	4.37	3.97	4.42	6.51	6.34	6.14	6.00	6.25
Green gram -sorghum	8.29	7.98	7.57	7.12	7.74	5.16	4.89	4.69	5.18	4.98	4.83	4.68	4.52	4.08	4.53	6.58	6.25	6.32	6.03	6.30
Soybean + pigeon pea (2:1)	8.24	7.81	7.27	7.22	7.64	5.01	5.06	4.46	5.01	4.89	4.88	4.62	4.29	4.13	4.48	6.61	6.43	6.16	6.16	6.34
Mean	8.18	7.85	7.43	7.11		5.08	4.97	4.75	4.99		4.81	4.64	4.40	4.03		6.54	6.31	6.23	6.03	
	S.Em±	CD (P=0.05)				S.Em±	CD (P=0.05)				S.Em±	CD (P=0.05)				S.Em±	CD (P=0.05)			
LCRM	0.02	0.06				0.03	0.11				0.02	0.06				0.03	0.11			
CS	0.02	0.03				0.05	0.09				0.02	0.05				0.02	0.05			
LCRM x CS	0.05	0.15				0.12	0.34				0.07	0.20				0.10	0.31			

Table 7.3.6. Number of insect pests population in pigeonpea and soybean under soybean + pigeonpea (2:1) intercropping system influenced by land configuration and residues management (Dharwad)

	Pigeonpea					Soybean			
Land configuration and residues management (LCRM)	**Gall weevil (%)**	**Pod borer (%)**	**No. of spider**	**Defoliators/m row length**	**Number of Cadavers/ m row length**	**Number of thrips/ leaf**	**Pod borer (%)**	**Number of Coccinellids/ plant**	**Number of spiders/ plant**
Broad bed and furrow (BBF) method of planting with crop residues	20.23 (25.70)	19.32 (25.62)	2.61 (1.81)	7.64 (2.86)	3.41 (1.95)	1.18 (1.29)	21.16 (27.29)	3.94 (2.11)	2.72 (1.80)
Conventional flat bed (FB) method of planting with crop residues	27.38 (31.06)	23.51 (29.03)	2.16 (1.65)	7.91 (2.90)	2.20 (1.67)	1.35 (1.38)	23.87 (29.15)	2.01 (1.64)	2.45 (1.75)
Broad bed and furrow (BBF) method of planting without crop residues	19.81 (25.73)	22.02 (28.28)	2.33 (1.67)	7.88 (2.88)	2.21 (1.66)	1.23 (1.35)	24.46 (29.54)	2.45 (1.67)	2.38 (1.66)
Conventional flat bed method (FB) of planting without crop residues	22.73 (28.03)	28.66 (32.09)	1.69 (1.44)	7.22 (2.80)	1.83 (1.55)	1.43 (1.47)	28.67 (32.28)	1.31 (1.41)	1.41 (1.46)
Mean	22.54 (27.63)	23.38 (28.76)	2.20 (1.64)	7.66 (2.86)	2.41 (1.71)	1.30 (1.37)	24.54 (29.57)	2.43 (1.71)	2.24 (1.67)
S.Em±	1.16	084	0.05	0.03	0.06	0.06	0.50	0.11	0.08
LSD (p=0.05)	NS	2.60	0.15	NS	0.18	NS	1.56	0.33	0.25

Table 7.3.7 : Number of nodules and dry weight of legume crops in different cropping systems (Dharwad)

Cropping systems	Number of nodules/plant					Dry weight of nodules (g/plant)				
	Broad bed and furrow with crop residues	Flat bed with crop residues	Broad bed and furrow	Flat bed	Mean	Broad bed and furrow with crop residues	Flat bed with crop residues	Broad bed and furrow	Flat bed	Mean
Soybean-wheat	43.33	35.53	25.67	23.33	31.97	0.57	0.53	0.32	0.33	0.44
Groundnut +cotton (2:1)	42.00	39.00	28.00	21.67	32.67	0.53	0.27	0.32	0.25	0.34
Green gram -sorghum	55.33	36.00	31.00	22.33	36.17	0.36	0.23	0.15	0.13	0.22
Soybean + pigeon pea (2:1)	58.00	40.00	34.67	25.33	39.50	0.38	0.36	0.25	0.16	0.29
Mean	49.67	37.63	29.84	23.17		0.46	0.35	0.26	0.22	
	S.Em±	CD (P=0.05)				S.Em±	CD (P=0.05)			
LCRM	1.87	6.46				0.02	0.07			
CS	0.68	1.99				0.02	0.05			
LCRM x CS	2.48	7.23				0.29	0.84			

Table 7.3.8 Severity of rust in soybean under soybean-wheat system and of *Cercospora* leaf spot in greengram under greengram-sorghum system influenced by land configuration and crop residues (Dharwad)

Cropping systems	Rust of soybean (cv. JS 9305) per cent disease index				
	Broad bed and furrow with crop residues	Flat bed with crop residues	Broad bed and furrow	Flat bed	Mean
Soybean-wheat	80.3	81.6	77.6	82.5	80.5
Soybean + pigeon pea (2:1)	78.0	80.7	87.2	85.4	82.8
	***Cercospora* leaf spot of green gram(cv. DGGV 2) (% disease index)**				
Green gram -sorghum	81.1	86.5	92.2	96.1	89.0
	Powdery mildew of green gram				
Green gram -sorghum	80.5	70.9	56.9	43.5	62.9

Pantnagar (Table 7.3.9 to 7.3.13)

Yield attributes, yield and harvest index of rice (Table 7.3.9)

Significantly higher plant height (110cm), effective tillers/m^2 (318), panicle weight (1.85 g) and 1000 grain weight (28.7g) was recorded in SRI of rice-wheat-*sesbania.*Panicle weight in SRI rice-wheat- *sesbania* was found *at par* with basmati rice-wheat-*sesbania* and direct seeded rice-chickpea–moong system.

There was significant influence of resource conservation practiceson grain yield, straw yield and harvest index of basmati rice. SRI method of rice-wheat-*sesbania* system reported significantly higher grain (3336kg/ha) and straw yield (7740 kg/ha), though, grain yield under SRI-wheat-*sesbania* system was *at par with* basmati rice-wheat-*sesbania* and DSR+ soybean -vegetable pea+ mustard. Significantly higher harvest index (0.41) was obtained with rice +pigeon pea-cowpea +okra in furrow in raised bed system,though it

Table 7.3.9 Yield attributes, yield and harvest Index of rice as influenced by resource conservation method under organic management (Pantnagar)

Treatments	Plant height (cm)	Effective tillers/m^2	Wt. of grain/ panicle (g)	1000-grain wt. (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest Index
(Basmati rice-wheat-*sesbania*	108	310	1.77	27.7	2978	7174	29.5
SRI-wheat- *sesbania*	110	318	1.85	28.7	3336	7740	30.7
DSR-wheat (zero tillage) – *sesbania*	104	264	1.35	25.9	2714	5419	33.4
DSR-wheat-moong on BBF system	107	288	1.46	27.2	2821	5985	32.1
DSR-vegetable pea -cowpea on BBF system	104	273	1.42	25.9	2750	6636	29.5
DSR-chickpea–moong on BBF system	107	291	1.66	27.4	2833	6136	32.2
FIRB:DSR+soyabean -vegetable pea+mustard	101	241	1.28	25.6	3004	5249	37.0
FIRB:rice +pigeon pea-cowpea +okra	94	217	1.26	24.8	2428	3577	40.6
$SE_m\pm$	2.9	14.4	0.11	0.74	126	660	2.8
CD(p=0.05)	8.7	43.6	0.32	2.24	381	2000	8.6

was found *at par* with DSR-wheat (zero tillage) –*sesbania*,DSR-wheat-moong on broad bed and furrow system, DSR-chickpea–moong on broad bed and furrow system and DSR+soyabean -vegetable pea + mustardin furrow in raised bed system .

Total Nutrient uptake in rice (Table 7.3.10 to 7.3.11)

Nutrient uptake (N, K& S) except P were significantly influenced by different resource conservation practices. Significantly higher nitrogen (155.7 kg/ha), potassium uptake (115.0 kg/ha) and maximum phosphorus uptake (32.0 kg/ha) by paddy crop was recorded with DSR + soybean -vegetable pea+ mustard in furrow in raised bed system. However, S uptake was significantly higher under SRI-wheat- *sesbania*. Potassium uptake in rice under DSR + soybean -vegetable pea+ mustard in furrow in raised bed system was found *at par* with basmati rice-wheat-*sesbania* system, SRI-wheat-*sesbania* system and DSR-vegetable pea -cowpea on broad bed and furrow system.

Table 7.3.10. Nutrient uptake (kg/ha) by rice influenced by resource conservation methods (Pantnagar)

Treatments	N uptake (kg/ha)	P uptake (kg/ha)	K uptake (kg/ha)	S uptake (kg/ha)
(Basmati rice-wheat-*sesbania*)	76.7	27.9	103.8	19.4
(SRI-wheat- *sesbania*)	91.2	29.3	103.5	28.9
(DSR-wheat(zerotillage) –*sesbania*)	65.1	27.3	82.8	19.2
(DSR-wheat-moong on BBF system)	71.3	25.1	94.0	23.0
(DSR-vegetable pea -cowpea on BBF system)	83.8	25.7	105.0	23.0
(DSR-chickpea–moong on BBF system)	73.4	26.5	94.9	26.3
(FIRB :DSR+soyabean -vegetable pea+mustard)	155.7	32.0	115.0	17.3
(FIRB:rice +pigeon pea-cowpea +okra)	88.2	19.8	84.7	5.5
$SE_m\pm$	5.2	3.0	6.2	2.2
CD(p=0.05)	15.7	NS	18.9	6.7

Table 7.3.11. Yield of *rabi* crops influenced by different resource conservation methods (Pantnagar)

Treatments	Plant height (cm)	Spikes/m^2 of wheat or Pods/plant of vegetable pea and chickpea	No. of grains/ spike of wheat or seeds/pod of V.P and C.P	1000 grain weight of wheat or 100 seed weight of V.P and C.P
(Basmati rice-wheat-*sesbania*)	97.2	297	45.2	42.6
(SRI-wheat- *sesbania*)	100.2	275	47.7	41.9
(DSR-wheat(zerotillage) –*sesbania*)	98.3	300	45.2	44.3
(DSR-wheat-moong on BBF system)	104.5	305	45.2	42.0
(DSR-vegetable pea -cowpea on BBF system)	75.0	16	6.5	36.2
(DSR-chickpea–moong on BBF system)	69.6	44	2.0	27.4
(FIRB:DSR+soyabean-vegetablepea+mustard)	66.7	13	5.3	33.0
(FIRB:Rice +pigeon pea-cowpea +okra)	-	-	-	-

Yield attributes and yield of *rabi* Crops (Table 7.3.11 to 7.3.12 and figure 7.3.1)

Maximum plant height (104.5 cm) and spikes/m^2 (305) of wheat was observed in direct seeded rice-wheat-moong on broad bed and furrow system followed by DSR-wheat (zero tillage) –*sesbania* resource

Table 7.3.12. Yield (kg/ha) of *rabi* crops and wheat equivalent yield as influenced by different treatments (Pantnagar)

