FRONTLINE DEMONSTRATIONS
UNDER AICRP SYSTEM

AN EFFECTIVE TOOL FOR TRANSFER OF SOYBEAN PRODUCTION TECHNOLOGY

S. D. BILLORE, B. U. DUPARE, RAGHAVENDRA M,
R. K. VERMA, SANJAY GUPTA AND
NITA KHANDEKAR

ICAR- Indian Institute of Soybean Research
Khandwa Road, Indore-452001

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Dr. Nita Khandekar, Acting Director
ICAR-Indian Institute of Soybean Research, Khandwa Road, Indore 452001
Tel.: 0731 2476188, 2362835, 2364879
Fax: 0731 2470520

Compiled and Edited by
Dr. S. D. Billore, Principal Scientist (Agronomy)
Dr. B. U. Dupare, Principal Scientist (Agricultural Extension)
Dr. Raghavendra Madar, Scientist (Agronomy)
Dr. R.K. Verma, Scientist (Agronomy)
Dr. Sanjay Gupta, Principal Scientist (Genetics and Plant Breeding)
Dr. Nita Khandekar, Principal Scientist (Agricultural Extension)

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Foreword

India has made a significant stride in oilseed production since 1986. This appreciable growth in oilseeds production was possible due the concerted efforts made by the R & D agencies with the active support of Technology Mission on Oilseeds. The contribution of soybean during this period was unparalleled to any other crop, thus contributing for spectacular improvement in oilseeds production. It has revolutionized rural economy and has uplifted socio- economic status of farmers.

Soybean is a very important legume crop in India. It contributes 45% of the total oilseeds and about 25% of the total edible oil produced in the country and the seed contains 40% protein and 20 % oil being one of the most economical sources of good quality protein. It also contains many minerals and useful nutraceuticals like iso-flavones, which have immense health benefits. Therefore, the crop has a potential to provide nutritional security and eradicate rampant protein malnutrition in the country. Soybean being a leguminous crop fixes atmospheric nitrogen, reduces consumption of synthetic nitrogenous fertilizer in the subsequent crop and maintains soil fertility.

All over the country, Frontline Demonstrations on farmers' field have been organized since 1989 to attempt to narrow yield gap by establishing impact of adoption of research emanated production technology on augmenting per hectare yield. The results of 'Frontline Demonstrations' established an increase in soybean productivity by adopting recommended research emanated improved production technology.

The improved technologies have not only registered higher productivity levels but are economically viable. Still there exists a wide gap between the realizable yield levels under farmers' field conditions and the state/national average yield levels. In order to exploit this commercially untapped yield potential, there is an urgent need to assess technological feasibility, economic viability and sustainability of the improved technologies.

It is felt that the publication of this bulletin is relevant and timely. The bulletin contains valuable information on the productivity potentials, profitability and production efficiency of improved technologies under real farm situations.

I appreciate and congratulate the efforts made by authors who have put in commendable efforts in bringing out this publication. The scientists working at various research centers that had contributed in evaluating improved technologies at farmers' fields over the years also deserve my appreciation. I am sure this bulletin would be a valuable source of information for all concerned with soybean research and development in the country.

December 09, 2021

Nita Khandekar,

Acting Director,

ICAR-IISR, Indore

Preface

India has achieved self-sufficiency in food production in the era of Green Revolution but one of the important food ingredients; edible oil could not reach the level of self-sufficiency till yet. Looking to daring need of edible oil, the Govt. of India initiated the work of enhancing the production of oilseeds in a mission mode approach with the inception of Technology Mission on Oilseeds (TMP) in 1986. To give further impetus to this endeavor, the Department of Agriculture and Cooperation under Oilseed Production Programme (OPP) sponsored Frontline Demonstrations in different oilseeds since 1989. The basic objective of this scheme was to demonstrate the latest research emanated production technologies by scientists working under All India Coordinated Research Projects on Soybean under real farm situations. Such demonstrations have bought desirable improvement in area, production and productivity of soybean across the country. Since, the commercial cultivation of soybean, the area and production has been increased tremendously. About 14834 Frontline Demonstrations over 31 years across the country have shown that the Improved Production Technology of soybean under real farm situations can increase about 31 % yield, with monetary benefits of about Rs. 6825/ha and Incremental Benefit: Cost Ratio of 7.07 % over farmers' practice.

Here in this bulletin an effort has been made to summarize the impact of improved production technology in enhancing the productivity of soybean under real farmers' situations and to understand the various trends on yield, cost, returns and production efficiency. This would certainly help us to learn some important lessons related to soybean production, productivity, profitability and sustainability.

It would be most appropriate to acknowledge the guidance and financial assistances provided by the Department of Agriculture and Cooperation, GOI, New Delhi and Indian Council of Agricultural Research, New Delhi without which the scheme could have not been implemented. Our sincere thanks are due to all the soybean workers of All India Coordinated Research Project on Soybean and other agencies who have conducted the demonstrations over the years with great sincerity.

Authors

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List of contributors and PI's/Incharge's of different centers

S. no.	Centers	Contributors	Name of PI's/Incharge's
1.	AICRP-FLD on Soybean, ICAR-Indian Institute of Soybean Research, Indore	Dr. S. D. Billore/Dr. Raghavendra M., Nita Khandekar, Dr B. U. Dupare, Dr. O. P. Joshi	Dr. S. D. Billore/Dr. Raghavendra M
2.	CSK Krishi Vishwa Vidyalaya, Palampur–176 062, Himachal Pradesh	Dr. (Mrs.) Vedna Kumari, Dr. O.P. Sood,	Dr. Vedna Kumari
3.	Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora-263601, Uttarakhand	Dr. Anuradha Bhartiya, Dr Ved Prakash	Dr. Anuradha Bhartiya
4.	Asstt. Agronomist, PAU, Ludhiana-141004, Punjab	Ms. Harpreet Kaur /Dr. Guriqbal Singh, Dr R. S. Jolly	Dr. B.S. Gill
5.	GBPUA&T, Pantnagar, Uttarakhand	Dr. Ajay Kumar Srivastava. Dr S C. Saxena, Dr. A. S. Chandel	Dr. Kamendra Singh
6.	Central Agricultural University, Impal-795004 Manipur	Dr. (Mrs.) Toijam Sunanda Devi	Dr. H. Nanita Devi
7.	School of Agril. Sci. & Rural Development, Nagaland University, Medziphema-797 106, Nagaland	Dr. Engrala Ao	Dr. Amarendra Kumar Singh
8.	IGKVV, Raipur -492 012, Chhattisgarh	Dr. Ram Mohan Savu, Dr. R. Lakpale	Dr. Sunil Kumar Nag
9.	BAU, Ranchi-6, Jharkhand	Dr. A.K. Singh	Dr. Arvind Kumar Singh
10.	Rajendra Agricultural University, Tirhut College of Agriculture, Dholi-843 121, (Muzaffarpur) , Bihar	Dr. Anil Pandey/Dr. Vikram Bharti	Dr. Anil Pandey
11.	RVSKVV, SEHORE-446 001, Madhya Pradesh	Dr. M.D. Vyas, Dr. P.P. Singh	Dr. Ramgiri
12.	Agriculture University, Kota, Borkhera Farm, Baran Road Kota-324001 Rajasthan	Dr. D.S. Meena, Dr. Pratap Singh	Dr. D. S. Meena
13.	MAU, Parbhani-431 402, Maharashtra	Dr. S.P. Mehtre, Dr. P.K. Joshi	Dr. S.P. Mehtre
14.	AICRP on Soybean Dr. PDKV, Regional Research Center, Morshi Road, Amravati-444 603, Maharashtra	Dr. M.S. Dandge	Dr. Satish Nichal

15.	SOPA, Indore, Madhya Pradesh	Shri. Jitendra Singh	Shri. D N Pathak
16.	KVK, Bharuch, Gujarat	Dr. M.M. Patel	Dr. M.M. Patel
17.	KVK, Karda-444506, Maharashtra	Dr. Ravindra Kale	Dr. Ravindra Kale
18.	Tribal Research Cum Training Center, Anand Agricultural University, Devgadh Baria – 389 380, DIST : Dahod (Gujarat)	Dr. G.J. Patel	Dr. G. J. Patel
19.	SOLIDARIDAD, Bhopal, Madhya Pradesh	Dr. Suresh Motwani/ Shri Hasan	Dr. Suresh Motwani
20.	PJTSAU - Agricultural Research Station, Adilabad, Telangana State	Dr. C. Sreedhar	Dr. Sreedhar Chauhan
21.	University of Agricultural Sciences, Dharwad-580 005, Karnataka	Dr. Somanagoude, Dr. Sangashetty, Dr. V. V. Angadi,	Dr. G. T. Basavaraja
22.	R & D Unit, The Ugar Sugar Woks Ltd., Ugar-khurd, Karnataka-591316	Mr. Jagadish S. Patwardhan, Dr. J. Kulkarni	Mr. Jagadish S. Patwardhan
23.	MPKV, Agricultural Research Station, Mahatma Phule Krishi Vidyapeeth, K. Digraj-416305 Distt. Sangli (M.S.)	Dr. Dilip Kathmale	Dr. D. K. Kathmale
24.	TNAU Coimbatore	Dr. Sanbagavalli, Dr. K Vaiyapuri	Dr. R. Sudhagar
25.	JNKVV Jabalpur	Dr A. N. Srivastava	Dr. M. K. Shrivastava
26.	Srijan Rajasthan	Dr. R. Sudhagar	Dr. Padam Jain
27.	SRIJAN, Bundi	Shri Shovik Dhar, Dr. Padam Jain	
28.	UAS, GKVK, Bengaluru 560065, Karnataka	Dr. M. Chandrappa,	
29.	Agriculture Research Institute, Agharkar Road, Pune 411 004, Maharashtra	Dr. S. Jaybhay, Dr. G. B.Halvankar	
30.	ITC, Bhopal	Shri Rakesh Mohan Rawat	
31.	Lam	Dr. Pramila Rani	

1. Introduction

Agriculture continues to be the backbone of Indian economy in 21st century. About 55% of the population depends on agriculture for livelihood and it accounts for about 60% of gross domestic product. Place of oilseeds is next to cereals in acreage, production and value. In terms of vegetable oils, India is the third largest oil economy in the world, next to USA and China. Oilseed cultivation is undertaken across the country in two seasons in about 26 million ha, mainly marginal lands, dependent on monsoon rains (rainfed) and with low levels of input usage. Yields are low about 1 ton/ha. Of the nine major oilseed crops of India, three oilseeds (groundnut, soybean and rapeseed/mustard), together contribute major share to aggregate cultivated oilseeds output.

The diverse agro-climatic conditions of the country are ideal to support the cultivation of different oilseeds. Out of nine oilseeds grown, 7 (groundnut, rapeseed and mustard, soybean, sesame, niger, sunflower and safflower) generate edible while 2 (castor and linseed) produce non-edible oil. In addition to these, the traditional i.e. coconut and oil palm, and non- traditional (Neem, Mahua, etc.) oil yielding trees are also in cultivation in India.

The thoughtful conceptualization and implementation of oilseed promotion programme with mission mode approach under "Technology Mission on Oilseeds (TMO)" in 1986 by the Government of India led to doubling the production during nineties (Table 1.1) despite of the fact that production growth rate had been substantially negative during 1997-98, 1999-2000 and 2000-01. The concerted efforts made under TMO paid off in terms of gradual increase in the area under oilseed crops. The average yield of oilseeds has registered remarkable improvement from 481 to 1270 kg/ha during 1950-51 to 2017-18. The change in production, in general, was mainly through the pathway of change in yield as a result of change in area. While the production of oilseeds has risen over the years, it has not been able to keep pace with the domestic demand for edible oils.

Looking into the regional dimensions of oilseed production in India (Table 1.1), Madhya Pradesh, Andhra Pradesh, Gujarat, Maharashtra, Karnataka and Tamilnadu emerged as major oilseed growing and producing states in the country. Soybean has made great strides in area and production after commercial cultivation started (Table 1.1.) and achieved a very coveted place, ranking first in area during 2005 and onwards. The total share of soybean in area and production to total oilseeds is 0.17 to 57.74 % and 0.10 to 61.84%, respectively during 1970-71-2017-18. The growth of soybean has been phenomenal since 1980. The area and production of soybean has increased by 348 and 1097%, respectively. Ironically the improvement in productivity of soybean (2.18%) could not follow the trend exhibited by area and production. The production of soybean remained raising at increasing rate till 1970-71 owing to increase in the yield and area.

Indian vegetable oil industries comprise over 15,000 oil mills, 600 solvent extraction units, 400 refining units and 230 vanaspati (hydrogenated oils) units, employing directly and indirectly over one million people across the country. The consistent increase in percent share of soybean in past few years underlines its potentials in supplementing edible oil in the country.