Treatments	Yield of *rabi* crops(kg/ha)					
	Wheat	Veg. pea	Chickpea	Coriander	Mustard	Wheat equivalent yield(kg/ha)
Basmati rice-wheat-*sesbania*	3061	-	-	-	-	3061
SRI-wheat- *sesbania*	2985	-	-	-	-	2985
DSR-wheat (zero tillge) –*sesbania*	3450	-	-	-	-	3450
DSR-wheat-moong on BBF system	2715	-	-	-	385	3458
DSR-vegetable pea -cowpea on BBF system	-	5109	-	267	-	3623
DSR-chickpea–moong on BBF system	-	-	1405	222	-	5876
FIRB :DSR+soyabean -vegetable pea+mustard	-	3343	-	-	636	3010
FIRB:rice +pigeon pea-cowpea +okra	-	-	-	-	-	-
$SE_m\pm$	-	-	-	-	-	303
CD(p=0.05)	-	-	-	-	-	936

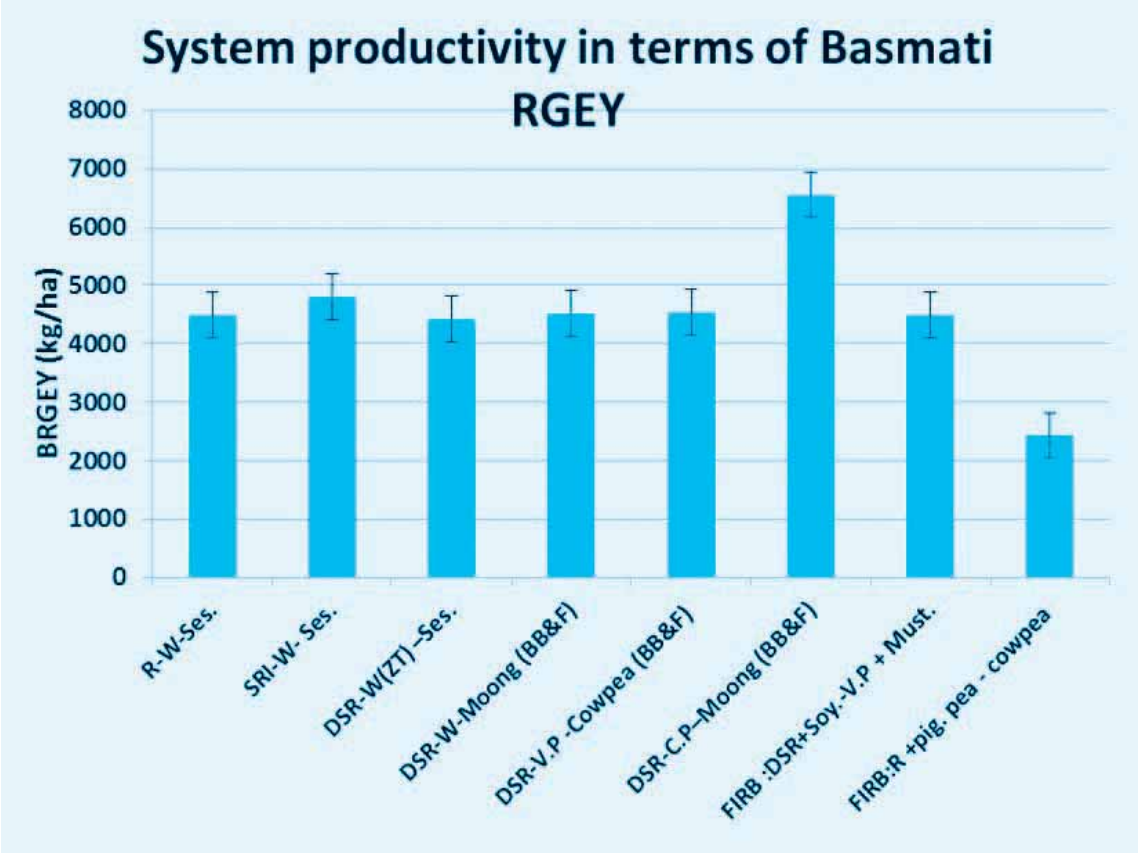


Fig. 7.3.1. System productivity in terms of basmati rice grain equivalent yield influenced by different resource conservation methods

conservation practice. Plant height and pods/plant of chickpea under DSR-chickpea–moong on broad bed and furrow system was 69.6 cm and 44 cm, respectively. In case of vegetable pea, highest plant height (75cm) and pods/plant (16) were observed in DSR-vegetable pea -cowpea on broad bed and furrow system as compared to DSR+soybean -vegetable pea+mustard on furrow in raised- bed system. Maximum number of grains/spike of wheat (48) was observed in SRI-wheat- *sesbania* whereas, maximum 1000 grain weight (44.3g)of wheat was observed in DSR-wheat (zero tillage) –*sesbania*.

Maximum grain yield of wheat (3450 kg/ha) was observed in DSR-wheat (zero tillage)–*sesbania* followed by in Basmati rice-wheat-*sesbania*(3061 kg/ha) while lowest grain yield (2715 kg/ha) was observed in DSR-wheat-moong on broad-bed and furrow system.Green pod yield of vegetable pea was found highest (5109 kg/ha) in DSR-vegetable pea -cowpea on broad-bed furrow system compared to 3343 kg/ha in DSR+soybean -vegetable pea+mustard on furrow in raised-bed system. Chickpea yield under DSR-chickpea–moong on broad-bed furrow system was 1405kg/ha. Mustard yield was found highest (636 kg/ha) in DSR+soybean -vegetable pea+mustard on furrow in raised-bed system while lowest mustard yield (385 kg/ha) was observed in DSR-wheat-Moong on broad-bed and furrow system. Significantly higher wheat equivalent yield (5876 kg/ha) was observed in DSR-chickpea-moong on broad-bed and furrow system over all other resource conservation practices.

Economics (Table 7.3.13)

Economic analysis of different cropping systems managed through different resource conservation practices revealed that maximum net returns (Rs. 1,79,840 /ha) and B:C ratio (2.72) was recorded in DSR-chickpea–moong on broad bed and furrow system followed by DSR-vegetable pea –cowpea on broad-bed and furrow system. Lowest net returns (Rs. 49,230 /ha) and B: C ratio (1.18) was observed in rice +pigeon pea-cowpea +okra under furrow in raised-bed system. System productivity in terms of basmati ricegrain equivalent yield was significantly influenced by these resource conservation practices. Significantly higher system productivity (6561 kg/ha) was observed in DSR-chickpea–moong on BBF System over all other resource conservation practices.

Soil nutrient status (Table 7.3.14)

Significantly higher organic carbon (1.1 %) in soil was observed in DSR+ soybean -vegetable pea+ mustard under furrow in raised bed system which was at par with DSR-vegetable pea -cowpea on BBF System and DSR-chickpea–moong on BBF system. Significantly higher available N (403 kg/ha) was recorded under DSR-wheat-moong on broad bed and furrow system which was *at par* with all other treatments except basmati rice-wheat-*sesbania* and DSR-chickpea–moong on broad bed and furrow system. Available P ranged from 34.5 to 45.9 kg/ha and significantly higher available P was recorded with DSR-wheat - (zerotillage) –*sesbania* and *at par* with SRI-wheat- *sesbania* and DSR-chickpea–moong on BBF system. Available K in soil ranged from 227 to 247 kg/ha and significantly higher and at par available K was recorded in DSR-wheat-moong on BBF system, DSR+ soyabean -vegetable pea+ mustard under furrow in raised bed system and rice +pigeon pea-cowpea +okra under furrow in raised bed system. Significantly higher available S in soil (42.8 kg/ha) was observed in rice +pigeon pea-cowpea +okra under furrow in raised bed system.

Table 7.3.13. Economics of different resource conservation practices (Pantnagar)

Treatments	System productivity (kg/ha)	Cost of cultivation (Rs./ha)	Net Return (Rs./ha)	B:C Ratio
Basmati Rice-wheat-*sesbania*	4488	69225	99074	1.43
SRI-wheat- *sesbania*	4809	72890	107434	1.47
DSR-wheat (zero tillage) –*sesbania*	4416	61692	103910	1.68
DSR-wheat-moong on BBF system	4527	62520	107259	1.72
DSR-vegetable pea -cowpea on BBF system	4538	61265	108887	1.78
DSR-chickpea–moong on BBF system	6561	66180	179840	2.72
FIRB :DSR+soyabean -vegetable pea+mustard	4489	67285	101053	1.50
FIRB:rice +pigeon pea-cowpea +okra	2428	41820	49230	1.18
$SE_m\pm$	151		-	-
CD(p=0.05)	460		-	-

Table 7.3.14. Nutrient status of soil at the end of crop cycle (Pantnagar)

Treatments	Organic carbon (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)	Available S (kg/ha)
Basmati rice-wheat-*sesbania*	1.04	343	34.5	227	41.6
SRI-wheat- *sesbania*	1.06	381	43.7	247	37.4
DSR-wheat (zero tillage) –*sesbania*	1.02	375	45.9	232	32.6
DSR-wheat-moong on BBF system	1.07	403	36.3	246	38.7
DSR-vegetable pea -cowpea on BBF system	1.09	390	40.5	232	30.3
DSR-chickpea–moong on BBF system	1.10	343	41.0	227	34.9
FIRB:DSR+soyabean-vegetablepea+mustard	1.15	396	35.4	240	42.2
FIRB:rice +pigeon pea-cowpea +okra)	1.06	381	37.1	236	42.8
$SE_m\pm$	0.02	10.1	1.7	4.9	1.7
CD(p=0.05)	0.07	30.6	5.1	14.9	5.2

Performance of direct seeded rice + soybean under organic management at Pantnagar

Performance of rice + pigeon pea intercropping under organic management at Pantnagar

Umiam (Table 7.3.15 to 7.3.19)

Raised and sunken bed (RSB) is a technology for effective land and water management in case of low land and inter-plot water harvesting in upland to increase cropping intensity. The RSB were made in sequence for efficient drainage and inter-plot water harvesting with a fixed width of 1 m for raised and 1.25 m for sunken bed. The lengths of all the plots were same (8 m). The surface soil layer of each sunken bed was removed and deposited on the adjacent raised beds making about 30 cm bed height. All the crop

Table: 7.3.15. Growth parameters of different rice varieties in sunken beds (Umiam)

Cropping sequence	Plant height(cm)	Tiller/m² no's.	Panicle/m² no's.
Rice (IR-64) - lentil	71.1	212.6	205.9
Rice(VD-82) -lentil	71.0	200.2	173.4
Rice(Shahsarang-1) -lentil	69.0	260.0	234.4
Rice(Lampnah) -lentil	61.1	251.0	221.7

Table 7.3.16. Yield of vegetables under raised bed of various cropping sequences (Umiam)

Cropping sequences	Yield of raised bed crops (t/ha)	
	Pre-*kharif*	*Kharif*
Potato-Okra	16.82	8.53
Frenchbean- Okra	10.06	9.06
Carrot- Okra	14.24	8.30
Mean	**13.71**	**8.63**

Table 7.3.17. Yield of rice on sunken bed of various cropping sequences (Umiam)