Soybean has experienced phenomenal growth in area and production in India. Area under soybean cultivation has steadily increased over the years from the level of 3000 ha in 1970. Agricultural feasibility and economic viability of soybean as sole as well as in cropping systems has been established. Soybean has emerged as the second important oilseed crop in India next only to groundnut. In addition, it led to improvement in economy and socio-economic status of growers, particularly in the state of Madhya Pradesh.

Table 1.1 Area, production and productivity of nine annual oilseeds in India

Year	Nine oilseeds			Soybean		
	Area (mha)	Production (mt)	Productivity (kg/ha)	Area (mha)	Production (mt)	Productivity (kg/ha)
1950-51	10.73	5.16	481	-	-	-
1951-52	11.69	5.03	430	-	-	-
1952-53	11.18	4.73	424	-	-	-
1953-54	10.99	5.37	488	-	-	-
1954-55	12.52	6.40	511	-	-	-
1955-56	12.09	5.73	474	-	-	-
1956-57	12.49	6.36	509	-	-	-
1957-58	12.66	6.35	502	-	-	-
1958-59	13.00	7.30	561	-	-	-
1959-60	13.95	6.56	470	-	-	-
1960-61	13.77	6.98	507	-	-	-
1961-62	14.77	7.28	493	-	-	-
1962-63	15.34	7.39	482	-	-	-
1963-64	14.82	7.13	481	-	-	-
1964-65	15.26	8.56	561	-	-	-
1965-66	15.25	6.40	419	-	-	-
1966-67	15.00	6.43	428	-	-	-
1967-68	15.67	8.30	530	-	-	-
1968-69	14.47	6.85	473	-	-	-
1969-70	14.81	7.73	522	-	-	-
1970-71	16.64	9.63	579	0.03 (0.18)	0.01 (0.10)	426
1971-72	17.27	9.08	526	0.03 (0.17)	0.01 (0.11)	426
1972-73	15.79	7.14	452	0.03 (0.19)	0.03 (0.19)	819
1973-74	16.90	9.39	555	0.05 (0.29)	0.04 (0.42)	829
1974-75	17.31	9.15	529	0.07 (0.40)	0.05 (0.55)	768
1975-76	16.92	10.61	627	0.09 (0.53)	0.09 (0.85)	975
1976-77	16.47	8.43	512	0.13 (0.79)	0.12 (1.42)	988
1977-78	17.17	9.66	563	0.20 (1.16)	0.18 (1.86)	940
1978-79	17.71	10.10	570	0.31 (1.75)	0.30 (2.97)	975
1979-80	16.94	8.74	516	0.50 (2.95)	0.28 (3.20)	568
1980-81	17.60	9.37	532	0.61 (3.46)	0.44 (4.69)	728
1981-82	18.91	12.08	639	0.48 (2.54)	0.35 (2.90)	741
1982-83	17.76	10.00	563	0.77 (4.33)	0.49 (4.90)	637
1983-84	18.69	12.69	679	0.84 (4.49)	0.61 (4.80)	735
1984-85	18.92	12.95	684	1.24 (6.55)	0.95 (70.33)	768
1985-86	19.02	10.83	570	1.34 (7.04)	1.02 (9.42)	764
1986-87	18.63	11.27	605	1.53 (8.21)	0.89 (7.89)	584
1987-88	20.13	12.65	629	1.54 (7.65)	0.90 (7.11)	582
1988-89	21.90	18.03	824	1.73 (7.90)	1.55 (8.60)	892
1989-90	22.80	16.92	742	2.25 (9.87)	1.81 (10.70)	801

1990-91	24.15	18.61	771	2.56 (10.60)	2.60 (13.97)	1015
1991-92	25.89	18.60	719	3.18 (12.28)	2.49 (13.39)	782
1992-93	25.24	20.11	797	3.79 (15.01)	3.39 (16.86)	894
1993-94	26.90	21.50	799	4.37 (16.24)	4.75 (22.09)	1086
1994-95	25.30	21.34	843	4.32 (17.08)	3.93 (18.42)	911
1995-96	25.96	22.11	851	5.04 (19.41)	5.10 (23.07)	1012
1996-97	26.31	24.38	927	5.44 (20.68)	5.38 (22.06)	989
1997-98	26.09	21.32	817	5.99 (22.96)	6.46 (30.30)	1079
1998-99	26.20	24.75	945	6.49 (24.77)	7.14 (28.85)	1100
1999-00	24.26	20.71	854	6.22 (25.64)	7.08 (34.19)	1138
2000-01	22.77	18.44	810	6.42 (28.19)	5.28 (28.63)	823
2001-02	22.64	20.66	913	6.34 (28.00)	5.96 (28.85)	940
2002-03	21.49	14.84	691	6.11 (28.43)	4.65 (31.33)	762
2003-04	23.66	25.19	1064	6.55 (27.68)	7.82 (31.04)	1193
2004-05	27.52	24.35	885	7.57 (27.51)	6.87 (28.21)	908
2005-06	27.86	27.98	1004	7.71 (27.67)	8.27 (29.55)	1073
2006-07	26.51	24.29	916	8.33 (31.42)	8.85 (36.43)	1063
2007-08	26.69	29.76	1115	8.88 (33.27)	10.97 (36.86)	1235
2008-09	27.56	27.72	1006	9.51 (34.50)	9.91 (35.75)	1041
2009-10	25.96	24.88	958	9.73 (37.48)	9.96 (40.03)	1024
2010-11	27.22	32.48	1193	9.60 (35.27)	12.74 (39.22)	1327
2011-12	26.31	29.80	1133	10.11 (38.43)	12.21 (40.97)	1208
2012-13	26.48	30.94	1168	10.84 (40.94)	14.67 (47.41)	1353
2013-14	28.05	32.75	1168	11.72 (41.78)	11.86 (36.21)	1012
2014-15	25.60	27.51	1075	10.91 (42.62)	10.37 (37.70)	951
2015-16	26.09	25.25	968	11.60 (57.74)	8.57 (33.94)	738
2016-17	26.18	31.28	1195	11.18 (42.70)	13.16 (61.84)	1177
2017-18*	24.65	31.31	1270	10.47 (42.47)	10.98 (35.07)	1049
2018-19	24.79	31.52	1271	11.13(44.90)	13.67 (43.37)	1228
2019-20	27.14	33.22	1224	12.19 (44.92)	11.22 (33.77)	920
2020-21	25.25	39.28	1556	13.41 (53.11)	14.67 (37.35)	1040

Source: Directorate of Economics & Statistics, DAC&FW
Data in parenthesis is percentage to total oilseeds.

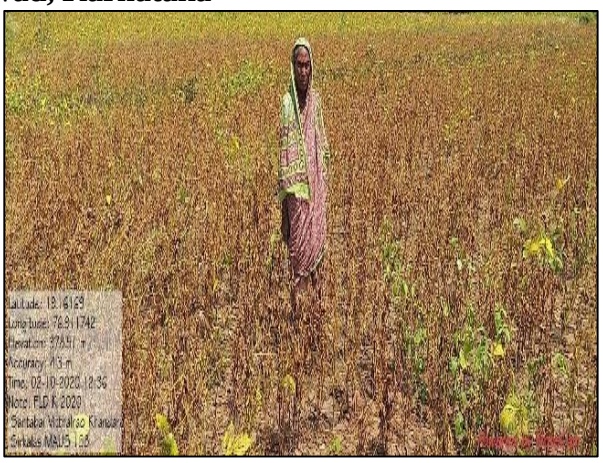
The average yield in China is around 1.78 t/ha, while it was about 3.3 t/ha in the USA, 3.16 t/ha in Brazil and 2.99 t/ha in Argentina during 2017-18. The average national productivity of India is hovering around 1.0 t/ha. It is not fair to compare the yield of India with that of above countries, as the comparisons across latitudes need adjustment for duration. Comparison of per day productivity revealed that against 11 kg/ha/day in India, the productivity of USA and China is about 15 kg and that of Brazil and Argentina is 19 kg/ha/day. However, the system efficiency in India is much higher as wheat or chickpea normally succeeds soybean. We have to target an average per day productivity of above 15 kg ha/day and desirably 20 kg/ha/day as national average. If we adjust this average for crop duration for our country, it makes a target of about 1.6 to 1.8 t/ha, which should be achievable by all means (Tiwari et al. 2001).

As the potentials for raising productivity of oilseeds substantially exists, extremely sincere efforts by all the players is needed to bridge the gap between vegetable edible oil production and consumption in the country. This will help in reducing the import of edible oils to meet the demand of the Indian population. The past experience has revealed that promoting horizontal and vertical growth in the soybean crop can help supplementing edible oil need reasonably limiting the exchequer on import. This could be very well done through disseminating the improved soybean production technology to farmers and educating them on intricacies of cultivation. On farm demonstration of the impact of improved technology (IT) by the scientists themselves at the farmers' field has been yielding desirable result. With these views the concept of conducting Frontline Demonstrations (FLDs) on soybean came into existence.

2. Genesis of frontline demonstrations

On Farm Research in Annual Oilseed crops was initiated during 1988-89 under the financial support of the Department of Agriculture and Cooperation, (DAC), Govt. of India through ICAR research system with the existing staff. In soybean, the scientists initiated the Front Line Demonstration under different agro-climatic conditions of the country in 1989-90 onwards. The scheme amply provides opportunities to the researchers of AICRP on Soybean for the dissemination/evaluation of improved production technologies under real farm conditions and provides feedback for further refinement of the developed technologies.

FLDs at UAS Dharwad, Karnataka



FLDs at Parbhani, Maharashtra

FLDs at ICAR-IISR, Indore, Madhya Pradesh

3. Objectives of frontline demonstrations

The primary objective of the project is to demonstrate under real farm situations the productivity potentials and profitability of the latest improved soybean production technologies including newly released/identified/notified varieties, seed treatment, balanced fertilizer application, herbicide application, plant protection chemicals and timely harvesting etc., recommended for various agro-ecological zones vis-à-vis prevailing farmer's practices.

FLDs at Imphal, Meghalaya

FLDs at Pantnagar, Uttarakhand

4. Agro-ecological sub-zones for cooperating centers organizing FLDs

S. No.	Eco-regions	AICRP Soybean Centers
1.	Central highlands, Gujarat plains, Kathiawar, Peninsula	**Indore and Kota**
2.	Deccan plateau- Hot semi-arid	**Parbhani**
3.	Deccan plateau- Hot semi-arid	**Pune and Dharwad**
4.	Hot semi humid-Eastern ghats, Tamilnadu uplands and Deccan plains	**Coimbatore**
5.	Hot semi humid-Eastern ghats, Tamilnadu uplands and Deccan plains	**Bangalore**
6.	Northern plains-hot sub-humid	**Pantnagar and Ludhiana**
7.	Central highlands (Malwa, Bundelkhand and eastern Satpura range)-hot, sub humid (dry/moist)	**Sehore and Jabalpur**
8.	Chhattisgarh, Mahanadi basin	**Raipur**
9.	Hot, sub humid- Eastern (Chhotanagpur) plateau and Eastern Ghats (J2Cd5)	**Ranchi**
10.	Warm per-humid ecoregion with brown and red hill soils (D2A9)	**Medziphema**
11.	Warm per-humid ecoregion with brown and red hill soils (D3A10)	**Imphal**
12.	Hot sub-humid (moist) ecoregion with alluvium-derived soils (A15Cd)	**Almora**
13.	Hot semi-arid ecoregion with medium and deep black soils (K5Dm4)	**Amravati**
14.	ecoregion with medium and deep black soils (K4Dd3)	**Sangli**
15.	hot semi-arid ecoregion with alluvium-derived soils (L4Dd3)	**Lokbharti**
16.	Hot semi-arid ecoregion with alluvium-derived soils (L4Dd3)	**Bundi**
17.	Hot semi-arid ecoregion with shallow and medium (dominant) black soils (K6Dm4)	**Hyderabad**
18.	Hot sub-humid ecoregion with red and lateritic soils (O8Cd)	**Dholi**

The detailed agro-ecological sub-zones for cooperative centers are presented in *Annexure IV*.

5. Methodology

5.1. Feature/Norms: The following are the norms of the project formulated for its successful implementation.

- Planning and implementation including release of funds to cooperating centers, monitoring, reviewing and evaluation of the project to be done by the Director, NRC for Soybean/ DSR/IISR, Indore.
- The selected AICRP on Soybean centers and other agencies shall conduct the demonstrations. The numbers of demonstrations to be conducted by each of the selected centers are decided in the Annual Workshop of AICRP on Soybean.
- The agronomist/in-charge of the center is responsible for organizing demonstrations.
- The existing staff at cooperating center is to be utilized for organizing the demonstrations and no separate staff, either scientific or technical, is provided for this purpose.
- The demonstrations are laid out in cluster approach preferably within a radius of 30 to 50 km from the concerned research center.
- The cluster of the villages selected for demonstrations shall change every year with a provision that no farmer shall benefit from the programme for more than one year.
- The location of the village and site of the demonstration shall be easily approachable, preferably on the main roadside in order to help organize "Field /Farmers day" and training programmes etc., effectively.
- Invariably in all the demonstrations, the size of Improved Technology plots is proposed as0.4 ha. In case of farmers practice, the adjoining field under similar crop growing would serve as check for the purpose of data recording.
- Only released/identified/notified and recommended varieties/technologies are used in the demonstrations. Pre-released varieties/technologies shall not be used in demonstrations.
- The expenditure on all major inputs such as seed, fertilizer, and plant protection chemicals etc., in respect of demonstrations (IT) plot is completely borne from the funds available in the project. Whereas expenditure on preparation of field, inter-cultivation operations, manual weeding, harvesting and threshing in respect of demonstration plot and the entire cost of cultivation in respect of control plot are borne by the farmer himself.
- A set of literature describing the details of improved production technology in easily understandable local language is made available to the farmers.
- All important and crucial operations are carried out under the personal supervision of the concerned scientist.
- A team of scientists comprising of plant breeder, agronomist, entomologist and plant pathologist visits these demonstrations two to three times during crop season. They assess the overall impact of IT and critically examine the qualitative and quantitative constraints to use them as feedback for further refinement of the technologies.
- These demonstrations are utilized as a tool for rapid dissemination of the technology. In order to achieve this objective, "Field/Farmers day" are organized by the cooperating centers.
- The cooperating centers shall submit preliminary, mid-season, follows up action and final technical reports to the Director, NRC for Soybean, Indore in the proforma designed by the Director and supplied to the centers.
- The data obtained from the centers shall be compiled and submitted by the Director to the Council for onward transmission to the Technology Mission on Oilseeds and Pulses.

5.2. Data Collection

The primary data were collected from over 14834 demonstrations conducted on farmers' fields over 31 years (from 1989 to 2019) under the guidance of scientist of various research centers of All India Coordinated Research Project on Soybean (AICRPS) in soybean crop under the project on" Frontline Demonstrations in Soybean", which is centrally sponsored Oilseed programme.

State	Center(s)
Madhya Pradesh (10)	1. ICAR-IISR, Indore*; 2. JNKVV, Jabalpur; 3. RVSKVV, Sehore; 4. SOPA, Indore; 5. NICT, Indore; 6. ITC, Bhopal; 7. Solidaridad, Bhopal; 8. HFCL, 9. COOIT, Delhi and 10. SPS, Bagli
Maharashtra (5)	1. ARI, Pune; 2. MAU, Parbhani; 3. PDKVV, Amravati; 4. MPKV, Sangli and 5. KVK, Karda
Rajasthan (3)	1. MPUA&T, Kota; 2. SRIJAN, Bundi and 3. ITC, Bhopal
Chhattisgarh (1)	1. IGKVV, Raipur
Karnataka (3)	1. UAS Dharwad; 2. UAS, Bangalore and 3. Ugarkhurd
Telangana (1)	1. PJTSAU, Adilabad
Andhra Pradesh (2)	1. APAU, Lam and 2. CRIDA, Hyderabad
Gujrat (3)	1. AAU, Devgarbaria ; 2. KVK, Bharuch and 3. Lokbharti, Bhavnagar
Uttarakhand (2)	1. GBPUA & T, Pantnagar and 2. VPKAS, Almora
Himachal Pradesh (1)	HPKVV, Palampur
Punjab (1)	PAU, Ludhiana
Manipur (1)	CAU, Imphal
Nagaland (1)	Nagaland University, Medziphema
Jharkhand (1)	RAU, Ranchi
Bihar (1)	RAU, Dholi
Tamilnadu (1)	TNAU, Coimbatore

5.3. Data analysis

All the collected primary data center-wise, state-wise and at national level were subjected to following analyses.

5.3.1. Standard deviation (SD)

It indicates a sort of group standard spread of values around their mean. The SD was computed as follows.

$$\sigma = \sqrt{\frac{\sum(x_i - \mu)^2}{N}}$$

5.3.2. A relative measure of dispersion/ coefficient of variation (CV)

It indicates the variability in different characteristics under study. The coefficient of variation is given by:

CV= (SD/Mean)/100

5.3.3. Economical parameters

The economics of improved technology in relation to prevailing farmer's practices was studied taking into consideration of prevailing costs of inputs and prices of output in respective years and areas. The superiority of IT over FP was assessed mainly in terms of yield increments, additional returns from IT over FP and incremental benefit cost ratio (IBCR). The IBCR was computed as follows:

IBCR = Additional gross returns obtained from IT over FP/ Additional costs incurred towards IT over FP

5.3.4. Trend analysis

The response trends of demonstrations on various parameters under study over the years were analyzed by fitting the regression line. The linear growth equation was computed as follows:

Y = a + bt

(Where, Y = parameters, a= intercept, b = slope/ per unit change, t = number of years).

5.3.5. Linear growth rate (LGR)

It was calculated as: LGR (%) = b/mean x 100 where, b= slope.

5.3.5. Sustainability yield index (SYI) or Sustainable value index (SVI)

It compared the deviation of treatment mean and the overall standard deviation (SD) over the n years with the maximum attained yield or value (Y max.) to arrive at sustainable index (Singh et al. 1990). It was computed as follows:

SYI = mean yield – SD/ maximum attained yield

5.3.6. Yield gap II analysis

Yield gap II is the difference between Yield in IT and yield in FP.

5.3.7. Production efficiency

Production efficiency is the per rupee production of soybean.

6. Results

A total of 14834 Frontline demonstrations were conducted during the past 31 years across the country to demonstrate the superiority of improved production practices (IP) over farmers' practice (FP). It is evident from the results that the highest soybean yield (1991 kg/ha) could be achieved under IP in the year 1991 which varied from 1540 to 1991 kg/ha with an average of 1771 kg/ha (Table 6.1). These corresponding values under FP were 1540 kg/ha in 1996 (1110 – 1540 kg/ha) with an average of 1356 kg/ha. The yield reduction in IP over the years was to the 0.0256 kg/annum. However, the yield in FP showed a positive increase over the years as evidenced from slope and linear growth rate (LGR). The overall yield improvement in soybean yield was 20.95 and 45.14% under IP and FP over the years. The improved practice showed lower yield variation over the years as compared to FP as evident from coefficient of variation values. However, the standard deviation value was lower under FP than IP. Sustainable yield index (SYI) indicated that the IT was more sustainable than FP. The major concern is that the data accrued over 31 years showed that the yield levels are stagnant in between 1700 to 1900 kg/h under IP and similarly 1300 to 1400 kg/ha under FP even after using the new improved varieties of soybean under IP. There is a need to concentrate on breaking the yield barriers in soybean production.

The average cost of cultivation under both the conditions (IP and FP), were linearly increased over the years. The cultivation cost varies from 3000 to 30065/ha with the average of Rs. 12461/ha under IP while in case of FP, it ranged from Rs. 2182 to 25931 with the average of Rs. 10219/ha (Table 6.1). Soybean cultivation cost significantly increased by 902.17 and 1088.41% under IP and FP over the last 31 years. The cultivation cost under FP showed higher variation under FP than IP (CV values) while the FP possesses lower SD values. The expenditure on inputs depends on the income incurred from the previous crop may be the reason for the higher variation under FP. The gross income from soybean varies from Rs. 4101 to 67688/ha with an average of Rs. 31499/ha under IP and these values under FP ranged from Rs. 2700 to 50141/ha with an average of Rs. 24136/ha. The variation in gross income from soybean over years and sustainable value index (SVI) remained more or less similar under both IP and FP. Similarly, net income from soybean varied from Rs. 1101 to 37629/ha with an average of Rs. 19144/ha. However, under FP, these values were Rs. 552 to 27740/ha with the average of Rs. 14108/ha. A substantial improvement in gross and net returns was recorded to the tune of 1550.50 and 1733.98% under IP and FP. The variation under net income was higher under IP as compared to FP. The FP showed higher sustainability value index than FP. Gross returns in IP and cultivation cost and net returns indicated a positive growth rate over the years. This might be due to the increase in selling price of soybean. Improved practices showed marginally higher B:C ratio than FP. However, the variation under IP was found to be lower than FP. The marginal differences under both the production practices might be due to proportional differences in their yield and cost of cultivation. The B:C ratio declined over the years under both the production systems.

The yield gap II data revealed that the yield gap II substantially reduced during the initial years and further it varies between 300 to 500 kg/ha (Table 6.2) and also evidenced from slope and LGR. The maximum (1050 kg/ha) and minimum (280 kg/ha) yield gap II was recorded in 1989 and 2003. The average yield gap II was 434 kg/ha with the 31.63% variation over the years. The variation might be

due to the soybean is a rainfed crop and variation in crop management practices under FP. The adaptation of IP for soybean production enhanced the yield to the tune of 30.95% (50.00 to 19.39 %) over the years and showed 22.18% variation over the years. The on an average additional cost was Rs. 2329/ha (Rs. 801 to 4224/ha) resulted in net additional returns of Rs. 6825/ha (Rs. 2586 to 15062/ha). The incremental cost benefit ratio (IBCR) was found to be Rs. 1:4.28 and with the variation values of 165.34%. The soybean production efficiency varied from 555 to 58 g/Rs with the average of 216 g/Rs under IP, while these values under FP were 545 to 51 g/Rs with an average of 214 g/Rs. The difference between IP and FP was found to marginal. The variation over the period under both the practices was found to more or less similar. The soybean production efficiency substantially decreased over the period under both the practices. The decrease in production efficiency may be due to the appreciable enhancement in the cultivation cost and the productivity remained more or less constant over the years. The additional cost and IBCR was linearly increased over the years while the additional returns declined. The production efficiency showed declined trend over the years.

Table 6.1 Frontline Demonstrations on whole package of soybean production technology in India during 1989 to 2019.

Year	Demonstrations (14834)	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
		IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
1989	167	1665	1110	4101	2734	3000	2182	1101	552	1.37	1.25
1990	153	1921	1283	10991	7341	3475	2356	7516	4985	3.16	3.12
1991	134	1991	1448	18606	13531	4139	3174	14467	10357	4.5	4.26
1992	227	1925	1427	13532	10031	4961	3812	8571	6219	2.73	2.63
1993	210	1854	1407	15273	11591	5626	4001	9647	7590	2.71	2.9
1994	218	1810	1360	16684	12536	5836	4396	10848	8140	2.86	2.85
1995	220	1830	1380	16204	12219	5907	4248	10297	7971	2.74	2.88
1996	187	1890	1540	26156	21312	6583	5026	19573	16286	3.97	4.24
1997	186	1852	1409	19323	14701	7006	5170	12317	9531	2.76	2.84
1998	186	1736	1245	17084	12252	7294	5342	9790	6910	2.34	2.29
1999	134	1736	1292	15929	11855	6891	5035	9038	6820	2.31	2.35
2000	191	1540	1191	16980	13132	8321	5939	8659	7193	2.04	2.21
2001	210	1769	1420	23240	18655	7412	5717	15828	12938	3.14	3.26
2002	218	1646	1299	23068	18205	7471	5815	15597	12390	3.09	3.13
2003	309	1724	1444	33008	27647	7656	5849	25352	21798	4.31	4.73
2004	301	1744	1341	18790	14448	8443	6579	10347	7869	2.23	2.20
2005	372	1693	1344	20068	15661	8776	6760	11292	8901	2.34	2.39
2006	690	1765	1427	23329	18424	9594	7612	13735	10919	2.43	2.42

Year	Demonstrations (14834)	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
		IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
2007	572	1865	1469	27544	21701	10570	8704	16939	12828	2.61	2.49
2008	748	1702	1302	30069	22933	11570	9295	18504	13645	2.60	2.47
2009	468	1744	1320	37340	30800	12637	9742	24678	17191	2.95	3.16
2010	398	1688	1307	36335	27752	10752	10549	22941	17073	3.38	2.63
2011	718	1813	1438	40238	31067	15672	12992	23851	18502	2.75	2.67
2012	755	1881	1469	52276	43403	19902	16329	36596	27740	2.97	2.81
2013	660	1661	1299	55601	43022	23015	19129	32634	24069	2.42	2.25
2014	714	1778	1359	56539	42129	24640	21070	33698	22685	2.24	1.99
2015	1126	1484	1061	52085	37027	24226	20002	27859	17026	2.00	1.74
2016	1103	1854	1480	61610	47192	27522	23878	34933	25279	2.19	2.00
2017	1132	1772	1388	60400	45579	28121	24671	32015	22361	1.94	1.72
2018	1147	1831	1451	66377	50141	29216	25498	37207	26545	2.09	1.88
2019	980	1738	1321	67688	49202	30065	25931	37629	25024	2.07	1.78
Mean		**1771**	**1356**	**31499**	**24136**	**12461**	**10219**	**19144**	**14108**	**2.69**	**2.63**
SD		**109.57**	**106.33**	**18437.57**	**14021.58**	**8590.21**	**7647.71**	**10548.63**	**7417.33**	**0.68**	**0.76**
CV (%)		**6.19**	**7.84**	**58.53**	**58.09**	**68.94**	**74.83**	**55.1**	**52.58**	**25.39**	**29.07**
SYI/SVI		**0.83**	**0.81**	**0.19**	**0.2**	**-**	**-**	**0.18**	**0.25**	**-**	**-**
b		**-0.0256**	**0.04006**	**0.0167**	**-0.0007**	**0.0005**	**2.3473**	**1.3139**	**0.9877**	**-4572.48**	**-2047.42**
LGR (%)		**-0.0014**	**0.003**	**0.0000531**	**-0.000003**	**0.0000042**	**0.023**	**0.0069**	**0.007**	**-170296**	**-77828.1**

Table 6.2 Frontline Demonstrations of whole package on soybean production technologies in India during 1989 to 2019.