Cropping sequences	Grain yield on sunken bed crops (t/ha)	
	Kharif	
	Rice	Lentil
Rice (IR-64) - Lentil	3.52	1.22
Rice(VD-82) -Lentil	3.21	1.34
Rice(Shahsarang-1) -Lentil	4.29	1.16
Rice(Lampnah) -Lentil	4.06	1.24
Mean	**3.77**	**1.24**

Table 7.3.18. Physico-chemical properties of soil under raised beds (Umiam)

Cropping sequences	pH	Organic carbon (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
Potato-Okra	5.13	2.18	250.52	21.30	260.58
Frenchbean- Okra	5.15	2.31	265.82	23.78	261.50
Carrot- Okra	5.07	2.21	264.03	20.87	259.71
Mean	**5.12**	**2.23**	**260.12**	**21.98**	**260.60**

Table 7.3.19. Physico-chemical properties of soil under sunken bed (Umiam)

Cropping sequences	pH	Organic carbon (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
Rice (IR-64) - Lentil	5.08	2.41	263.92	22.50	264.50
Rice(VD-82) -Lentil	5.08	2.28	261.13	21.09	263.57
Rice(Shahsarang-1) -Lentil	5.13	2.61	265.50	23.44	266.98
Rice(Lampnah) -Lentil	5.21	2.63	266.51	24.60	262.40
Mean	**5.13**	**2.48**	**264.27**	**22.91**	**264.36**

Evaluation of rice and okra under raised and sunken bed system at Umiam

residues and weed biomass were placed below the raised beds and covered properly with the soil from sunken beds.Farmyard manure (FYM) was used for all the crops to meet crop nutrient requirement on nitrogen (N) equivalent basis. Phosphorus requirement was compensated through rock phosphate. *Kharif* rice was harvested by leaving at least 20 cm standing stubble during last week of November and thereafter in sunken beds lentil (DPL 15) was grown under zero tillage.For growing lentil in sunken beds, the rice fields were drained at physiological maturity.

Growth parameters of ricein sunken bed (Table 7.3.15)

Among the rice varieties, the highest plant height was recorded in IR-64 (71.1cm) which was followed by Vivek-Dhan-82 (71 cm) and Shahsarang-1 (69 cm). Lampnah (61.1.cm) recorded the shortest plants. Tillers per square meter was recorded highest in Shahsarang-1(260.0) followed by Lampnah (251.0) and IR 64 (212.6).

Yield on raised bed (Table 7.3.16)

The highest vegetable yield was harvested in potato (16.82 t/ha) followed by carrot (14.24 t/ha) and french bean (10.06 t/ha) on raised beds. The yield of okra during *kharif* season was found higher with french bean as preceding crop and ranged from 8.30 to 9.06 t/ha under different cropping sequences on raised beds.

Yield on sunken bed (Table 7.3.17)

In rice based cropping systems in sunken beds, the rice productivity in sunken beds ranged from 3.52 to 4.29 t/ha under various sequences with mean productivity of 3.77 t/ha. Among the rice varieties, Shahsarang-1 recorded the highest yield (4.29 t/ha) followed by Lampnah (4.06 t/ha). During *rabi* season, lentil yield ranged from 1.16 to 1.34 t/ha.

Physico-chemical properties of soil (Table 7.3.18 & 7.3.19)

Soil pH, Organic Carbon (OC), available nitrogen, available phosphorus and available potassium were recorded highest under french bean-okra cropping systems recording 5.15, 2.31%, 265.82 kg/ha, 23.78 kg/ha and 261.5 kg/ha respectively under raised beds. In case of sunken beds, rice (Lampnah)-lentil cropping system recorded maximum soil pH (5.21), organic carbon (2.63%), available nitrogen (266.51 kg/ha) and available phosphorus (24.6 kg/ha) whereas, highest available potassium was observed under rice (Shahsarang-1)-lentil (266.98 kg/ha).

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/Buffalo/Goat/Poultry depending upon the location and size of the model
Complimentary enterprises	Biogas, Vermicompost unit, Live fencing, seed/planting material production unit

Locations: Calicut, Coimbatore and Umiam

Year of start: 2013-14

Results:

Calicut

Turmeric based integrated organic farming system

Since, it is the first year, maximum efforts were made to establish the model. The plot with spices, fodder and vegetables combination was established at Chelavoor farm. Crop component comprises of turmeric (2000 m^2), fruit crop banana (100 m^2), pineapple (200 m^2), vegetable cow pea (100 m^2) and fodder grasses viz., CO3 (500 m^2), Hybrid Napier (200 m^2), CO4 (500 m^2) and Congo signal (200 m^2).

The crops, turmeric, ginger, fodder grasses (congo signal grass, CO3, CO4), yams, tapioca, banana and pineapple were planted and established. Harvested fodder grasses (686 kg), Tapioca (80 kg) and vegetable cowpea (8 kg).

Banana in IOFS

Fodder and turmeric in IFS

Coimbatore (Table 7.4.1 to 7.4.7)

Composition of organic farming system (0.40 ha)

Components	Treatments/ Remarks
Crop component	Cropping Systems: 1. Okra + leaf coriander - maize + cowpea (fodder) - (0.12 ha) 2. Green manure - cotton - sorghum (0.12 ha) 3. Fodder grass CO CN (4) and desmanthus (0.10 ha)
Agro forestry	*Sesbania grandiflora, Thespesia populnea, Leuceania leucocephala*
Dairy	2 cows with calves
Vermicompost	The residue of the crops and manure from the dairy unit are converted into vermicompost and used as enriched manure for crops
Area under supporting activities	Manure pit, threshing floor
Border plants	Desmanthus, Banana, *Glyricidia*

Performance of okra + leaf coriander - maize + cowpea (fodder) system

In okra plant height of 72.6 cm was recorded at harvest with 1666 kg/ha of dry matter production. Fruit yield of 11287 kg/ha was recorded in okra variety Anarva. Organic okra seeds were produced during the final harvest. In okra net return of Rs. 68,837/ha was recorded in organic farming system.

In okra + leaf coriander cropping system, the grasses were dominating with 198.6 numbers/m^{-2} at 20 DAS & 157 numbers/m^{-2} at 40 DAS followed by broad leaved weeds (20 DAS - 21.6/m^{-2} & 40 DAS – 15/m^{-2}) and negligible with sedges. The weed biomass at 20 & 40 DAS revealed that the dry weight of grasses (211 kg/ha at 20 DAS & 14 kg/ha at 40 DAS respectively) were the highest under okra + leaf coriander cropping system. The dry weight of broad leaved weeds (58 kg/ha at 20 DAS & 7 kg/ha at 40 DAS respectively) were also higher when compared to sedges.

Table 7.4.1. Plant growth, soil fertility and yield parameters of okra under organic farming system model

Particulars	Okra (at harvest)
Plant height (cm)	72.6
DMP (kg/ha)	1666
N (kg/ha)	252.0
P (kg/ha)	8.6
K (kg/ha)	473.0
Fruit length (cm)	9.04
Fruit girth (cm)	5.08
No. of fruits/plant	17.4
Fruit weight (g/ fruit)	14.6
Fruit yield (kg/ha)	11287
Cost of cultivation (Rs/ha)	100475
Gross return (Rs/ha)	169312
Net return (Rs/ha)	68837

Table 7.4.2. Weed density (per m^2) and weed biomass (kg/ha) at 20 & 40 DAS under organic farming system model (Coimbatore)

Particulars	Weed density/m^2		Weed biomass (kg/ha)	
	20 DAS	40 DAS	20 DAS	40 DAS
Grasses	198.6	157.0	211	14
Sedges	1.0	2.0	1.5	0.17
Broad leaved weeds	21.6	15.0	58	7.0

Maize: Maize var. COH (M) 6 recorded 4352 kg/ha of grain yield with 5013 kg/ ha of straw yield. Maize recorded the net income of Rs. 27,876/ ha under organic farming system model.

Performance of maize under IOFS

Table 7.4.3 Plant growth, soil fertility, yield parameters, yield and economics of maize under organic farming system model (Coimbatore)

Particulars	Maize (at harvest)
Plant height (cm)	215.9
DMP (kg/ha)	8143
N (kg/ha)	257.00
P (kg/ha)	11.50
K (kg/ha)	458.00
No. of rows/cob	14.2
No. of grains/row	35.2
100 Seed wt. (g)	31.40
Grain yield (kg/ha)	4352.00
Straw yield (kg/ha)	5013.00
Cost of cultivation	26850
Gross return	54725
Net return	27876

Performance of green manure - cotton – sorghum system

Cotton: The results indicated that the number of grasses, sedges and broad leaved weeds observed were 237.0, 7.0 and 16.0 at 20 DAS & 127.0, 2.0, 11.0 at 20 and 40 DAS respectively. Higher weed biomass was observed in grasses followed by broad leaved weeds at 20 & 40 DAS.

Table 7.4.4. Weed density (per m^2) and weed biomass (kg/ha) at 20 DAS & 40 DAS under organic farming system model (Coimbatore)

Particulars	Weed density/m^2		Weed biomass (kg/ha)	
	20 DAS	40 DAS	20 DAS	40 DAS
Grasses	237.0	127.0	312.0	12.0
Sedges	7.0	2.0	17.0	0.1
Broad leaved weeds	16.0	11.0	55.0	3.7

Cotton recorded 4293 kg/ha of dry matter production was recorded at the stage of harvest. Seed cotton yield of 1122 kg/ha was recorded. In cotton net return of Rs. 15,430/ha was recorded under organic farming system.

Under organic farming system model, sorghum yielded 4251 kg/ha of grain and 6078 kg/ha of straw yield. Post harvest soil nutrient status shows the high amount of available nitrogen, phosphorus and potassium in soil. In organic farming system model, sorghum recorded Rs. 14,702 as net income with Rs. 16,882 as cost of cultivation.

Agroforestry: Trees species like malaivembu *(Melia dubia),* pungam *(Pongamia pinnata),* perumaram *(Ailanthus excelsa),* neem *(Azadirachta indica),* kumil *(Gmelina arborea)* and sithagathi *(Sesbania sesban)* are planted and utilized for fodder, pest control source, soil enrichment and as wood.

Table 7.4.5. Plant growth, yield parameters, yield, soil fertility and economics of cotton under organic farming system model (Coimbatore)

Particulars	Cotton (at harvest)
Plant height (cm)	108.6
DMP (kg/ha)	4293
N (kg/ha)	251
P (kg/ha)	9.4
K (kg/ha)	477
No of sympodial branches	15.8
No of bolls per plant	21.7
Seed cotton yield (kg/ ha)	1122
Cost of cultivation (Rs/ha)	40670
Gross return (Rs/ha)	56100
Net return (Rs/ha)	15430

Table 7.4.6. Plant growth, yield parameters, yield, soil fertility and economics of sorghum under organic farming system model (Coimbatore)

Particulars	Sorghum (at harvest)
Plant height (cm)	226.70
DMP (kg/ ha)	5425.00
N (kg /ha)	253.00
P (kg /ha)	12.50
K (kg /ha)	471.00
Grain yield (kg/ha)	4251.00
Straw yield (kg/ha)	6078.00
Cost of cultivation (Rs/ha)	16,882.00
Gross Return (Rs/ha)	31,584.00
Net Return (Rs/ha)	14,702.00

Dairy unit: Two numbers of cross bred Holstein Friesian cows (1 milch animal and 1 heifer) are maintained. Fodder obtained from crop component (fodder sorghum and fodder cowpea) along with Cumbu Napier grass was fed to the animals.

Table 7.4.7 Performance of dairy components in organic farming system

Animal No.	Sex	Age (as on 30.09.2014)	Year of purchase & price	Intercalving period (days)	Milk quality	
					Fat (%)	SNF (%)
TNAU 0002(COW)	F	3 yrs 10 months and 27 days	06.02.2014 Rs. 5,000/-	359	4.5	9.0
TNAU 0005(Heifer)	F	2 yrs 10 months and 22 days	06.02.2014 Rs. 1,000/-	-	4.3	8.9

Vermicompost: In the existing vermicompost unit two chambers were maintained for composting of cow dung. The crop residues and weed biomass obtained from the crop component were allowed for partial decomposition by adding cow dung and cow urine. The partially decomposed wastes were then shifted to the vermicompost unit and earthworms were released. Required moisture level was maintained by frequent watering and the unit was monitored for the activity of earthworms.

Umiam (Table 7.4.8 to 7.4.9)

The Integrated Organic Farming System Model (IOFS) comprises of different enterprises which includes cereals *viz*. rice and maize, pulses and oilseeds *viz*. soybean, lentil and pea, vegetable crops *viz.* frenchbean, tomato, carrot, okra, brinjal, cabbage, potato, broccoli, cauliflower, chilli, coriander, etc. fodder, fruits *viz.* Assam lemon and papaya, livestock unit(dairy), vermicomposting and fishery unit. A farm pond of 460 square metre area with average depth of 1.5 m was part of the IFS model for life saving irrigation and aquaculture.The value of REY is found to be comparatively higher in case of vegetable crops like cole crops, french bean, tomato and broccoli. The effect (legume) of soybean on other subsequent crops such as tomato and french bean and potato was found to be high. Apart from crop component good dividends from other enterprises like permanent fruit crops and live stock were also derived. In the model one cow along with one calf produced 1458 liters of milk per year with gross return of as Rs.43740.

Orgain chilli harvested form IOFS

General view of IOFS model

Table 7.4.8. Area, production and economics of the IFS model for organic food production

Components	Gross Area (m^2)	Net Area (m^2)	Production (t)	Cost of cultivation (Rs)	Gross Income (Rs)	Net Return (Rs)	REY (t/ha)
Cereals							
Rice	1579	1579	0.71	4800	7515	2715	4.50
Maize	485	485	0.23	1780	2338	558	4.82
Pulses/Oilseeds							
Soybean	485	Intercrop with maize	0.04	318	480	162	0.99
Lentil(Utera)	225	Under rice fallow	0.03	282	450	168	2.00
Pea	225	Under rice fallow	0.06	388	1200	812	5.34
Vegetables							
Frenchbean	234	Rotation with maize and okra	0.23	1043	3506	2463	20.00
Tomato	403	Rotation with maize and brinjal	0.44	1882	6646	4764	16.50
Carrot	110	Rotation with okra	0.15	953	1500	547	14.00
Okra	337	337	0.29	1569	2861	1292	17.00
Brinjal	282	282	0.23	1351	2300	949	8.15
Cabbage	181	181	0.36	1123	3616	2493	20.00
Potato	256	Rotation with maize and okra	0.38	1487	3837	2350	15.00
Broccoli	118	118	0.18	1050	4500	3450	38.27
Cauliflower	118	118	0.24	1100	3600	2500	30.00
Chilli	96	96	0.02	350	576	226	5.94
Coriander	32	32	0.02	321	485	164	15.00
Fruits							
Assam Lemon	80	80	0.04	595	1600	1005	
Papaya	54	54	0.14	687	1400	713	
Livestock							
Dairy (1 cow with 1 calf)	36	36					
Milk			1458 lit/year	36488	43740	13252	
Cowdung (adult)			4.5		4500		
Cowdung (calf)			1.5		1500		
Fishery							
Composite fish culture	460	460	0.24	8462.0	19200	10738	
Vermicompost	72	72	0.15	400	1200	800	
Fodder	382	382	4.01	1826	8026	6200	
Total	6249	4311		68255	126576	58321	
Rice Equivalent Yield (t/ha)	12.66						
Cropping Intensity	144.94						
Farmers' Practice (Rice mono cropping)		1.724	8622	17240	8618		

Table 7.4.9. Assumptions on food requirement and other expenditure per day for a four member family (2 adults and 2 children)

Food items	Quantity (g)	Price (Rs.)
Rice	1500	37
Dal	200	16
Oil	100	10
Vegetables	1500	30
Fruits	500	30
Others	-	37
Total		**160**

In an area of 6249 m^2 under gross cropping, 9.37 t of FYM (@15t/ha) is required for organic crop production. FYM produced within existing farming system is 6.3 t [6t + 0.3t (FYM equivalent from 0.15 t vermicompost)]. Hence initially, only 3.07 t of FYM is required to be purchased from outside to sustain the model in the first year of establishment. The requirement of FYM would be reduced substantially with the efficient recycling of on farm biomass, pond silt, intercropping with legumes, etc. and the model can be self-sustainable. The net income from 0.43 ha area of IFS model was Rs.58321 or Rs 4860 per month or Rs. 160 per day. The increase in net income over farmers practice was found to be 5 times. Considering the benefits from the IFS model with a net income of Rs 160 per day, it can sustain a four member family as the model could also meet the requirement of healthy food for the family.

Fish culture in Integrated organic farming system

Chili under Integrated organic farming system

Cabbage production under organic farming system

7.5 Tribal Sub Plan (TSP)

Tribal sub plan activities were undertaken at selected locations in which cluster based demonstrations, trainings, human resources development activities were undertaken.

Locations: Coimbatore,Dharwad, Raipur and Umiam

Year: 2013-14

Coimbatore (Tamil Nadu): Twenty five farmers in Maanaaru village of Karamadai block in Coimbatore district of Tamil Nadu were covered. Training on "Cluster based capacity building cum livelihood generation programme to tribal farmers" was conducted in the Maanaaru village in Tamil Nadu in which 25 tribal families including 6 female benefitted. From the trained group from Tamil Nadu, ManarVanadesa Farmers Group was formed for organic certification and registered at Joint Registrar Office, Coimbatore.

Dharwad (Karanataka): Fifty tribal farmers in 4 villages (Emmatti, Gudihal, Tavargeriand Devikoppa) in KalaghatagiTaluk of Dharwad district in Karnataka were covered. The bench mark study of the farm families and inventorization of farm resources has been done in four villages of Karnataka.

Raipur (Chhattisgarh): Ten tribal farmers in Raipur district of Chattisgarh covered. Five number vermicompost unit and 5 number of azolla production units established. Two trainings (Vermicompost and azolla production) were also organized.

Umiam

Cluster based demonstration of organic farming package in tribal clusters was undertaken for organic food production through integrated farming system using cluster approach. Mynsain village in Meghalaya adapted for disseminating organic production technology developed under NPOF in participatory mode. The village was having 120 households with area of around 60 ha. As per the interaction with the farmers and elder persons of the village, it is learnt that the village is totally organic as no inorganic input is applied. The sensitization meeting with the villagers including village head (Headman), member of the SHGs, Department of agriculture (Gram Sabath) was organized on 13th May 2013, subsequently a group of farmers visited NPOF experiment at Umiam to get first hand exposure to various technologies to be demonstrated under the programme. The improved seeds like maize, groundnut, frenchbean and some vegetables seeds were distributed to the farmers. The formal Memorandum of Understanding (MOU) between institute and the village was made. The participatory rural appraisal (PRA) and farmers training were conducted to initiate the programme.

Food-Feed Crop Production: Farmers was encouraged to grow crops such as sweet potato, maize, cucumber etc. as food for consumption purpose and as feed for livestock.

Livestock: As pig farming is mostly followed by the farmers, improved piggery were promoted. Some farmers practiced dairying. The cowdungwas used for vermicomposting, FYM preparation etc. for crop production and organic milk was sold at comparatively higher price.

Green leaf manuring trees: Leguminous multipurpose trees such as *Acacia auriculiformis* (Japenese Acacia), *Erythrina indica*, *Samanea saman* (Acacia), *Delonix regia* (Gulmohar*), Pongamia glabra* (Pogamia)

and *Azadirachta indica* (Neem) was grown in wasteland, degraded community lands for green leaf manuring..

Participatory Rural Appraisal: Participatory Rural Appraisal (PRA) on "Organic food production through integrated farming system- cluster approach" was conducted on the 27th-28th August,2013 to analyze the socio economic conditions and problems related to agriculture being faced by the villagers. The programme was actively participated by the villagers where information was collected through direct interaction among the group members and the villagers.

Interaction with the villagers

Villagers Participating in PRA

Geographical Coordinates of village was latitude 25^{0}44'339'', longitude 092^{0}00'937'' and altitude 884 m. Agriculture and Landless labourers constituted (85%) while remaining was in service, private shops etc.

Crop husbandry

Crops in Pre *kharif*	: Groundnut, cucurbits (bottle gourd, bitter gourd etc.), lettuce, french bean.
Crops in *kharif*	: Rice, cowpea, tomato.
Crops in *rabi*	: Toria, potato, cabbage, cauliflower, radish, carrot
Other major crop	: Maize
Other Fruit Trees	: Guava, carambola, pumelo,
Vegetables	: Cucurbits, tomato, cabbage & cauliflower, cowpea, radish, carrot, leafy vegetables (lettuce), potato.
Spices	: Ginger and turmeric

Animal husbandry

Animals	Population in entire village	Economic yield	
		Milk (litre/day)	Uses
Cattle	Indigenous (Desi) (29 no.'s)	2.5-4	Milk
	Cross-bred (1 no.'s)	8-10	Milk
Goat	Bengal goat (2 no.'s)	-	Meat
Poultry	Desi (226 no.'s)	-	Meat and egg
Pig	Local (42 no.'s)	-	Meat

Information on ecological aspects: Natural vegetation found are Bamboo, Pine trees, Sal, Amla. Major weeds observed are Parthenium*, Melilotus, Cyperus rotundus, Euphorbia hirta, Cyperus iria, Echinocloa colonum, Echinocloa cruss galli, Eupatorium odoratum, Lantana, Chenopodium, Martelia. Ageratum conezoic, Biden pilosa*.

Major findings from the PRA: The villagers were actively engaged in agriculture for their livelihood and most of the farmers in this village were small and marginal. Besides organic farming, *Jhum* Cultivation was also prevalent in the village and mostly followed mono-cropping system. Cultivated low yielding local varieties and thus very low farm income. Lack of irrigation facilities, even for drinking is a major problem during dry season where the villagers have to walk long distances (up to 0.5 km) in order to get drinking water. Almost each and every household are rearing pigs which is the most common livestock, but the productivity is very low due to local breed. Only few households have dairy and poultry.Rice is the most common cereal followed by maize. No improved farm mechanization, manual spading is followed for land preparation. Free grazing during winter season limits the scope for double cropping.Overall, lack of awareness about improved agricultural practices was found to be major issue affecting productivity. From the survey it was also found that village is nearest to Bhoirymbong (5 km) where farmers frequently visit for purchasing and selling of goods. There is only one primary school and one Anganwadi centre. For higher education the students goes to Shillong. For health care the villagers have to go to the nearby villages' viz. Bhoirymbong (5 km) and Pynthor village (2 km) from Mynsain village. Before the initiation of the programme the villagers are not aware about ICAR and extension machineries.