Year	Demonstrations (14834)	Yield gap (kg/ha)	% increase	Additional cost (Rs/ha)	Additional returns (Rs/ha)	IBCR	Production efficiency (g/Rs)	
							IP	FP
1989	167	1050	50.00	801	2586	3.55	555	509
1990	153	679	49.73	1287	3885	3.21	553	545
1991	134	545	37.50	1110	5093	4.6	481	456
1992	227	506	34.90	1149	3557	3.61	388	374
1993	210	492	31.77	1623	4053	2.86	330	352
1994	218	450	33.09	1485	4148	3.4	310	309
1995	220	454	32.61	1660	4020	2.95	310	325
1996	187	323	22.73	1614	4470	3.06	287	306
1997	186	443	31.44	1829	4622	2.76	264	273
1998	186	491	39.44	1952	4832	2.84	238	233
1999	134	444	34.37	1836	4074	2.51	252	257
2000	191	349	29.30	2195	3848	2.47	185	201
2001	210	349	24.58	1701	4585	2.62	239	248
2002	218	347	26.71	1778	4863	2.67	220	223
2003	309	280	19.39	1938	5361	2.85	225	247
2004	301	403	30.05	1977	4342	2.38	207	204
2005	372	349	25.97	4169	4323	2.34	193	199
2006	690	338	23.69	1982	4905	2.47	184	187
2207	572	396	26.96	1866	5843	3.13	176	169
2208	748	400	30.72	2275	7136	3.14	147	140
2009	468	424	32.12	2895	6540	2.26	138	135
2010	398	381	29.15	203	8583	42.28	157	124
2011	718	375	26.08	2680	5349	2.00	116	111
2012	755	412	28.05	3573	11693	3.27	95	90
2013	660	362	27.87	3886	12118	3.12	72	68
2014	714	419	30.83	3570	12043	3.37	72	64
2015	1126	423	39.87	4224	11805	2.79	61	53
2016	1103	374	25.27	3644	12615	3.46	67	62
2017	1132	384	27.67	3450	10696	3.10	63	56
2018	1147	380	26.19	3718	14515	3.90	63	57
2019	980	417	31.57	4134	15062	3.64	58	51
Mean		**434**	**30.95**	**2329**	**6825**	**4.28**	**216**	**214**
SD		**137.14**	**6.87**	**1096.35**	**3681.40**	**7.07**	**137.98**	**136.05**
CV (%)		**31.63**	**22.18**	**47.07**	**53.94**	**165.34**	**63.79**	**63.63**
b		**-2.9941**	**-0.6221**	**4.5860**	**-5.2E-05**	**9.34E-05**	**-19.709**	**-0.0055**
LGR (%)		**-0.6907**	**-2.0099**	**0.1969**	**-7.6E-07**	**0.0022**	**-9.1116**	**-0.0026**

6.1.1. India-Balanced nutrition

A total of 243 front line demonstrations on balance nutrition were conducted during 2006 to 2010 at different center (Table 6.3). The yield varied from 1558 to 1858 kg/ha with the average of 1742 kg/ha under balanced nutrition of soybean and these values under FP were 1210 to 1480 with an average of 1360 kg/ha. The difference in yield levels might be due to skewed application of nutrients under FP. The application of balanced nutrients showed higher SYI than FP. However, the higher variation in gross returns was recorded under IP, while just reverse the case with net returns and cultivation cost under FP. The economic benefits of balance nutrition also noticed from the values of sustainable value index (SVI). The benefit cost ratio was found to more or less similar values under both the production practices. However, the IP showed lesser variation over the years as compared to FP. The yield gap II ranged from 348 to 414 kg/ha with an average of 243 kg/ha (Table 6.4). The use of balanced nutrients in soybean crop substantially enhanced the productivity of soybean to the tune of 28.16% over the years as compared to FP. The additional expenditure of Rs. 1650/ha on balanced nutrition resulted in 29.58 and 31.59% higher gross and net returns from the soybean as compared to FP. The use of balanced fertilizers showed higher IBCR over FP. The production efficiency of both the production practices were more or less similar. However, the variation in production efficiency over the years was found to be lesser under IP as compared to FP.

Table 6.3 Frontline Demonstrations of balanced nutrition on soybean in India during 2006 to 2010.

Year	Demonstrations (243)	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
		IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
2006	16	1858	1480	23741	18645	8522	6682	15219	11076	2.79	2.79
2007	40	1850	1481	26636	21309	8347	6765	18355	14544	3.19	3.15
2008	57	1746	1332	30154	23228	8277	6694	22003	16534	3.64	3.47
2009	64	1700	1295	36713	27797	6026	4128	30588	23669	6.09	6.73
2010	66	1558	1210	34161	25861	5837	4489	27435	20508	5.85	5.76
Mean		**1742**	**1360**	**30281**	**23368**	**7402**	**5752**	**22720**	**17266**	**4.09**	**4.06**
SD		**123.24**	**118.90**	**5303.27**	**3619.29**	**1346.82**	**1323.91**	**6323.94**	**4943.94**	**1.55**	**1.75**
CV (%)		**7.07**	**8.75**	**17.51**	**15.49**	**18.20**	**23.02**	**27.83**	**28.63**	**37.82**	**43.19**
SYI/SVI		**0.87**	**0.84**	**0.68**	**0.71**	**-**	**0.65**	**0.54**	**-**	**-**	**-**

Table 6.4 Frontline Demonstrations of balanced nutrition on soybean in India during 2006 to 2010

Year	Demonstrations (243)	Yield gap (kg/ha)	% increase	Additional cost (Rs/ha)	Additional returns (Rs/ha)	IBCR	Production efficiency (g/Rs)	
							IP	FP
2006	16	378	25.54	1840	5096	2.77	218	221
2007	40	369	24.92	1582	5327	3.37	222	219
2008	57	414	31.08	1583	6926	4.38	211	199
2009	64	405	31.27	1898	8916	4.70	282	314
2010	66	348	28.76	1348	8300	6.16	267	270
Mean		**383**	**28.16**	**1650**	**6913**	**4.19**	**235**	**236**
SD		**26.88**	**2.99**	**222.44**	**1714.12**	**1.31**	**32.26**	**46.56**
CV (%)		**7.02**	**10.63**	**13.48**	**24.80**	**31.17**	**13.70**	**19.70**

6.1.2. India- plant protection

A total of 261 front line demonstrations were conducted on plant protection measures of soybean during 2006 to 2010 (Table 6.5). The IP yield varies from 1484 to 1790 kg/ha with an average of 1641 kg/ha and these values were 1205 to 1458 kg/ha with the mean of 1318 kg/ha. The IP yield showed lesser variation over the years and possess higher SYI value than FP. The use of recommended pesticides as per schedule incurred higher cost of cultivation under IP than FP. The higher variation was found with FP. The gross and net returns were appreciably higher under IP with

higher variation over the years than FP. However, the SVI values were found to be more or less identical under both the production systems. Per rupee return was slightly higher with IP with greater variation over years than FP. The yield gap II was noted to be 323 kg/ha (279 to 368 kg/ha) as evidenced from Table 6.6. A total of Rs. 2683.74/ ha had been achieved at the additional cost of Rs. 1550/ha with IBCR of

4.57. The additional returns showed more variation over the years as compared to additional cost.

The production efficiency under FP was higher (3.0%) with higher variation over years than IP.

Table 6.5 Frontline Demonstrations of plant protection on soybean in India during 2006 to 2010.

Year	Demonstrations (261)	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
		IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
2006	32	1760	1448	22805	18244	8919	6934	13887	11587	2.56	2.63
2007	44	1790	1458	25795	20830	8251	6783	17543	14047	3.13	3.07
2008	56	1603	1235	27929	21313	7911	6449	20017	14864	3.53	3.30
2009	64	1568	1242	32593	21275	5788	4164	28167	22429	5.63	5.11
2010	65	1484	1205	32482	25612	5844	4631	25899	19090	5.56	5.53
Mean		**1641**	**1318**	**28321**	**21455**	**7343**	**5792**	**21103**	**16403**	**4.08**	**3.93**
SD		**130.18**	**124.43**	**4258.07**	**2647.37**	**1440.13**	**1295.78**	**5891.21**	**4319.89**	**1.42**	**1.30**
CV (%)		**7.93**	**9.44**	**15.04**	**12.34**	**19.61**	**22.37**	**27.92**	**26.34**	**34.92**	**33.11**
SYI/SVI		**0.84**	**0.82**	**0.74**	**0.73**	**-**	**-**	**0.54**	**0.54**	**-**	**-**

Table 6.6 Frontline Demonstrations of plant protection on soybean in India during 2006 to 2010

Year	Demonstrations (261)	Yield gap (kg/ha)	% increase	Additional cost (Rs/ha)	Additional returns (Rs/ha)	IBCR	Production efficiency (g/Rs)	
							IP	FP
2006	32	312	21.55	1985	4561	2.30	197	209
2007	44	332	22.77	1468	4965	3.38	217	215
2008	56	368	29.80	1462	6616	4.53	203	192
2009	64	326	26.25	1624	11318	6.97	271	298
2010	65	279	23.15	1213	6870	5.66	254	260
Mean		**323**	**24.70**	**1550**	**6866**	**4.57**	**228**	**235**
SD		**32.29**	**3.33**	**284.05**	**2683.73**	**1.84**	**32.48**	**43.64**
CV (%)		**9.99**	**13.49**	**18.32**	**39.09**	**40.26**	**14.22**	**18.59**

6.1.3 India- Soybean improved varieties

A sum of 261 front line demonstrations were conducted at farmer's field on soybean improved varieties during 2006 to 2010 (Table 6.7). The performance of soybean improved varieties ranged from 1221 to 1787 kg/ha with the mean of 1596 kg/ha. The yield under FP varied from 1009 to 1484 kg/ha with an average of 1282 kg/ha. The yield variation under both the production system was found to be more or less similar. However, the improved soybean varieties showed numerically higher sustainability over FP. The average cost of cultivation was Rs. 7136 and 5751/ha under IP and FP which resulted in 26.60 and 25.60% higher gross and net returns over FP. The SVI values remained similar under both the production systems. The yield gap II varied from 212 to 372 kg/ha over the years with the mean of 314 kg/ha which showed that a hike of 24.50% as compared FP (Table 6.8). A sum of additional returns Rs 5898 had been achieved on the additional expenditure of Rs. 1385/ha which resulted in IBCR of Rs. 4.50. The production efficiency was found to be identical under both the production systems. However, FP indicated higher variation over the years.

Table 6.7 Frontline Demonstrations of soybean improved varieties in India during 2006 to 2010.

Year	Demonstrations (261)	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
		IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
2006	26	1699	1345	21844	17052	8013	6151	13390	10901	2.73	2.77
2007	44	1787	1484	25938	21206	8560	7182	17311	14025	3.03	2.95
2008	58	1595	1223	27552	21369	7889	6483	19662	15065	3.49	3.30
2009	63	1677	1349	37241	29373	5617	4462	31624	25554	6.63	6.58
2010	70	1221	1009	27786	21871	5601	4476	22185	17395	4.96	4.89
Mean		**1596**	**1282**	**28072**	**22174**	**7136**	**5751**	**20834**	**16588**	**4.17**	**4.10**
SD		**220.38**	**178.38**	**5651.65**	**4464.79**	**1416.64**	**1227.88**	**6845.57**	**5528.81**	**1.62**	**1.62**
CV (%)		**13.81**	**13.91**	**20.13**	**20.14**	**19.85**	**21.35**	**32.86**	**33.33**	**38.91**	**39.55**
SYI/SVI		**0.77**	**0.74**	**0.60**	**0.60**	**-**	**-**	**0.44**	**0.43**	**-**	**-**

Table 6.8 Frontline Demonstrations of soybean improved varieties in India during 2006 to 2010.