Social: From the finding it was found that the villager's settlement was closed from each other and majority of them is Christian. The village has a Dorbarshnong (Village Panchayat) headed by the headman of the village, the people meet each other in church, community hall and tea shop. Any problem which arises within the village was solved by the Dorbarshnong.

Agro-Ecology: Rice in low land and maize in upland are the most common cereals. Ginger, turmeric and french bean are also grown and mono-cropping pattern was being adopted. Different type of trees available in hills and fodder grass (paragrass). Cyperus are commonly present in lowland.

Village resources

Particulars	Articles
Transport facilities	Shared Taxi
Common facility	Tap water, Football Ground.
Communication facilities	Mobile, Television, DTH services,
Educational facilities	Lower Primary school
Health and welfare societies information	Aganwadi centre, Self help group, ASHA.
Agriculture implements	Power tiller, Knapsack sprayer, Spade,
Animals use for agriculture	Hired Bull for Ploughing and levelling of paddy field
Advisory facilities information	ICAR, SIRD.
Animal Reproduction	Naturally

Mobility: The most frequently visited places by the villagers are Bhoirymbongand Umroi. They visit these places for marketing of agricultural produce, education, medical facilities, bank, and veterinary hospital,

purchase of agricultural inputs, entertainment, household purpose and purchase and repair of agricultural machineries. There is no government as well as private bus service for the villagers. So they commute mainly by local cab or taxi and sometimes on foot to nearby places.

Table 7.5.1. Places frequently visited by villagers and mode of transport

Sl. No.	Place	Distance	Mode	Frequency	Purpose
1	Bhoirymbong	5 (km)	Local cab (Car, Van)	Very frequently	Marketing, Education, Medical, Bank, Agril. Inputs, Entertainment, household purpose
2	Umroi	10 (km)	Sumo, Auto, Car, Van and Bus	Sometimes	Bank, Marketing, Veterinary hospital.
3	Pynthor	2 (km)	Local cab (Car, Van), Walking	Frequently	Education, Medical (Sub center)
4	Shillong	30 (km)	Bus, Sumo, Car, Van	Sometimes	Court, Hospital, Marketing

Table 7.5.2. Daily activity profile of village male and female

Time	Male	Female
6:00am	Wake Up	Wake Up
7.00 am	Breakfast	Cooking & household works
8.00 am		
9.00 am	Farm Work	Cooking, preparation/collection of fuel wood
10.00 am		
11.00 am		
11.30 am		
12.30 pm		
1.30 pm	Lunch,	Lunch,
3.00- 5.00 pm	Farm Work	
5.30 pm	Marketing,	
6.30 pm	Visit to town, gossiping	Cooking & household works
7.30 pm	Dinner/watching TV	Dinner/watching TV
9.00 pm		
10.30 pm	Sleep	Sleep

Table 7.5.3. The various technologies adopted/Non adopted/ partially /discontinued in Mynsain village

Sl.No	Crops	Technology	Status	Reasons
	Technology table for crops			
1	Paddy	-	Not-adopted	Lack of accessibility and information's
2	Ginger	-	Not-adopted	Lack of accessibility and information's
3	Turmeric	-	Not-adopted	Traditional way of growing crops
4	Maize	-	Non-adopted	Lack of opportunity
5	Mustard	-	Not -adopted	Lack of knowledge and processing and marketing unit
6	Chilli	-	Not-adopted	Not yet experience
7	Potato	-	Not-adopted	Lack of opportunity
	Technology table for agricultural practice			
1	Jhum improvement/ Terracing	Bench terrace		Reduced runoff and less soil degradation
2	Line Sowing	Not adopted		Do not know about the benefit by planting in line
3	Recommended spacing	Not adopted		Lack of knowledge
4	Fodder cultivation	Not adopted		Lack of knowledge and planting skills
5	Zero tillage	Not introduced		Lack of awareness
6	SRI cultivation	Not introduced		Lack of awareness

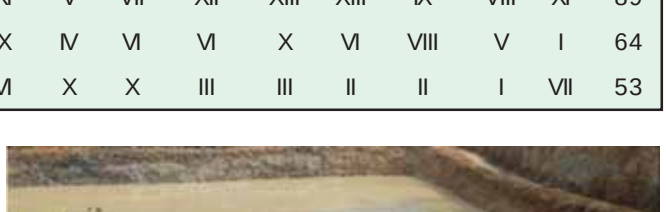
Sl.No	Crops	Technology	Status	Reasons
7	Improved varieties		Adopted	For better yield and disease free plants
	Technologies for farm implements			
1	Country plough		Not adopted	Unavailability of bullock within the village
2	Tractor		Not adopted	Lack of finance
3	Paddy and wheat thrasher		Adopted	High grain separating efficiency , less time consuming and less labour intensive
4	Knapsack sprayer		Adopted	High efficiency in spraying , low cost, easily manageable
	Technologies for animal husbandry			
1	Cross breed		Partially adopted	High yield, Improvement of progeny
2	Indigenous Cow (Desi)		Continued	Less feed requirement, high fat content, less disease prone, local demand for its milk
3	Exotic breed		Not adopted	Less preference of meat to consumers
4	Artificial insemination		Partially adopted	Reason for adoption: High milk yield, improve ofbreed Reason for low popularization: Low awareness, less availability of expertise person, less success rate.
5	Pisciculture		Adopted at very limited scale	Water holding capacity of the soil is low resulting in drying of ponds

Problem identification: Health problem in pig and poultry and soft rot of ginger were identified as major problem in the locality. Lists of problems obtained from the villagers were put in a table and the villagers were asked to rank those problems in the scale of 1-10, 1 being the most important problem. The details are presented in table 7.5.4.

Table 7.5.4. Ranking of Problems by the respondents

Problems	Rank by the respondents										
	1	2	3	4	5	6	7	8	9	10	Total
Disease attack in pig and poultry	I	IV	I	I	I	I	IV	I	II	II	18
Shortage of HYV seeds	X	III	VIII	II	IV	II	VII	V	VII	VI	54
Pest and Disease attack in crops and vegetables	XI	V	XI	V	XII	XI	III	X	XI	IX	88
Soft rot in Ginger	III	II	XII	IV	VIII	IV	I	III	III	VIII	48
Lack of improved technology (Power tiller, Tractor etc)	VII	X	XIII	VIII	XIII	V	VIII	VI	VI	III	79
Marketing of agricultural inputs	XII	XIII	VII	IX	IX	VI	IX	XI	XII	IV	92
Expensive cost of feed and fodder	IV	VII	IX	XI	V	VII	V	VII	IX	V	69
Less yield in rice	XIII	I	II	III	XI	XII	X	XIII	XIII	XIII	91
Viral disease in chilli	V	VIII	III	XIII	X	VIII	XII	IV	IV	X	77
Lack of water storage facilities	VIII	XII	VI	XII	II	IX	XI	XII	X	XII	94
Damage in citrus fruit by insects	VI	XI	V	VII	XII	XIII	XIII	IX	VIII	XI	89
Over grazing in Rabi season	IX	IX	IV	VI	VI	X	VI	VIII	V	I	64
Lack of financial support	IX	VI	X	X	III	III	II	II	I	VII	53

Development of pond: One new pond was constructed in farmer's land of Mynsain village. The pond was constructed for multiple uses, such as, pisciculture and for rearing of animals, for irrigation purposes during lean period and for cultivation of



crops. Liming (2 t/ha) and application of FYM (10 t/ha) was performed after digging new pond for developing soil fertility. Apart from the new pond, three existing ponds were also renovated in farmer's field for multiple uses. The construction and renovation of these ponds were actively participated by the farmer's themselves which inturn added some amount of employment to the villagers. Names of farmers, village and geographical coordinates of the demonstration sites are given below.

Table 7.5.5. List of beneficiary for pond and their geographical location of the demonstration site

Name of beneficiary	Area of pond (m^2)	Latitude (N)	Longitude (E)	Elevation above sea level(m)
Mrs. Pretowon Rynghang	300	25°44'340''	092°01'082''	863m
Mr. Rongdondor Rympei	240	25°44'150''	092°00'920''	876m
Mr. Lambor Rympei	360	25°44'613''	092°01'214''	856m
Mr. Presion Mawlong	400	25°44'742''	092°01'157''	862m

***Jalkund*:** A small rain water harvesting structure called *Jalkunds* suitable for hilltops was introduced in Mynsain village. The dimension was 5m x 4m x 1.5m which can store about 30,000 liters water were constructed in farmer's fields. *Jalkund* were constructed at higher elevations, so as water flowing down the slopes is collected in a *Jalkund* that will roughly store an adequate amount of water for the farmers' to utilize for irrigation. Construction of *Jalkund* was done as per method given below:-

Excavation of the *Jalkund* on selected site was done before onset of monsoon. The bed and sides of the *Jalkund* were leveled by removing rocks, stones or other projections, which otherwise might damage the lining material. The inner walls including bottom of the *Jalkund* were properly smoothened by plastering

Sequential stages of preparation of *Jalkund*

with mixture of clay and muddy soil.After clay plastering, about 3-5 cm thick cushioning was done with locally and easily available (long tall grasses) on the walls and bottom to avoid any kind of damage to the lining material from any sharp or conical gravel. It is followed by laying down of 250 GSM silpaulin sheets. The sheet was laid down in the *Jalkund* in such a way that it touches the bottom and walls loosely and uniformly and stretched out to a width of about 50 cm all around the length and width of the *Jalkund*. About 30 x 30 cm trench was dug all around the *Jalkund* and 25 cm outer edge of the sheet was buried in the soil so that the sheet is tightly bound from all around.

Farmers in mynsain village are using stored water for growing vegetables such as frenchbean, cabbage, brocolli, tomato, lettuce, cucurbits and for rearing of animals such as pig and poultry. Using stored water economically in various farm activities is the most acceptable and profitable one particularly to those in hilltop where drought is the major problem. Therefore, the stored water helps the farmers of this village to raised crops for the whole year. The names of farmers, village and their geographical location of the demonstration are given below.

Table 7.5.6. List of beneficiary for *Jalkund* and their geographical locations

Name of beneficiary	Latitude (N)	Longitude (E)	Elevation above mean sea level (m)	Crops grown/livestock reared using harvested water
Mrs Pynsan Rynghang	25^{0}44'704'	092^{0}01'276''	872m	broccoli, cabbage, lettuce, french bean
Mrs Skola Kurbah	25^{0}44'542''	092^{0}01'236''	859m	broccoli, cabbage, lettuce, french bean)
Mrs Ladei Nongsiej	25^{0}44'573''	092^{0}01'318''	861m	broccoli, cabbage, lettuce, french bean
Mr Ambor Makhroh	25^{0}44'313''	092^{0}00'056''	875m	broccoli, cabbage, lettuce, french bean and for rearing of pigs
Mr Synsharsuk Rynghang	25^{0}44'539''	092^{0}01'447''	866m	french bean and vermicomposting unit
Mrs Guardian Shadap	25^{0}44'301''	092^{0}00'847''	884m	french bean
Mrs Hynniew Rynghang	25^{0}44'602''	092^{0}01'261''	874m	lettuce, french bean and for piggery and dairy.
Mrs Trias Makhroh	25^{0}44'222''	092^{0}00'835''	882m	broccoli, cabbage, lettuce, french bean and for rearing of pigs and poultry.
Mr Aphilous Makhroh	25^{0}44'317''	092^{0}00'068''	869m	broccoli, cabbage, lettuce, french bean and for rearing of pigs.
Mrs Entinora Rynghang	25^{0}44'557''	092^{0}01'296''	860m	brocolli,cabbage,lettuce,french bean for rearing pig and dairy.
Mr Pynskhem Kharsohnoh	25^{0}44'522''	092^{0}01'072''	868m	chilli, french bean.
Mr Phang Rympei	25^{0}44'623''	092^{0}01'287''	876m	broccoli, cabbage, lettuce, french bean and for rearing of pigs.
Mr Rongdondor Lapang	25^{0}44'313''	092^{0}00'037''	874m	tomato, broccoli, cabbage, lettuce, french bean.
Mrs Shandriana Rympei	25^{0}44'745''	092^{0}01'338''	876m	broccoli, cabbage, french bean and for rearing of poultry.
Mr Bolbahadur Sarki	25^{0}44'571''	092^{0}00'872''	882m	french bean and for rearing cows.
Mrs Blianda Lapang	25^{0}44'493''	092^{0}01'057''	874m	french bean.

Vermicomposting unit: A community vermicomposting unit (6m x 8m x2.6m) consisting of eight composting tanks (2m x 1.5m x 0.75m) was constructed in Mynsain village with an objective to recycle on-farm biomass to increase the fertility of the soil. Vermicomposting unit was constructed with rectangular bricks columns. Cement tanks which were filled with. The biomasses collected from farmer's field by the community and produced vermicompost for the village.

Community vermicompost tank

Bench terracing

Terracing: Bench terraces were developed in different farmer's field to bring additional area under cultivation. Bench terraces are usually found on medium to steep slope, they consist of beds which are more or less level and risers (walls or bunds). It is easy to grow crops on the beds because it is fairly level. To be effective, bench terraces must be well maintained. The risers planted with grass, and repair them if necessary. Use of conservation agriculture on the beds to conserve the soil, encourage water to sink in, and maintain soil fertility. The newly prepared terraces were applied with lime (2 t/ha), FYM (15 t/ha) and other biomass to develop soil fertility. The vegetables like groundnut, rice bean, green gram, soybean etc are planned to cultivate in first year to develop soil fertility. Five bench terraces were constructed in different farmer's field. The details are given below.

Table 7.5.7 List of beneficiary for terracing and their geographical locations

Name of beneficiary	Area (m^2)	Latitude (N)	Longitude (E)	Elevation above sea level (m)
Mrs. Guardian Shadap	2700	25°44'305''	092°00'836''	884m
Mrs. Tiewlang Lapang	1332.93	25°44'313''	092°00'036''	874m
Mr. Ambor Makhroh	1800	25°44'301''	092°00'048''	873m
Mrs. Dapbiang Makhroh	1856.28	25°44'377''	092°01'053''	874m
Mrs. Shandriana Rympei	2386.23	25°44'736''	092°00'335''	872m
Mr. Synsharsuk Rynghang	2703	25°44'537''	092°01'419''	861m

Raised and Sunken beds: Raised and Sunken beds were developed after rice harvest in lowland for cultivation of vegetables. The dimension of the raised bed were 0.75-1m breadth, 10m length, 0.3-0.5m height and the drainage channel (sunken bed) varies from 0.2-0.5m respectively. A total of 10509 m^2(about 1 ha) area has been brought under vegetable cultivation in lowland through raised and sunken beds land configuration. Vegetables such as tomato (var. Avinash, Rocky), french bean (var. Naga local), potato (var. Kufrimegha), Carrot (var. New Kuroda), lettuce were grown by the farmers on raised beds.

Table 7.5.8. Location of demonstration sites and beneficiary details

Name of beneficiary	Area (m^2)	Latitude (N)	Longitude(E)	Elevation above sea level(m)
Mr. Aphilous Makhroh	1031.2	25^{0}44'116''	092^{0}00'869''	864m
Mr. Ambor Makhroh	1209.3	25^{0}44'253''	092^{0}00'010''	857m
Mrs. Hostina Makhroh	220.70	25^{0}44'218''	092^{0}00'903''	858m
Mrs. Dapbiang Makhroh	1466	25^{0}44'402''	092^{0}01'016''	870m
Mrs. Hunlang Makhroh	582.30	25^{0}44'212''	092^{0}00'882''	860m
Mr. Debinus Nongsiej	1466	25^{0}44'614''	092^{0}01'100''	840m
Mr. Rongdondor Makhroh	621.28	25^{0}44'083''	092^{0}00'942''	873m
Mr. Shaibor Makhroh	1085.88	25^{0}44'090''	092^{0}00'879''	866m
Mr. Bankhrawbok Rynghang	469.82	25^{0}44'590''	092^{0}01'092''	844m
Mrs. Rina Lapang	1520.40	25^{0}44'151''	092^{0}00'900''	862m
Mrs. Paleiti Makhroh	836.14	25^{0}44'094''	092^{0}00'916''	869m
	Total Area = 10509.02m^2			

Raised and sunken bed developed by farmers in Mynsain Village

Fruit trees plantation: Two hundred numbers of Guava seedlings were planted in farmers field (LadeishaNongsiej) in the month of July covering an area of about 1500 m^2 (25^{0}44'623''N latitude, 092^{0}01'374''E longitude and 853m altitude). Pits of 1 x 1x 1 m were dugged at 5m x 5mapart and were incorporated with upper 30 cm soil along with 3 to 5 kg FYM. In the initial stages, plants were allowed to grow as a single upright stem up to a height of 70 to 80 cm. The shoots emerging from ground level or below the graft/bud union and dried twigs were removed periodically. Four varieties were planted in the field namely Allahabad Safeda, RCGH-1, RCGH-7 and RCGH-4. The survival percentage is about 85%. Intercultural practices are being done by the farmers.

Guava fruit tree plantation

Introduction of improved pig variety: Farmers were provided with improved breeds (75% Hampshire and 25% mixed local) of pigs for higher productivity and income.Seven units (one male and one female) improved cross breed piglets were provided to each beneficiary farmers in Mynsain village. Two units of local piglets were also included in farming system for comparison.

Popularization of improved varieties: Farmers in Mynsain village generally cultivate local low yielding varieties such as ginger, turmeric, french bean, rice, maize and mustard. Improved and high yielding varieties of crops, vegetables were provided to the farmers. Most of the crops were grown before by the farmers but groundnut, broccoli and tomato were introduced under scheme and basic package of practices were adopted them for higher productivity.

To promote small scale mechanization, implements and tools like paddy thresher, cono-weeder, sprayer, rosecan, maizecobsheller and one electric pump was provided to the village.

Table 7.5.9. List of crops, livestock and implements distributed

Particulars	Crop/livestock/other	Area (m^2)	Quantity
Vegetables	Frenchbean	4960	43kg
	Broccoli	600	40g
	Cabbage	610	50g
	Tomato		200g
	Lettuce		100g
	Bitter Gourd		80g
	Cucumber		200g
Rhizome	Turmeric		500 kg
	Potato		30kg
Fruits	Guava	3000	200 nos
Cereals	Rice	10000	100kg
	Maize	1268	100
Oilseed	Groundnut	1000	50kg
Feed and Fodder	Broom grass		200 nos
	Pig feed		300kg
	Poultry feed		550 kg
Water harvesting	Jalkund	320	16 nos
	Pond	1300	4 nos
Piglets	Improved		6 nos
	Local		4 nos
Poultry	Layer chicks		200 nos
Vermicomposting	-		850kg
Rock phosphate	-		2 quintal
Neem cake	-		1 quintal
Lime	-		3 quintal
Terracing	Bench terrace	10812	-
Implements	Paddy thresher	-	1 no
	Cono-weeder	-	5 nos
	Knapsack sprayer	-	2 nos
	Rose can	-	10 nos
	Maize sheller	-	5 nos
	HP electrical pump	-	1 no

Organic Ginger-Colocasia production in Mynsain village

Integrated organic Farming System in Mynsain village

Success: Organic ginger cultivation was adopted by the farmers (Mrs Hynniew Rynghang) covering an area of 2858 m^2. Quantity of planting material was used resulted in production of 2400 kg. Mostly the farmers adopted sequential cropping of ginger-colocasia –chilli for higher productivity. Five farmers in Mynsain village have already started practicing organic farming in integrated farming system (IFS) mode. They integrated crops (rice, maize), vegetables (tomato, french bean, potato, lettuce, carrot) livestock (dairy/ piggery) and water harvesting (*Jalkund*).

ITKs practiced in Mynsain village

1. Maize seed mixed with turmeric (Shynrai) before sowing helps to protect the seeds from disease attack during seedling stage. This method is generally practiced by khasi people of Meghalaya. Selection of maize seed was done by soaking the seed in water in which the infected seed will float on the surface of water, the selected seeds were taken in a plate/ vessel where turmeric powder are added and mixed. Turmeric powder @ 200g/kg of maize seeds are required. The application of this method helps to protect the seeds from damages which may cause through pest and diseases attack and also protect the seed from dormancy and late germinations.

2. Twigs and leaves of Sla Latdoh and pine trees: Sla Latdoh and pine trees needle was placed in rice field to prevent the plants affected from pest and diseases. This method was mainly practiced by the khasi community and is also prevalent in RiBhoi district of Meghalaya.The whole plant (Sla Latdoh) was placed at water entrance and sometimes the leaves of pine trees is dipped into the sources of water, the field is kept flooded with this water, after few days the water is drained away and the process is repeated for 3-4 times in each season. Sometimes the twig and leaves tied together are also placed within the paddy field. This was used for all pests but the main pest targeted is gundhi bug.

3. Mixture of silkworm excret and ginger to control pest of paddy: Silkworm and ginger extracts are used. Silkworm and Ginger extracts were prepared @ 1:1 and was kept overnight for decomposition and then 1litre of water was added to it, the mixture is applied at the time of flowering of paddy to protect it from pest and diseases. Silkworms excrete and Ginger is mixed @1:1 to make a paste. The mixture is applied for control of soil borne pest and act as disease repellant.

4. Leaves of *Cannabis sativa*to protect crops from pests:Cannabis leaves and soil is mixed in the ratio of 1:1 and is kept for 12- 24 hours for proper intermingling. Then the mixture is applied to paddy and ginger fields. The mixture protects paddy and ginger from all kind of pest and disease attack and acts as repellant of stored grain pests.