Year	Demonstrations (261)	Yield gap (kg/ha)	% increase	Additional cost (Rs/ha)	Additional returns (Rs/ha)	IBCR	Production efficiency (g/Rs)	
							IP	FP
2006	26	354	26.32	1862	4792	2.57	212	219
2007	44	303	20.42	1378	4732	3.43	209	207
2008	58	372	30.42	1406	6183	4.40	202	189
2009	63	328	24.31	1155	7868	6.81	299	302
2010	70	212	21.01	1125	5915	5.26	218	225
Mean		**314**	**24.50**	**1385**	**5898**	**4.50**	**228**	**228**
SD		**62.62**	**4.10**	**295.18**	**1279.18**	**1.64**	**39.91**	**43.66**
CV (%)		**19.96**	**16.73**	**21.31**	**21.69**	**36.52**	**17.51**	**19.12**

6.1.4 India- Soybean based Intercropping system

A total of 227 frontline demonstrations were conducted under real farm situations on soybean based intercropping (Maize/Pigeonpea) during 2006 to 2010 (Table 6.9). On an average soybean yield of 1725 kg/ha (1677 to 1828 kg/ha) was recorded under intercropping system while under FP, it varied from 1127 to 1303 kg/ha with the mean of 1235 kg/ha. The yield and economic parameters variation over the years was less with IP than FP. The SYI or SVI values were found to be identical under both the production systems. The intercropping system showed the higher values of cost of cultivation (30.11%) and gross (42.08%) and net returns 45.09%) and B:C ratio than FP. The average yield gap was found to be 490 which reflected an increase of 39.93% yield advantage as compared to sole soybean (Table 6.10). An additional expenditure of Rs. 1646/ha resulted in a net gain of Rs. 9230/ha with IBCR of 5.88. The production efficiency was substantially higher under intercropping system than sole soybean with the more or less similar variation over the years.

Table 6.9 Frontline Demonstrations of soybean based intercropping in India during 2006 to 2010.

Year	Demonstrations (227)	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
		IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
2006	28	1691	1127	21905	14801	7497	5358	14146	9443	2.92	2.76
2007	35	1677	1303	25611	19620	7311	5833	18300	13786	3.50	3.36
2008	47	1726	1239	30633	22082	8526	6790	20457	15291	3.59	3.25
2009	64	1702	1252	38753	28024	5863	4634	33675	23897	6.61	6.05
2010	53	1828	1255	38894	25121	6800	5150	31951	19279	5.72	4.88
Mean		**1725**	**1235**	**31159**	**21930**	**7199**	**5553**	**23706**	**16339**	**4.47**	**4.06**
SD		**60.41**	**65.18**	**7651.68**	**5086.78**	**975.50**	**814.49**	**8639.09**	**5498.59**	**1.60**	**1.36**
CV (%)		**3.50**	**5.28**	**24.56**	**23.20**	**13.55**	**14.67**	**36.44**	**33.65**	**35.80**	**33.59**
SYI/SVI		**0.91**	**0.90**	**0.60**	**0.60**	**-**	**-**	**0.45**	**0.45**	**-**	**-**

Table 6.10 Frontline Demonstrations of soybean based intercropping in India during 2006 to 2010

Year	Demonstrations (227)	Yield gap (kg/ha)	% increase	Additional cost (Rs/ha)	Additional returns (Rs/ha)	IBCR	Production efficiency (g/Rs)	
							IP	FP
2006	28	564	28.70	2139	7104	3.32	226	210
2007	35	374	39.31	1478	5991	4.05	229	223
2008	47	487	35.94	1736	8551	4.93	202	182
2009	64	450	45.66	1229	10729	8.73	290	270
2010	53	573	39.93	1650	13773	8.35	269	244
Mean		**490**	**8.33**	**1646**	**9230**	**5.88**	**243**	**226**
SD		**82.81**	**20.86**	**336.63**	**3096.69**	**2.50**	**35.49**	**33.21**
CV (%)		**16.91**		**20.45**	**33.55**	**42.55**	**14.59**	**14.69**

6.2 State wise frontline demonstrations on whole package of soybean during 1989 to 2019

6.2.1 Madhya Pradesh

The cooperating center in Madhya Pradesh, were namely Indore, Sehore, Jabalpur, The Soybean Processors of India (SOPA, Indore, Network of Information and Computer Technology (NICT), Indore, Solidaridad, Bhopal, ITC, Bhopal, Samaj Pragati Sahyog, Bagli and Central organization of Oil Industries and Trade (COOIT), Delhi were conducted a sum of 6709 frontline demonstrations on whole package of soybean production technology under real farm situations (Table 6.11). The center wise data are given in Annexure I and II. The soybean yield varied from 1295 to 1979 kg/ha over the different center with the mean of 1625 kg/ha while these values under FP were 853 to 1612 kg/ha with an average of 1216 kg/ha. The yield variation over the center was higher with FP than IP. Among the different center, the maximum yield was recorded at Indore under both the production systems (1979 and 1465 kg/ha). The improved soybean production practices (IP) clearly showed their superiority with regards to SYI than FP. The cultivation cost substantially increased over the period. The IP showed higher cultivation cost (21.29%) and showed less variation as compare to FP. The economic returns from soybean cultivation also showed increasing trend over the period. The gross and net returns from soybean were to the tune of 28.73 and 33.94% as compared to FP. The variations in gross and net returns were higher under FP than IP. The SVI values showed that the IP was found to be more superior than FP. Per rupee investment in soybean cultivation through IP indicated higher returns as compared to FP. The overall average yield gap II was recorded to be 421 kg/ha which indicated a hike of yield to the extent of 36.48% over FP (Table 6.12). An additional expenditure of Rs. 2330/ha resulted in net gain of Rs. 7040 with IBCR of 4.03. The production efficiency of IP was also higher than FP.

Table 6.11 Soybean yield and monitory returns under real farm situation in Madhya Pradesh (No. of FLDs=6709).

Year	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
Range	1295-1979	853-1612	6424-43851	4052-37882	6099-20520	4469-19373	3914-29601	1699-25732	1.13-3.14	0.93-3.12
Mean	1625	1216	32097	24933	12758	10519	19929	14880	2.47	2.39
SD	**255.14**	**214.13**	**13324.25**	**11561.28**	**4135.41**	**4092.85**	**9064.23**	**7771.79**	**0.66**	**0.72**
CV (%)	**15.70**	**17.61**	**41.51**	**46.37**	**32.41**	**38.91**	**45.48**	**52.23**	**26.93**	**29.98**
SYI/SVI	**0.69**	**0.62**	**0.42**	**0.35**	**-**	**-**	**0.37**	**0.28**	**-**	**-**

Table 6.12 Yield gap, additional returns and production efficiency under frontline demonstrations in Madhya Pradesh. (No. of FLDs=6709)

Year	Yield gap (kg/ha)	% increase	Additional cost (Rs/ha)	Additional returns (Rs/ha)	IBCR	Production efficiency (g/Rs)	
						IP	FP
Range	170-560	15.00-44.94	1224-4571	2390-11956	2.27-11.43	64-293	69-232
Mean	**421**	**36.83**	**2330**	**7043**	**4.03**	**170**	**160**
SD	**146.55**	**17.76**	**969.63**	**2803.70**	**2.74**	**69.49**	**55.46**
CV (%)	**34.80**	**48.22**	**41.61**	**39.81**	**67.89**	**40.82**	**34.71**

6.2.2 Maharashtra

In Maharashtra state, the cooperating center were Amravati, Parbhani, Sangli, KVK, Karda and Pune conducted a total of 1758 front line demonstrations of soybean (Table 6.13). The center wise data are appended in Annexure I and II. Soybean yield ranged from 1462 to 2828 kg/ha with the average of 2113 kg/ha and these values varied from 1252 to 2172 kg/ha with the mean of 1703 kg/ha. The center wise data are given in Annexure I and II. The maximum yield was recorded at Sangli i.e. 2828 and 2172 kg/ha under IP and FP, respectively. The yield variation under IP was higher than FP and reflected in lower SYI value as compared to FP. The average cost of cultivation was found to 9.58% higher under IP than FP and cultivation cost showed higher variation under FP. The gross and net returns under IP were higher to the extent of 32.94 and 37.05% as compared to FP. Both the returns showed higher variation under IP than FP. The higher B:C ratio was also recorded with IP than FP. The average yield gap ii was 414 with 47.23% variation over the center and indicated an enhancement of 24.69% in soybean yield over FP (Table 6.14). A sum of Rs 11578/ha as additional returns had been achieved with an additional cost of Rs. 2313/ha which resulted in IBCR of 4.94. The production efficiency under IP was greater with lesser variation than FP.

Table 6.13 Soybean yield and monitory returns under real farm situation in Maharashtra. (No. of FLDs= 1758).

Year	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
Range	1462-2828	1252-2172	32357-93146	26505-56376	13751-38162	12526-34889	19207-55007	14874-36582	1.95-2.47	1.74-2.39
Mean	**2113**	**1703**	**54237**	**40797**	**24731**	**22568**	**29632**	**21620**	**2.31**	**2.08**
SD	**509.14**	**332.83**	**25113.43**	**14025.73**	**10765.97**	**10558.84**	**15088.16**	**9092.56**	**0.38**	**0.46**
CV (%)	**24.09**	**19.55**	**46.30**	**34.38**	**43.53**	**46.79**	**50.92**	**42.06**	**16.39**	**21.95**
SYI	**0.57**	**0.63**	**0.31**	**0.48**	**-**	**-**	**0.26**	**0.34**	**-**	**-**

Table 6.14 Yield gap, additional returns and production efficiency under frontline demonstrations in Maharashtra (No. of FLDs= 1758).

Year	Yield gap (kg/ha)	% increase	Additional cost (Rs/ha)	Additional returns (Rs/ha)	IBCR	Production efficiency (g/Rs)	
						IP	FP
Range	210-657	16.72-37.06	1547-3273	5493-30210	2.48-9.71	60-229	54-228
Mean	**414**	**24.69**	**2313**	**11578**	**4.94**	**131**	**126**
SD	**195.53**	**9.13**	**746.83**	**10486.86**	**2.81**	**81.97**	**83.66**
CV (%)	**47.23**	**36.97**	**32.29**	**90.57**	**56.87**	**62.46**	**66.17**

6.2.3 Rajasthan

A sum of 1174 frontline demonstrations was conducted by Kota, SRIJAN and ITC. The center wise data are given in Annexure I and II (Table 6.15). On an average yield 1360 kg/ha was recorded under IP with the range of 704 to 1753 kg/ha. However, the mean yield under FP was 1033 kg/ha which varied from 603 to 1384 kg/ha. The IP showed higher SYI with greater variation yield as compared to FP. The average cost of cultivation under IP showed The average cost of cultivation was higher by 13.72% under IP than FP which resulted in higher gross and net returns to the tune of 21.26 and 46.80% over FP. The gross and net returns showed lower and higher variation under IP than FP and just reverse was true with SVI. The B:C ratio was higher under IP with lower variation under IP. The overall yield gap was 378 kg/ha (101 to 513 kg/ha) which reflected in yield hike of 31.17% over FP (Table 6.16). An additional expenditure of Rs. 1395/ha resulted in a net gain of Rs. 7659/ha with the IBCR of 5.87. The production efficiency was marginally higher with IP with lesser variation.

Table 6.15 Soybean yield and monitory returns under real farm situation in Rajasthan. Rajasthan (No. of FLDs= 1174).

Year	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
Range	704-1753	603-1384	15485-49282	13265-33533	3600-19172	3200-17250	11351-30109	10065-16284	2.61-4.30	1.98-4.15
Mean	**1360**	**1033**	**23360**	**19264**	**11578**	**10181**	**19264**	**13123**	**3.18**	**2.95**
SD	**572.53**	**396.52**	**10134.67**	**9717.02**	**7793.22**	**7025.35**	**9717.02**	**3110.81**	**0.97**	**1.10**
CV (%)	**42.08**	**38.38**	**43.39**	**50.44**	**67.31**	**69.01**	**50.44**	**23.70**	**30.57**	**37.25**
SYI/SVI	**0.48**	**0.46**	**0.39**	**0.32**	**-**	**-**	**0.32**	**0.61**	**-**	**-**

Table 6.16 Yield gap, additional returns and production efficiency under frontline demonstrations in Rajasthan. (No. of FLDs= 1174).

Year	Yield gap (kg/ha)	% increase	Additional cost (Rs/ha)	Additional returns (Rs/ha)	IBCR	Production efficiency (g/Rs)	
						IP	FP
Range	101--513	19..29-47.21	400-1922	2211-15752	2.96-9.12	86-234	66-242
Mean	**327**	**31.17**	**1395**	**7659**	**5.87**	**172**	**165**
SD	**209.38**	**14.42**	**862.46**	**7147.55**	**3.09**	**76.81**	**90.59**
CV (%)	**63.95**	**46.25**	**61.81**	**93.33**	**52.66**	**44.75**	**54.74**

6.2.4 Chhattisgarh

Only Raipur center conducted a sum of 261 frontline demonstrations in Chhatisgarh state (Table 6.17). The average soybean yield was 1349 kg/ha with the range of 1057 to 2499 kg/ha under IP while the values in FP were 984 kg/ha which varied from 399 to 1772 kg/ha. However, the yield variation over years was found to be slightly higher with IP while reverse was true with SYI. The adaptation of IP resulted in higher cost of cultivation by 31.82% which resulted in improvement of gross and net returns of 32.62 and 42.25% as compared to FP. Both the returns showed negligible higher variation under IP which reflected in lower SYI values. The B:C ratio was marginally higher under FP with lesser variation. The mean yield gap II was 378 kg/ha which reflected in 38.92% higher yield produced under IP than FP (Table 6.18). A 2.3-fold enhancement in additional returns was observed on the additional expenditure of Rs. 3429/ha.