Training cum awareness programme on 'Organic farming system in cluster approach'

A three days training cum awareness programme on "Organic farming system in cluster approach" was organized for the farmers of Mynsain village at ICAR Research complex for NEH Region,Umiam, Meghalaya under NPOF scheme to improve their package and practices and skills on organic farming. After the completion of the training, participants were able to practice conversion of land from conventional

Farmers from Mynsain village attended the training

Training on improved technology inputs

Training on Vermicomposting

Field demonstration on raised and sunken bed for improving productivity

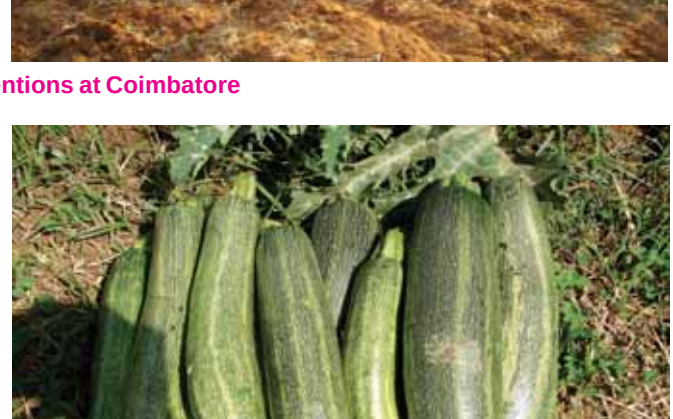
management to organic management, management of the entire surrounding system to ensure biodiversity and sustainability of the system, crop production with the use of alternative sources of nutrients such as crop rotation, residue management, organic manures and biological inputs and management of weeds and pests by better management practices, or biological control system.Thirty farmers benefitted from the training.

Farmers field day on "Conservation Agriculture and Organic Farming"

The Field Day was organized to create awareness among farmers and to disseminate information among the end users. The programme was participated by 65 farmers and 25 researchers and stakeholders. Organic farming and natural resource management were the major topics dealt in the field day. Farmers also had an exposure to the various components of organic farming.Field day also witnessed the practical demonstrations on zero tillage cultivation of pea, lentil and rapeseed (*toria*) in lowland rice fallow. Organic cultivation of vegetables such as tomato, french bean, carrot, potato was also discussed in the programme.Demonstration on various farm implements and tools such as furrow opener, zero till-seed drill, cono-weeder, paddy thresher were established. Extension leaflets in local language on organic farming and conservation agriculture were distributed to the farmers.

Tribal sub plan interventions at Coimbatore

Scientists visits at Bhopal



Summer squash at Bajaura

8. PUBLICATIONS/HUMAN RESOURCE DEVELOPMENT AND WORKSHOPS/MEETINGS

8.1 Publications

Research Papers

Chitale, S., A. Pali Tiwari, S.K. Sarawgi, J.S. Urkurkar, Vinod Kumar and G.C. Sharma. 2012. Effect of organic nutrient management using on/off- farm organic inputs on the productivityof basmati group of rice (*Oryza sativa*) - chickpea (*Cicer arietinum*)/wheat (*Triticum aestivum*) cropping system. *Journal of Farming Systems Research and Development* **18** (2): 12-19.

Chitale, S., A. Tiwari, S. Bhoi, R.M. Savu, H.S. Tomar and J.S. Urkurkar. 2013. Performance of soybean (*Glycine max*) – based cropping sequences under organic, inorganic and integrated nutrient supply systems in a *Vertisols*. *Indian Journal of Agronomy* **58**(2): 163-167.

Devkant, Prasad, M.S. Yadava and C.S. Singh. 2013. Diversification of rice (Oryzasativa)- based cropping systems for higher productivity, profitability and resource use effciciency under irrigated ecosystem of Jharkhand. *Indian Journal of Agronomy* **58**(3): 264-270.

Kumari, Niru, C.S. Singh, J. Prasad, M.K. Singh and Rajesh Kumar. 2013. Influence of organic nutrient sources on productivity of rice (*Oryza sativa*)-based cropping systems in Jharkhand. *Indian Journal of Agronomy* **58**(3): 277-281.

Rana, Monika, K.P. Raverkar, N. Pareek, R. Chandra and D.K. Singh. 2015. Impact of biodynamic preparations and *panchgavya* in organically managed cropping system comprising legumes on soil biological health. *Legume Research* **38**(2): 219-228.

Singh, D.K. 2014. Integration of organic nutrient sources to sustain the system productivity and soil fertility in organic basmati rice based cropping systems. *Journal of Eco-friendly Agriculture* **9**(2):113-116.

Singh, D.K., M. Rani, P. Tripathi, S.K. Yadav and A.K. Dubey. 2013. Weed management practices in organic basmati rice based cropping systems under *Tarai* conditions of Uttarakhand. *Green Farming* **4**(6):711-715.

Singh, D.K., Manisha Rani, A.K. Dubey and Priyanka Tripathi. 2014.Cutting edge research in Organic farming. *Journal of Eco-friendly Agriculture* **9**(1):1-5.

Singh, D.K., Shilpi Gupta, A.K. Dubey and P.C. Pandey. 2014. Harnessing cosmic energy to enhance productivity of organic basmati rice-based cropping system. *Green Farming* **5**(5):725-729.

Singh, D.K., Jyoti Pandey, Geeta Kaur and A.K. Dubey. 2013. Agronomic evaluation of biodynamic practices for organic cultivation of basmati rice based cropping system. *Journal of Eco-friendly Agriculture* **8**(1): 20-23.

Popular article/folders

Bhoi, S., S. Chitale and A. Tiwari, 2012. tfod /kku dh mRiknu rduhd] NRrhlx< [krh] an IGKVV publication **19**(2): 10-13.

Chitale, S., T. Harishankar Pandagre, S. Abraham and G.P. Pali. 2014. tfod [krh e to mojdk dh Hkfedk] NRrh lx< [krh] an IGKVV publication **21**(2): 12-16 April- June 2014.

Singh, A.B. and A.K.R. Tripathi. 2013. vukj dh tfod [krh] Folder, pp 1-5.

Singh, A.B., S. Ramana, Brijlal Lakaria, K. Ramesh, J.K. Thakur, P. Ramesh and N.R. Panwar. 2013. Mje xg dh tfod [krh] Folder, pp 1-5.

Singh, A.B., S. Ramana, Brijlal Lakaria, K. Ramesh, J.K. Thakur, P. Ramesh, and N.R. Panwar. 2013. lk;chu dh tfod [krh] Folder, pp 1-5.

Singh, A.B., S. Ramana, Brijlal Lakaria, K. Ramesh, J.K. Thakur, P. Ramesh and N.R. Panwar. 2013. blcxky dh tfod [krh] Folder, pp 1-5.

Singh, A.B., S. Ramana, Brijlal Lakaria, K. Ramesh, J.K. Thakur, P. Ramesh and N.R. Panwar. 2013. vjgj dh tfod [krh] Folder, pp 1-5.

Singh, A.B., S. Ramana, Brijlal Lakaria, K. Ramesh, J.K. Thakur, P. Ramesh and N.R. Panwar. 2013. puk dh tfod [krh] Folder, pp 1-5.

Singh, A.B., S. Ramana, Brijlal Lakaria, K. Ramesh, J.K. Thakur, P. Ramesh and N.R. Panwar. 2013. ljlk dh tfod [krh] Folder, pp 1-5.

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Singh, A.B. 2014. vf/kd mRiknu gr ljlk dh tfod [krh] CEDMAP, Patrika, Feburuary, 2014 pp 48-52.

Book Chapter

Ramesh, K. and A.B. Singh. 2014. Conservation agriculture vis-a vis organic farming. Conservation agriculture for carbon sequestration and sustaining soil health (J. Somasundrametal Eds book), pp. 425-435.

Ramesh, K., Brijlal Lakaria, A.B. Singh and A. SubbaRao. 2013.The pracrice of organic farming –A SWAOT analysis. Souvenir soil health for sustainable productivity, Western region agrilcultre fair, *Indian Institute of Soil Science Bhopal*, pp. 144-147.

Singh, A.B. and A. SubbaRao. 2013. tfod [krh e mojrk lLdj.k] Souvenir soil health for sustainable productivity, Western region agrilcultre fair, *Indian Institute of Soil Science Bhopal*, pp. 70-83.

Singh, A.B., K. Ramesh, B.L. Lakaria and A. Subba Rao. 2013. Organic farming produce for produce quality and soil health. In: Kundu S., M.C. Biswa, A.K. Chaudhary, R.S., Lakurai B.L. and SubbaRao, A. (Eds) IISS contribution in frontier ares of soil research, IISS Bhopal, pp. 221-226.

SubbaRao, A., A.B. Singh, K. Ramesh and B.L. Lakaria. 2013. Nutrient management stratigies for organic package of practices. In: Kundu S., M.C. Biswa, A.K. Chaudhary, R.S., Lakurai B.L. and SubbaRao, A. (Eds) IISS contribution in frontier ares of soil research, IISS Bhopal, pp. 237-258.

Thakur, J.K., K. Ramesh, A.B. Singh and A. Subba Rao. 2013. Nutrient supplementing preparation and bio-pest control agent for their use in organic farming. Issue and perspective, Souvenir soil health for sustainable productivity, Western region agrilcultre fair, *Indian Institute of Soil Science* Bhopal, pp. 148-156.

Papers presented in Seminar/ Symposia/Conferences

Singh, D.K., Shilpi Gupta and A.K. Dubey. 2013. Comparative response of organic, chemical and integrated mode of cultivation in basmati rice based cropping systems-A long-term study. In *International Conference on Organic Farming,* organized by ICCOA and Nurnberg Messe (Germany), Nov. 14-16 at Bangalore (Karnataka).

Singh, D.K., Shilpi Gupta and A.K. Dubey. 2014.Harnessing Cosmic Energy through Biodynamic Approach.In*National Seminar*on Role of Organic Farming in Climate Resilient and Sustainable Agriculture, Jan. 9-10 at AAU, Gujrat.

Singh, D.K., Z. Akhtar, A. Srivastava, M. Chakraborty and S. Gupta. 2015. Sustainable production organic basmati rice in North-Western Himalayas of India. In: *International Conference on Agriculture and Biological Sciences* (ABS2015), July 25-28, 2015 at Beijing, China

Singh, D.K. Shilpi Gupta, A.K. Dubey, Dipti Bisarya and P.C. Pandey. 2014. Productivity potential comparisons and potential for mitigating of soil fertility of organic and conventional farming system under different basmati rice based cropping system. In*National Seminar on Organic Agriculture* held May 28-29, CSK HPKV, Palampur.

Singh, A.B., A.K. Tripathi, Muneshwar Singh and A. Subba Rao. 2013. Quality evaluation of soybean under long term fertilizer experiment. *In proceedings of international conference* of role of plant bio-chemistry and bio-technilogy in food and nutritional security held during December 11-14, 2013, p 31.

Subba Rao, A. and A.B. Singh. 2013. Improving nutritional quality of soybean in different nutrient management system under organic farming. *In proceedings of international conference* of role of plant bio-chemistry and bio-technilogy in food and nutritional security held during December 11-14, 2013, p 31.

8.2 Human Resource Development

Sponsored training organised for farmers

Name of the institute/ organisation	Name of the trainees	Coordinators	Duration of the training	Nature of training imparted
Farmers welfare and agriculture development under ATMA, District: Hosangabad, (M.P.)	25 Farmers	Dr. A. Subba Rao Dr. A. B. Singh Dr. A. K. Tripathi	January 09-13, 2014	Organic farming and soil health
Farmers welfare and agriculture development under ATMA, District: Morena, (M.P.)	30 Farmers	Dr. A. Subba Rao Dr. A. B. Singh Dr. A. K. Tripathi	March 10-14, 2014	Organic farming and soil health
Farmers welfare and agriculture development under ATMA, District: Morena, (M.P.)	30 Farmers	Dr. A. Subba Rao Dr. A. B. Singh Dr. A. K. Tripathi	March 24-28, 2014	Organic farming and soil health

Training organized under Tribal Sub Plan

- **12 number of trainings** on various aspects of **"Organic production of crops"** was conducted in 5 states (Chhatisgarh, Jharkhand, Meghalaya, Maharashtra and Tamil Nadu) in which **355 tribal families benefitted**. From the trained group of Tamil Nadu, **Manar Vanadesa Farmers Group** was formed for organic certification and registered at Joint Registrar Office, Coimbatore. A field day was also conducted in Meghalaya.

8.3 Workshops/Group Meetings

X Annual Group Meeting of Network Project on Organic Farming organized at MPUAT, Udaipur

The X Annual Group Meeting of Network Project on Organic Farming (NPOF) was organized at Maharana Pratap University of Agriculture and Technology (MPUAT), Udaipur during 19-21 August 2015. Shri Chandra Singh Kothari, Mayor of Udaipur Corporation inaugurated the group meeting as Chief Guest. Shri Kothari expressed concern about the ill effects of indiscriminate use of chemicals especially pesticides and called for growing safe food for all on the principles of organic farming combining the tradition, modern science and farmers innovation. Professor P.K. Dashora, Vice Chancellor, MPUAT who chaired the inaugural session lauded the efforts of agricultural scientists and farmers along with policy makers for making self-sufficient India in terms of food production in the post-independence period. Further, he said that today's need is to go near to our nature as consumers have started to look for safer and better controlled foods produced in environment friendly way. Dr J.P. Singh, Director, ICAR-IIFSR said that, considering the importance of organic farming in the country and to provide technological backstopping, the number of centres have been increased to 20 from 13. He also informed that all the 7 new centres have been made functional from 2015-16 and during the year, geo-referenced characterization of 453 organic growers have been done to understand the dynamics of organic farming. Dignitaries also released nine publications brought out by IIFSR and cooperating centres. Dr G.S. Ameta, Director of Research, MPUAT welcomed the participants while Dr S.K. Sharma, PI, MPUAT proposed the vote of thanks in the inaugural session.

Release of publications by dignitaries in the inaugural session

Professor P.K. Dashora, Vice Chancellor addressing in the inaugural session

In the first two days, review of on-going programmes and re-orientation/finalization of technical programme was taken up. Besides, special lecture on third party/GGC/PGS certification by Dr A.K. Yadav,

Ex-Director, NCOF & Member, RAC of IIFSR was also organized. On 21 August 2015, interface meeting of researchers-farmers-development departments-NGOs-certification agencies was organized to take stock of research requirements of all the stake holders. All the stakeholders expressed that scientific package of practices for organic production, identification of suitable varieties for organic farming and reducing the external organic inputs as requirement for successful organic farming. Dr J.P. Singh, Director, ICAR-IIFSR informed that location specific organic package of Interface meeting of researchers-farmers-development departments-NGOs-certification agencies practices for 42 cropping systems have been prepared from the scheme which will be finalized and published in multiple-languages shortly. Experiments for identification of varieties and reducing the external organic input costs through integrated organic farming system models are being undertaken through the scheme.

Field visit to NPOF experiments at MPUAT, Udaipur

Interface meeting of researchers-farmers-development departments-NGOs-certification agencies

Based on the overall performance, Pantnagar (GBPUAT) centre of NPOF was selected as best centre and a certificate were issued in the plenary session. The group meeting ended with vote of thanks proposed by Dr N. Ravisankar, National PI, ICAR-IIFSR. The consolidated recommendations of the group meeting is given below

A. Research

- Geo-referenced characterization of organic farmers is mandatory activity for all the centres. Data from minimum of 30 organic farmers per year per centre should be collected in the prescribed proforma and synthesized. The activity should be reflected in the Annual Report.
- Allelopathic kind of weed management needs to be considered in organic farming. Collaborative study on organic weed management with AICRP on weed management should consider this aspect.
- Quality of milk obtained under organic management of dairy should also be observed in the Integrated Organic Farming System (IOFS) models experiment.
- Long term analysis of yield, economics, soil physical, chemical and microbial properties in the experiment on evaluation of organic, inorganic and integrated production systems should be done and presented briefly (only 2 slides) in all future group meetings before presenting the current year results.
- Economics should be calculated with premium and without premium for organic management. This should be compared with other management practices such as integrated and inorganic which are to be calculated without any premium price.Net return per rupee invested (NRPRI) should be used as measuring parameter instead of B:C ratio.

- Yield transition period (number of years taken to obtain statistically on par yield with chemical management) for all the cropping systems under organic management should be worked out using system equivalent yield.

- New centres should initiate all the approved experiments as per the technical programme discussed and finalized. Long term experiment of evaluation of organic, inorganic and integrated production systems should be laid out as per the plan provided which includes alley strips with perennials and buffer channels.

B. Others

- Detailed Package of Practices (PoP) for organic production of crops in cropping systems perspective should be published in English and Hindi. English version should be published by December 2015 and hindi version by March 2016. It should also be translated in to regional languages especially Tamil, Gujarati, Malayalam and Kannada. Regional translation and publication should be done by centres. For regional publication, relevant crops and packages from other locations can also added.

- All the centres should document techniques used for management of weed, pest and disease under organic management in the experiment on evaluation of organic, inorganic and integrated production systems.

- All the centres should improve the publications from the scheme especially research papers and popular articles.

9. APPENDIX

Details of crops and varieties used in Evaluation of organic, inorganic and integrated production systems for crops and cropping systems at various locations

Crop	Variety
Bajaura	
Tomato (*Kharif*)	7730
Black gram (*Kharif*)	Palampur-93
Lady's Finger (*Kharif*)	P-8
Cauliflower (*Rabi*)	PSBK-1
Pea (*Rabi*)	Azad P-1
French bean (Summer)	Falguni
Tomato (Summer)	RK-123
Summer Squash (Summer)	Australian Green
Bhopal	
Soybean	JS-335
Durum wheat	HI-(Malwa Shakti) 8498
Mustard	Pusa Bold
Chickpea	JG-130
Linseed	JL-9
Calicut	
Ginger	Varada, Rejatha and Mahima
Turmeric	Alleppey Supreme, Prathibha
Black Pepper	Sreekara, Panniyur -1
Coimbatore	
G M (Sunnhemp)	CO 1
Cotton	Suraj
Maize	COH(M)6
Chillies	PKM1
Sunflower	COSFV 5
Beetroot	Ruby Queen
Maize	COH(M)6
Ladyfinger	Anarva
Dharwad	
Cowpea	C 152
Safflower	A1
Pigeonpea	TS-3R
Greengram	DGGV 2

Crop	Variety
Sorghum	M 35-1
Groundnut	GPBD 4
Hy. cotton	DHB 263
Maize	ARJUN
Chickpea	JG 11
Karjat	
Rice	Karjat – 4
Groundnut	SB – XI
Maize (Sweet corn)	Sugar – 75
Mustard	Varuna
Dolichos bean (Green pod vegetable)	Konkan Bhushan
Crop	**Variety**
Jabalpur	
Basmati rice	Pusa Basmati -1
Wheat	MPO-1106
Chickpea	JG-322
Berseem	J B - 1
Vegetable pea	Arkel
Maize fodder	African tall
Sorghum fodder	MP Chari
Ludhiana	
Basmati rice	Panjab basmati 3
Pigeonpea	PAU 881
Moong	PAU 911
Wheat	HD 2967
Chickpea	GPF 2
Modipuram	
Basmati rice	PB-6
Rice	Saket-4
Maize Grain	Bajaura pop corn
Green cob	Madhuri
Wheat	HI - 8498
Okra	Arka Anamika
Potato	Chipsona-3

Crop	Variety
Barley	DWRB-91
Green gram	Pusa vishal
Mustard	Pusa bold
Pantnagar	
Basmati rice	Pusa Basmati -1
Wheat	UP-2572
Chickpea	Pant Kabuli chana-1
Vegetable Pea	Arkel
Potato	Kufri bahar 3797
Coriander	Harit RS-5
Sesbania	Pant Ses-1
Rice	Pusa-1121
Soybean	PS 1347
Maize	PSM-3
Pigeon pea	UPAS 120
Moong	PM-5
Cowpea	PL-2
Mustard	PR-15
Okra	Arka Anamika

Crop		Variety
Raipur		
Soybean		JS – 335
Maize		Sugar-75
Vegetable pea		Pant sabjimatar" (PSM 3)
Chilli		Agnirekha
Onion		Nasik red
Ranchi		
Rice		Birsamati
Wheat		K- 9107
Lentil		PL 406
Potato		Kufr iAshoka
Linseed		Shekhar
Umiam		
Rice (sunken bed)	*kharif*	Megha Aromatic 2 Lampnah Ngoba Sahsarang-1
Rice (raised bed)		Bhalum-1
Carrot		New Koroda
Potato		Kufri jyoti
French bean		Naga local
Tomato		Rocky

10. ANNEXURE

ICAR-Network Project on Organic Farming
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ACRONYMS

ALE : Aquous leaf extract

ASE : Aquous seed extract

BBF : Broad bed and furrow

B:C : Benefit:Cost

BD : Biodynamic

CC : Cost of cultivation

CDM : Cowdung manure

Cu : Copper

DSR : Direct seeded rice

DTPA : Diethylene triamine penta acetic acid

EC : Enriched compost

ECe : Electrical conductivity

Fe : Iron

FB : Flat bed

FYM : Farm yard manure

GLM : Green leaf manure

GM : Green manure

GR : Gross returns

IOFS : Integrated organic farming system

ITK : Indigenous technical knowledge

K : Potassium

KC : Karanj cake

Mn : Manganese

MOP : Muriate of potash

N : Nitrogen

NC : Neem coated

NEOC : Non edible oil cakes

NPV : Nuclear Polyhedrosis virus

NR : Net returns

NRPRI : Net return per rupee invested

OC : Organic carbon

P : Phosphorus

PG : Panchagavya

pH : Negative logarithum of hydrogen ion concentration

PPM : Parts per million

RBD : Randomized block design

RP : Rock phosphate

RSB : Raised and sunken bed

SRI : System of rice intensification

SSP : Single super phosphate

TSP : Tribal sub plan

VC : Vermicompost

Zn : Zinc

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Monitoring of NPOF experiment at Bhopal by Dr. A.K. Sikka, DDG (NRM) ICAR, New Delhi

Organic food production system under NPOF-Tribal Sub Plan in Mynsain village of Ri-Bhoi district (Meghalaya)

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