Table 6.17 Soybean yield and monitory returns under real farm situation in Chhattisgarh. (No. of FLDs= 261).

Year	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
Range	1057-2499	399-1772	4673-58904	2987-45403	6033-18995	4824-14825	4673-88400	2987-45403	0.28-5.78	0.28-6.01
Mean	**1349**	**984**	**15727**	**11859**	**14204**	**10775**	**13700**	**9631**	**1.94**	**2.05**
SD	**191.71**	**135.38**	**61.29**	**63.40**	**7540.03**	**6292.57**	**8226.27**	**5769.21**	**0.50**	**0.47**
CV (%)	**14.21**	**13.76**	**0.17**	**0.15**	**53.08**	**58.40**	**60.05**	**59.90**	**25.66**	**22.87**
SYI/SVI	**0.73**	**0.74**	**0.16**	**0.23**	**-**	**-**	**0.18**	**0.17**	**-**	**-**

Table 6.18 Yield gap, additional returns and production efficiency under frontline demonstrations in Chhattisgarh. (No. of FLDs= 261).

Year	Yield gap (kg/ha)	% increase	Additional cost (Rs/ha)	Additional returns (Rs/ha)	IBCR	Production efficiency (g/Rs)	
						IP	FP
Range	300-1593	25.32-164.91	952-8697	1686-56620	2.27-6.72	67-310	36-364
Mean	**378**	**38.92**	**3429**	**7336**	**2.30**	**134**	**130**
SD	**88.79**	**9.28**	**1536.83**	**3739.06**	**0.80**	**106.44**	**93.89**
CV (%)	**23.49**	**23.84**	**44.82**	**50.97**	**34.64**	**79.32**	**72.18**

6.2.5 Karnataka

A total of 1305 frontline demonstrations were conducted by Bengaluru, Dharwad and Ugarkhurd center (Table 6.19). The center wise data depicted in Annexure I and II. On an average soybean yield 1884 kg/ha was recorded under IP with the range of 1672 to 2005 kg/ha and the corresponding values under FP were 1513 kg/ha which varied from 1361 to 1670 kg/ha. The application of inputs as per recommendations (IP) which showed higher cultivation cost (15.03%) than FP which resulted in enhanced gross and net returns to the tune of 24.07 and 32.16% over FP. The gross returns under IP showed less variability than FP while in case of cultivation cost and net returns just reverse was true. The gross returns showed higher SVI values than FP while the reverse was case with net returns. The FP proved to be better than IP with regards to B:C ratio. The mean yield gap II was found to be 384 kg/ha (306 to 494 kg/ha) which showed an increase of 27.86% over FP (Table 6.20). A sum of Rs 2500/ha as additional cost resulted in 3.60-fold increase in net gain from soybean. The production efficiency of FP was found to be superior to IP in the state.

Table 6.19 Soybean yield and monitory returns under real farm situation in Karnataka. (No. of FLDs= 1305).

Year	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
Range	1672-2005	1361-1670	31332-51715	25808-43700	9511-32686	7787-29660	19075-24286	14284-17432	1.69-4.12	1.56-4.93
Mean	**1884**	**1513**	**40757**	**32849**	**19045**	**16557**	**21547**	**16303**	**2.96**	**3.17**
SD	**184.63**	**154.67**	**10277.54**	**9534.95**	**12121.16**	**11562.28**	**2616.03**	**1752.33**	**1.22**	**1.69**
CV (%)	**9.80**	**10.22**	**25.22**	**29.03**	**63.64**	**69.83**	**12.14**	**10.75**	**41.18**	**53.25**
SYI/SVI	**0.85**	**0.81**	**0.59**	**0.53**	**-**	**-**	**0.78**	**0.83**	**-**	**-**

Table 6.20 Yield gap, additional returns and production efficiency under frontline demonstrations in Karnataka. (No. of FLDs= 1305).

Year	Yield gap (kg/ha)	% increase	Additional cost (Rs/ha)	Additional returns (Rs/ha)	IBCR	Production efficiency (g/Rs)	
						IP	FP
Range	306-496	18.36-33.49	1746-3027	5189-10473	3.05-4.31	76-260	64-307
Mean	**384**	**27.86**	**2500**	**7880**	**3.60**	**180**	**191**
SD	**99.41**	**8.28**	**670.28**	**2643.38**	**0.65**	**94.65**	**121.97**
CV (%)	**25.90**	**29.71**	**26.81**	**33.55**	**17.97**	**52.57**	**63.86**

6.2.6 Telangana

Only 110 frontline demonstrations were conducted by Adilabad center (Table 6.21). Soybean yield varied from 1244 to 2785 kg/ha with the mean of 2035 kg/ha while in case of FP it ranged from 1324 to 2352 with an average of 1680 kg/ha. The yield variability over years was found to be higher under IP. However, the SYI was observed to be identical under both the production system. The ip indicated higher cost of cultivation to the extent of 15.47% over FP which turns in to extra gain of 22.71 and 32.16% as gross and net returns over FP. Both the returns showed more or less similar variation over the years, however, the cultivation cost under IP indicated higher variation than FP. The higher SVI values were associated with IP and FP, respectively. Per rupee returns was greater than FP with lesser variation. The mean yield gap II was recorded to be 355 kg/ha (81 to 898 kg/ha). An additional expenditure of Rs. 3501/ha enhanced the additional returns by 3.60 fold. The production efficiency of IP was found to be higher with higher variation over the years than FP (Table 6.22).

Table 6.21 Soybean yield and monitory returns under real farm situation in Telengana (No. of FLDs= 110).

Year	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
Range	1244-2785	1324-2352	27869-103320	24598-87255	13453-37256	12109-30668	14416-64275	12053-53313	1.85-4.52	1.67-3.64
Mean	**2035**	**1680**	**60603**	**49384**	**26133**	**22632**	**34471**	**26756**	**2.41**	**2.22**
SD	**468.69**	**368.54**	**22039.20**	**17892.92**	**9741.27**	**7716.37**	**16122.83**	**12414.49**	**0.77**	**0.54**
CV (%)	**23.03**	**21.94**	**36.37**	**36.23**	**37.28**	**34.09**	**46.77**	**46.40**	**31.74**	**24.10**
SYI/SVI	**0.56**	**0.56**	**0.59**	**0.57**	**-**	**-**	**0.54**	**0.50**	**-**	**-**

Table 6.22 Yield gap, additional returns and production efficiency under frontline demonstrations in Telangana (No. of FLDs= 110).

Year	Yield gap (kg/ha)	% increase	Additional cost (Rs/ha)	Additional returns (Rs/ha)	IBCR	Production efficiency (g/Rs)	
						IP	FP
Range	81-898	4.85-53.68	454-6621	2187-24831	1.00-10.38	55-141	49-119
Mean	**355**	**21.39**	**3501**	**8847**	**3.60**	**86**	**80**
SD	**207.68**	**12.26**	**2248.87**	**6411.18**	**2.85**	**29.15**	**23.82**
CV (%)	**58.43**	**57.33**	**64.24**	**72.46**	**79.22**	**33.96**	**29.73**

6.2.7 Andhra Pradesh

A sum of 236 frontline demonstrations was conducted by Lam and CRIDA, Hyderabad (Table 6.23). The center wise data are embodied in Annexure I and II. On an average yield under IP FP was 1392 kg/ha (905-1839 kg/ha) and 1161 kg/ha (680 -1642 kg/ha), respectively. The IP proved to be superior to FP in terms of variation (low) and SYI (high). The adoption of IP increased the cultivation cost by 10.52% which resulted in enhanced gain of 26.62 and 44.69% as gross and net income. The variation in gross returns and cost was higher under IP than FP. However, net returns showed lesser variation under IP. The FP and IP indicated higher SYI with reference to gross and net returns. The IP gave higher returns on per rupee investment with less variation as compared to FP. The yield gap was only 238 kg/ha which showed an increase in yield by 27.82% over FP (Table 6.24). An additional expenditure of Rs. 804/ha resulted in 3.36-fold enhancement I additional gain. The production efficiency of IP was found to be better with less variation than FP.

Table 6.23 Soybean yield and monitory returns under real farm situation in Andhra Pradesh (No. of FLDs= 236)

Year	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
Range	905-1839	680-1642	13007-15416	10936-11511	6428-7621	6004-6674	6341-7795	4262-5507	1.94-2..02	1.64-1.90
Mean	**1392**	**1161**	**14212**	**11224**	**7025**	**6339**	**7068**	**4885**	**1.98**	**1.77**
SD	**688.43**	**734.30**	**1703.33**	**406.69**	**843.46**	**473.83**	**1028.36**	**880.52**	**0.06**	**0.19**
CV (%)	**49.46**	**63.23**	**11.99**	**3.62**	**12.01**	**7.47**	**14.55**	**18.03**	**2.82**	**10.51**
SYI/SVI	**0.37**	**0.25**	**0.81**	**0.94**	**-**	**-**	**0.77**	**0.73**	**-**	**-**

Table 6.24 Yield gap, additional returns and production efficiency under frontline demonstrations in Andhra Pradesh (No. of FLDs= 236).

Year	Yield gap (kg/ha)	% increase	Additional cost (Rs/ha)	Additional returns (Rs/ha)	IBCR	Production efficiency (g/Rs)	
						IP	FP
Range	212-263	12.32-43.33	661.947	2002-4480	2.99-3.73	119-369	96-360
Mean	**238**	**27.82**	**804**	**3241**	**3.36**	**244**	**228**
SD	**35.74**	**21.93**	**202.43**	**1752.53**	**0.52**	**176.78**	**186.23**
CV (%)	**15.03**	**78.81**	**25.18**	**54.08**	**15.55**	**72.52**	**81.72**

6.2.8 Gujrat

Only 143 frontline demonstrations were conducted by Devgarbaria, Bharuch and Lokbharti (Table 6.25). The data of Lokbharti was not included in the mean due to incomplete data. The center wise data are given in Annexure I and II. The yield under IP varied from 1640 to 1662 kg/ha with the mean of 1651 kg/ha and the corresponding values under FP were 990 – 1451 with an average of 1221. The IP yield showed lesser variation and resulted in higher SYI values as compared to FP. The use of recommended practices increased the cost by 16.45% over FP and resulted in 35.87 and 47.58% increase in gross and net returns from soybean. Variation in cost was very low under FP than IP. However, the variation in both the returns was low under IP with higher SVI values. The IP also showed higher B:C ratio than FP. On an average yield gap II was to be noted 431 kg/ha (211 to 650 kg/ha and reflected a hike of 32.75% in yield over FP (Table 6.26). The additional expenditure of IT was Rs. 2779/ha resulted in a net gain of 7.16 fold as compared to FP. IP also showed their superiority over FP with reference to production efficiency.

Table 6.25 Soybean yield and monitory returns under real farm situation in Gujrat (No. of FLDs = 143).

Year	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
Range	1640-1662	990-1451	49186-51427	29323-44730	17577-21768	16747-17039	27419-33850	13534-27982	2.26-2.99	1.72-2.72
Mean	**1651**	**1221**	**50307**	**37026**	**19672**	**16893**	**30634**	**20758**	**2.62**	**2.22**
SD	**15.86**	**325.90**	**1584**	**10894**	**2962.93**	**206.00**	**4547.28**	**10216.28**	**0.52**	**0.70**
CV (%)	**0.96**	**26.70**	**3.15**	**29.42**	**15.06**	**1.22**	**14.84**	**49.22**	**19.73**	**31.59**
SYI/SVI	**0.98**	**0.62**	**0.95**	**0.58**	-	-	**0.77**	**0.38**	-	-

Table 6.26 Yield gap, additional returns and production efficiency under frontline demonstrations in Gujrat (No. of FLDs = 143).

Year	Yield gap (kg/ha)	% increase	Additional cost (Rs/ha)	Additional returns (Rs/ha)	IBCR	Production efficiency (g/Rs)	
						IP	FP
Range	211-650	14.92-50.59	830-4729	6123-14865	5.29-9.02	75-96	58-88
Mean	**431**	**32.75**	**2779**	**10494**	**7.16**	**86**	**73**
SD	**310.04**	**25.23**	**2756.93**	**6181.33**	**2.64**	**14.86**	**20.88**
CV (%)				**72.02**	**77.02**	**99.20**	**58.90**	**36.89**	**17.34**	**28.58**

6.2.9 Uttarakhand

A total of 1035 frontline demonstrations were conducted by Almora and Pantnagar center (Table 6.27). The center wise data are depicted in Annexure I and II, the average yield was found to be 1832 and 1474 kg/ha with negligible variation. IP was found to be more sustainable than FP. The adoption of IP increased the cost of cultivation by 5.10% which resulted in increased gross and net returns to the tune of 31.10 and 64.85%, respectively. The higher variation in both the returns was associated with IP while in cost of cultivation it was higher with FP. The SVI values of gross and net returns under FP were observed. The IP showed higher returns per rupee investment than FP. The average yield gap II was found to be 467kg/ha (351-583 kg/ha) which showed yield increase by 37.90% over FP (Table 6.28). A 2.88-fold increase was recorded in additional returns by the additional expenditure of Rs. 1397/ha.

Table 6.27 Soybean yield and monitory returns under real farm situation in Uttarakhand (No. of FLDs= 1035).

Year	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
Range	1825-1839	1255-1474	31835-84315	24805-63852	11387-45806	9193-45223	21021-36309	16149-18630	1.84-3.21	1.41-3.18
Mean	**1832**	**1365**	**58075**	**44329**	**28597**	**27208**	**28665**	**17389**	**2.53**	**2.29**
SD	**9.90**	**154.81**	**37109.37**	**27610.28**	**24338.07**	**25477.01**	**10810.29**	**1753.89**	**0.97**	**1.25**
CV (%)	**0.54**	**11.34**	**63.90**	**62.29**	**85.11**	**93.64**	**37.71**	**10.09**	**38.42**	**54.39**
SYI/SVI	**0.99**	**0.82**	**0.25**	**0.26**	**-**	**-**	**0.49**	**0.84**	**-**	**-**

Table 6.28 Yield gap, additional returns and production efficiency under frontline demonstrations in Uttarakhand (No. of FLDs= 1035).

Year	Yield gap (kg/ha)	% increase	Additional cost (Rs/ha)	Additional returns (Rs/ha)	IBCR	Production efficiency (g/Rs)	
						IP	FP
Range	351-583	27.59-48.21	583-2210	5801-20463		39-243	29-257
Mean	**467**	**37.90**	**1397**	**13132**	**2.88**	**141**	**143**
SD	**164.48**	**14.58**	**1150.35**	**10367.60**	**-**	**144.60**	**161.43**
CV (%)	**35.23**	**38.47**	**82.36**	**78.95**	**0.00**	**102.57**	**112.82**

6.2.10 Himachal Pradesh

A total of 864 frontline demonstrations were conducted by the only Palampur center (Table 6.29). Soybean yield ranged from 790 to 2500 kg/ha with mean of 1664 kg/ha under IP while in FP, it varied from 690 to 1600 kg/ha with the average of 1220 kg/ha. Soybean under FP showed higher value of SYI. An additional expenditure on IP enhanced the gross and net returns to the extent of 30.58 and 31.13% over FP. The cultivation cost and both the returns showed lower variability under IP than FP. However, the IP showed higher values of SVI as compared to FP. FP indicated more returns from per rupee investment than IP. The average yield gap II was 465 kg/ha which showed an increase of 39.31% yield as compared to FP (Table 6.30). The additional expenditure on IP i.e. Rs. 3555/ha enhanced the net gain by 2.33 fold. The production efficiency of FP was higher than IP.

Table 6.29 Soybean yield and monitory returns under real farm situation in Himachal Pradesh (No. of FLDs= 864).

Year	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
Range	790-2500	690-1600	6007-73933	4419-57953	5560-39403	3557-34540	1909-35849	2692-25371	1.15-3.15	1.02-3.56
Mean	**1664**	**1220**	**34695**	**26569**	**16340**	**12738**	**19373**	**14774**	**2.34**	**2.44**
SD	**379.94**	**249.69**	**20772.84**	**16732.52**	**10471.15**	**9795.12**	**10932.60**	**8587.21**	**0.57**	**0.69**
CV (%)	**22.84**	**20.46**	**59.87**	**62.98**	**64.08**	**76.90**	**56.43**	**58.12**	**24.51**	**28.49**
SYI/SVI	**0.51**	**0.61**	**0.19**	**0.17**	**-**	**-**	**0.24**	**0.24**	**-**	**-**

Table 6.30 Yield gap, additional returns and production efficiency under frontline demonstrations in Himachal Pradesh (No. of FLDs= 864).

Year	Yield gap (kg/ha)	% increase	Additional cost (Rs/ha)	Additional returns (Rs/ha)	IBCR	Production efficiency (g/Rs)	
						IP	FP
Range	186-1396	17.74-126.39	1627-3000	1588-13981	0.98-4.23	32-363	29-379
Mean	465	39.31	3555	7876	2.33	143	152
SD	270.25	24.43	1434.51	3410.82	0.99	90.58	96.77
CV (%)	58.12	62.14	40.36	43.31	42.59	63.18	63.83

6.2.11 Punjab

A sum of 351 frontline demonstrations was conducted by the Ludhiana center (Table 6.31). The IP and FP yield were compared only during 2007 to 2012 and in the rest of the years there were no comparison with FP. The mean yield under IP was 162 kg/ha which varied from 1211 to 2061 kg/ha whereas under FP, it was 1542 kg/ha with the range of 1450 to 1744 kg/ha. The FP was found to be more sustainable than IP with lesser yield variation. Improved practice enhanced the cultivation cost by 36.86% and resulted in enhanced gross and net returns to the tune of 72.87 and 85.81% over FP. Gross return and cultivation cost showed less variation under FP than IP and just reverse was true with net returns. The IP showed higher amount of gain on per rupee investment. The yield gap was 344 kg/ha which resulted in 22.89% improvement in soybean yield over FP. A 9.98 fold enhancement in additional returns was recorded when additional expenditure of only Rs. 1545/ha. The production efficiency of IP was found to superior than FP (Table 6.32).

Table 6.31 Soybean yield and monitory returns under real farm situation in Punjab (No. of FLDs = 351).

Year	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
Range	1211-2062	1450-1744	21318-71400	15400-36107	6400-30110	12000-13320	8090-46219	5875-19836	1.61-2.80	1.28-3.28
Mean	**1620**	**1542**	**44534**	**25761**	**16563**	**12102**	**23748**	**12781**	**2.26**	**2.14**
SD	**258.06**	**123.31**	**16942.65**	**7920.96**	**9238.22**	**743.52**	**10316.66**	**6728.22**	**0.43**	**0.72**
CV (%)	**15.927**	**7.997**	**38.044**	**30.748**	**55.776**	**6.144**	**43.442**	**52.643**	**19.191**	**33.529**
SYI/SVI	**0.66**	**0.81**	-	-	-	-	-	-	-	-

Table 6.3 Yield gap, additional returns and production efficiency under frontline demonstrations in Punjab (No. of FLDs = 351).

Year	Yield gap (kg/ha)	% increase	Additional cost (Rs/ha)	Additional returns (Rs/ha)	IBCR	Production efficiency (g/Rs)	
						IP	FP
Range	86-561	5.80-38.42	500-6000	1936-6000	4.42-13.46	100-165	116-147
Mean	**344**	**22.89**	**1545**	**5098**	**9.98**	**140**	**128**
SD	**178.89**	**12.69**	**2202.18**	**1706.49**	**3.37**	**23.73**	**13.19**
CV (%)	**52.078**	**55.468**	**142.521**	**33.476**	**33.734**	**16.894**	**10.318**

6.2.12 Manipur

A sum of 126 frontline demonstrations was conducted by Imphal center (Table 6.33). The mean yield under IP was 1487 kg/ha with a range of 1100 to 1978 kg/ha while the corresponding values under FP were 942 kg/ha with a range of 537 to 1177 kg/ha. IP yield showed lesser variation over the years than FP. Both the production systems showed more or less SYI. The adoption of IP increased the cultivation cost by 55.92% which enhanced the gross and net returns to the tune of 60.38 and 72.64% over FP. The gross returns and cultivation cost showed higher variation under IP than FP while in case of net returns it was reverse. FP and IP showed higher SVI values as compared to their respective production practices. The adoption of IP improved the B:C ratio than FP. The yield gap ii was 545 kg/ha which reflected in increased yield by 61.68% over FP (Table 6.34). The additional expenditure of Rs. 9604/ha brought out 2.91-fold increase in net gain. The IP possesses higher production efficiency in comparison to FP with lesser variability.

Table 6.33 Soybean yield and monitory returns under real farm situation in Manipur (No. of FLDs= 126)

Year	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
Range	1100-1978	537-1177	49500-118704	27923-70611	12483-36710	10317-22154	25655-85159	8640-85159	1.80-5.57	1.57-5.56
Mean	**1487**	**942**	**76130**	**47469**	**26714**	**17133**	**49326**	**28572**	**2.94**	**2.86**
SD	**255.34**	**198.41**	**25570.96**	**15421.83**	**8525.47**	**4414.66**	**19984.59**	**15193.66**	**0.90**	**1.01**
CV (%)	**17.17**	**21.07**	**33.59**	**32.49**	**31.91**	**25.77**	**40.52**	**53.18**	**30.75**	**35.42**
SYI/SVI	**0.62**	**0.63**	**0.43**	**0.45**	**-**	**-**	**0.34**	**0.27**	**-**	**-**

. Table 6.34 Yield gap, additional returns and production efficiency under frontline demonstrations in Manipur (No. of FLDs= 126)

Year	Yield gap (kg/ha)	% increase	Additional cost (Rs/ha)	Additional returns (Rs/ha)	IBCR	Production efficiency (g/Rs)	
						IP	FP
Range	300-801	25.88-118.40	2166-14556	6000-38021	1.25-5.59	41-117	29-112
Mean	**545**	**61.68**	**9604**	**20796**	**2.91**	**62**	**60**
SD	**156.21**	**23.75**	**4523.51**	**9790.35**	**1.45**	**24.70**	**26.05**
CV (%)	**28.65**	**38.50**	**47.10**	**47.08**	**49.72**	**40.02**	**43.46**

6.2.13 Nagaland

Only 50 frontline demonstrations were conducted by Medziphema center (Table 6.35). The average yield was 1552 kg/ha with a range of 1367 to 1800 kg/ha under IP while it varied from 962 to 1160 kg/ha with a mean of 1051 kg/ha under FP. IP was found to be more sustainable with less yield variation than FP. The use of IP technologies enhanced the cultivation cost by 37.06% over FP which resulted in increase of gross and net returns to the extent of 47.67 and 54.50% as compared to FP. Bothe the returns and cost of cultivation showed higher variability under IP. Both the returns under FP showed higher values of SVI. The IP possesses higher returns on per rupee investment. The average yield gap II was recorded to be 501 kg/ha which resulted in an increase of 47.66% higher soybean yield over FP (Table 6.36). An extra expenditure of Rs. 8266/ha enhanced the additional return by 2.79 fold. The production efficiency of IP was better than FP.

Table 6.35 Soybean yield and monitory returns under real farm situation in Nagaland (No. of FLDs= 50).

Year	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
Range	1367-1800	962 - 1160	82020-108000	57717-69600	28055-33109	7199-10369	53343-74891	35175-46860	2.74-3.26	2.56-3.05
Mean	**1552**	**1051**	**93097**	**63045**	**30569**	**22303**	**62528**	**40742**	**3.04**	**2.83**
SD	**175.38**	**83.02**	**10521.10**	**4981.23**	**1789.60**	**818.09**	**9015.31**	**4539.08**	**0.21**	**0.18**
CV (%)	**11.30**	**7.90**	**11.30**	**7.90**	**5.85**	**3.67**	**14.42**	**11.14**	**6.78**	**6.33**
SYI/SVI	**0.86**	**0.83**	**0.76**	**0.83**	**-**	**-**	**0.71**	**0.77**	**-**	**-**

Table 6.36 Yield gap, additional returns and production efficiency under frontline demonstrations in Nagaland (No. of FLDs= 50).

Year	Yield gap (kg/ha)	% increase	Additional cost (Rs/ha)	Additional returns (Rs/ha)	IBCR	Production efficiency (g/Rs)	
						IP	FP
Range	394-694	40.49-55.20	7199-10369	20424-24421	2.53-3.28	52-54	43-51
Mean	**501**	**47.66**	**8266**	**22755**	**2.79**	**51**	**47**
SD	**94.20**	**5.45**	**1219.13**	**1501.41**	**0.36**	**3.44**	**2.98**
CV (%)	**18.81**	**11.43**	**14.75**	**6.60**	**12.82**	**6.78**	**6.33**

6.2.14 Jharkhand

A sum of 304 frontline demonstrations was conducted by Ranchi center (Table 6.37). Soybean yield varied from 920 to 1588 kg ha with an average of 1349 kg/ha under IP while it varied from 664 to 1148 kg/ha with a mean of 984 kg/ha. Yield under both the production systems varied over years as

well as SYI behaved more or less in similar fashion. The adoption of IP increased the cultivation cost by 6.80% which resulted in enhanced gross and net returns of 37.19 and 24.72% as compared to FP. The IP showed return on per rupee investment with higher variation over the years than FP. On an average yield gap II was 378 kg/ha which reflected an increase of 38.92% over FP (Table 6.38). An additional expenditure of Rs. 3429/ha on IP increased net gain by 2030 fold over FP. The production efficiency of IP was better than FP.

Table 6.37 Soybean yield and monitory returns under real farm situation in Jharkhand (No. of FLDs= 304).

Year	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
Range	920-1588	664-1148	9327-58904	6027-45403	3692-28080	2817-22490	5527-30824	3100-22913	1.22-3.25	1.39-3.00
Mean	**1349**	**984**	**25661**	**18705**	**25426**	**23807**	**38657**	**30996**	**2.68**	**2.31**
SD	**191.71**	**135.38**	**15727.03**	**11859.08**	**844.53**	**737.06**	**9633.02**	**2750.97**	**0.31**	**0.16**
CV (%)	**14.21**	**13.76**	**61.29**	**63.40**	**3.32**	**3.10**	**24.92**	**8.88**	**11.48**	**6.86**
SYI/SVI	**0.73**	**0.74**	**0.17**	**0.15**	**-**	**-**	**0.59**	**0.83**	**-**	**-**

Table 6.38 Yield gap, additional returns and production efficiency under frontline demonstrations in Jharkhand (No. of FLDs= 304).

Year	Yield gap (kg/ha)	% increase	Additional cost (Rs/ha)	Additional returns (Rs/ha)	IBCR	Production efficiency (g/Rs)	
						IP	FP
Range	140-513	17.95-55.80	873-5590	1680-13501	1.80-4.20	52-406	50-376
Mean	**378**	**38.92**	**3429**	**7336**	**2.30**	**134**	**130**
SD	**88.79**	**9.28**	**1536.83**	**3739.06**	**0.80**	**106.44**	**93.89**
CV (%)	**23.49**	**23.84**	**44.82**	**50.97**	**34.64**	**79.32**	**72.18**

6.2.15 Bihar

Only 61 frontline demonstrations were conducted by Dholi center (Table 6.39). Soybean mean yield under IP was 1646 kg/ha with the mean of 1646 kg/ha whereas it ranged from 1320 to 1427 kg/ha with an average of 1367 kg/ha under FP. The FP showed higher value of SYI with lesser variation in yield over years than IP. The extra expenditure of 6.80% on IP resulted in an increase of 16.93 and 24.72% in gross as well as net returns. FP system showed lower variation with higher SVI values in both the returns. The IP system indicated higher returns on per rupee investment with higher variation as compared to FP. The mean yield gap II was 339 kg/ha which reflected as increase of 24.65% in yield over FP (Table 6.40). The additional expenditure of Rs. 1786/ha resulted in a hike of 7.23 fold as compared to FP. The IP system was found be more efficient than FP with reference to production efficiency.

Table 6.39 Soybean yield and monitory returns under real farm situation in Bihar (No. of FLDs= 61).

Year	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
Range	1465-1847	1320-1427	51281-73889	53164-57078	24515-26302	22956-24222	26359-49374	28941-34121	2.41-3.01	2.19-2.49
Mean	**1646**	**1367**	**64083**	**54803**	**25426**	**23807**	**38657**	**30996**	**2.68**	**2.31**
SD	**163.53**	**54.67**	**9557.47**	**2032.88**	**844.53**	**737.06**	**9633.02**	**2750.97**	**0.31**	**0.16**
CV (%)	**9.94**	**4.00**	**14.91**	**3.71**	**3.32**	**3.10**	**24.92**	**8.88**	**11.48**	**6.86**
SYI/SVI	**0.80**	**0.92**	**0.74**	**0.92**	**-**	**-**	**0.59**	**0.83**	**-**	**-**

Table 6.40 Yield gap, additional returns and production efficiency under frontline demonstrations in Bihar (No. of FLDs= 61).

Year	Yield gap (kg/ha)	% increase	Additional cost (Rs/ha)	Additional returns (Rs/ha)	IBCR	Production efficiency (g/Rs)	
						IP	FP
Range	257-420	19.47-29.45	1559-2080	10236-15364	4.92-9.86	60-75	54-62
Mean	**339**	**24.65**	**1786**	**12491**	**7.23**	**67**	**58**
SD	**81.50**	**5.00**	**266.76**	**2619.38**	**2.49**	**7.82**	**4.09**
CV (%)	**24.04**	**20.29**	**14.93**	**20.97**	**34.40**	**11.69**	**7.12**

6.2.16 Tamil Nadu

A total of 291 frontline demonstrations were conducted by Coimbatore center (Table 6.41). On an average yield gain under IP was 1390 kg/ha with a range of 848 to 1890 kg/ha while in case of FP, the mean yield was 1129 which varied from 687 to 1480 kg/ha. FP showed higher SYI with lesser variation in yield over years than IP. An additional investment (13.03%) reflected in enhanced gross and net returns of 26.35 and 25.94% over FP. The higher variation in gross and net returns and cultivation cost was observed in FP than IP. The SVI values of gross and net returns were found to be more of less similar under both the production systems. The average yield gap II was only 267 kg/ha which resulted in increase of 23.07% yield over FP (Table 6.42). An additional expenditure of

Rs. 1886/ha brought out an increment of 2.46 fold as compared to FP. The production efficiency of both the systems was superior under IP than FP.

Table 6.41 Soybean yield and monitory returns under real farm situation in Tamil Nadu (No. of FLDs= 291).

Year	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
Range	848-1890	687-1480	8135-52404	7756-40566	1750-29908	5055-26740	721-19502	799-14987	0.99-4.28	1.09-4.44
Mean	**1390**	**1129**	**24021**	**19011**	**21895**	**19370**	**19229**	**15268**	**1.90**	**1.86**
SD	**296.14**	**214.31**	**14925.71**	**12143.88**	**8990.34**	**8461.93**	**14224.75**	**11398.25**	**0.58**	**0.58**
CV (%)	**21.30**	**18.97**	**62.13**	**63.88**	**41.06**	**43.69**	**73.98**	**74.65**	**30.35**	**31.07**
SYI	**0.58**	**0.62**	**0.17**	**0.17**	**-**	**-**	**0.13**	**0.12**	**-**	**-**

Table 6.42 Yield gap, additional returns and production efficiency under frontline demonstrations in Tamil Nadu (No. of FLDs= 291).

Year	Yield gap (kg/ha)	% increase	Additional cost (Rs/ha)	Additional returns (Rs/ha)	IBCR	Production efficiency (g/Rs)	
						IP	FP
Range	131-538	12.16-32.00	892-3168	1691-10760	0.97-4.92	132-538	40-274
Mean	**267**	**23.07**	**1886**	**4551**	**2.46**	**166**	**136**
SD	**98.22**	**5.70**	**818.67**	**2887.56**	**1.05**	**137.49**	**73.62**
CV (%)	**36.73**	**24.71**	**43.41**	**63.45**	**42.58**	**82.73**	**53.98**

6.3 Soybean improved varietal performance under frontline demonstration

A total of 69 soybean improved varieties were demonstrated during 2011 to 2019. The details of each variety are given in Annexure III. Out of 69 varieties, 13 (CGS 1, DSb 23, MAUS 612, PS 23, RVS 2002 4, Palam soy, VLS 89, VLS 77, PS 1477, Pusa 12, MAUS 71, Ankur and DS 228) were demonstrated for single year, therefore standard deviation, CV and SYI were not computed. The maximum demonstrations were conducted on soybean variety JS 95 60 (3793) followed by JS 93 05 (816), JS 335 (384) and MAUS 158 (345). The demonstrations on improved varieties namely VLS Bhatt 201, JS 20 34, JS 20 29, MAUS 162, KDS 344, DSb 21, JS 97 52, Palam soy, VLS 47 and, RKS 18 were conducted with 100-200 FLDs whereas remaining varieties were demonstrated with less than 100 FLDs.

Based on yielding potential of soybean improved varieties, among the categories, DSb 23 was the variety which yielded more than 3 t/ha (Table 6.43). Out of 69 varieties, only 7 varieties (MACS 450, MACS 1188, KDS 344, MACS 1281, KDS 726, VLS 89, DS 228) yielded in between 2.5 to 3 t/ha. Majority of soybean varieties (40) belongs to category 1.5 to 2 t/ha. Twelve varieties yielded in between 1 to 1.5 t/ha. Only MAUS 71 yielded less than 1 t/ha.

Based on sustainability yield index (SYI) of soybean varieties, among the categories, only four varieties namely VLS 63, GJS 3, VLS Bhatt 201 and RKS 45 exhibited more than 0.90 SYI values (Table 6.44). Eight varieties showed in between 0.80 to 0.90 SYI. Fourteen and sixteen varieties exhibited SYI values in between 0.70 to 0.80 and 0.60 to 0.70, respectively. Ten remaining varieties belong to category 0.50 to 0.60 SYI. Only four varieties viz., JS 335, CO 3, JS 20 34, JS 20 69 showed less than 0.50 SYI.

Table 6.43 Categories based on yield performance of soybean varieties (69).

S. No.	Yield category (t/ha)	Variety
1.	**>3.0**	DSb 23 (1)
2.	**2.5 to 3.0**	MACS 450, MACS 1188, KDS 344, MACS 1281, KDS 726, VLS 89, DS 228 (7)
3.	**2 to 2.5**	VLS 63, MAUS 2, RKS 24, DSb 21, Basar, MACS 1460, VLS 59, PS 23 (8)
4.	**1.5 to 2.00**	JS 95 60, JS 93 05, JS 335, RKS 18, MAUS 81, VLS 47, JS 97 52, SL 525,SL 744, PS 1347, CO 3, Bragg, DSb 1, PS 1042, SL 688, MAUS 61 2, PS 1225, NRC 37, NRC 86, MACS 162, MAUS 158, PS 1368, SL 958, JS 20 29, JS 20 34, JS 20 69, DSb 19, Pusa 97 12, GJS 3, RVS 24, JS 20 98, RKS 113, PS 24, RKS 45, Himsoy, CGS 1, MAUS 612, RVS 2002-4, VLS 77, Pusa 12 (40)
5.	**1.0 to 1.5**	NRC 7, Hara soya ,PS 1092, Shivalik, BSS 2, RVS 2001-4, VLS Bhatt 201, RKS 18, VLS 65, Palam soy, PS 1477, Ankur (12)
6.	**< 1.0**	MAUS 71 (1)

Table 6.44 Categories based on sustainable yield index (SYI) (56).

S. No.	SYI category	Variety
1.	**>0.90**	VLS 63, GJS 3, VLS Bhatt 201, RKS 45 (4)
2.	**0.80 to 0.90**	VLS 47, MACS 450, KDS 344, DSb 19, Pusa 97 12, KDS 726, RKS 18, VLS 59 (8)
3.	**0.70 to 0.80**	JS 95 60, JS 93 05, RKS 18, NRC 7, SL 525, SL 744, RKS 24, MACS 1188, PS 1225, SL 958, Basar, RVS 24, MACS 1460, PS 24 (14)
4.	**0.60 to 0.70**	MAUS 81, Hara soya, MAUS 2, PS 1092, Bragg, DSb 1, PS 1042, SL 688, MAUS 61 2, BSS 2, MACS 1281, NRC 37, JS 20 98, RKS 113, Himsoy, VLS 65 (16)
5.	**0.50 to 0.60**	JS 97 52, PS 1347, Shivalik, DSb 21, NRC 86, MACS 162,MAUS 158, PS 1368, RVS 2001-4, JS 20 29 (10)
6.	**< 0.50**	JS 335, CO 3, JS 20 34, JS 20 69 (4)

6.4 Zone wise analysis of soybean yield and economics under improved and farmer's practices.

The zone wise analysis of soybean yield and economics from 2010-11 to 2019-20 given in *Annexure V*. Results, revealed that, highest grain yield was reported in southern zone under both improved and farmer's practices. Highest cost of cultivation incurred was witnessed in Northern Hill zone under both improved and farmer's practices. However, a highest gross and net return was reported in North eastern hill Zone under both improved and farmer's practices.

6.5 State wise % yield gaps of soybean and reasons identified through frontline demonstrations

State wise % yield gaps were analyzed from 2016-2021 under frontline demonstrations and was given in *Annexure VI*. The total of 16 states was taken for analysis. Highest frontline demonstrations conducted during reporting period was in Madhya Pradesh (2196) followed by Maharashtra (833) and Uttarakhand (655). The % yield gap in all states was ranged from 17.2% to 51.2%. Lowest % yield gap was reported in Telangana and highest in Bihar. The % yield gap in Madhya Pradesh, Maharashtra, Rajasthan, Karnataka and Uttarakhand was 41.7%, 21%, 23.4%, 31.4% and 30.7%, respectively. Being a rainfed crop, yield completely depends on quantity and distribution of rainfall during cropping season; Low photo synthetically active radiation levels during overcast days of the monsoon; Timely non-availability of improved quality seeds (seed replacement is low); Lack of availability improved location specific new varieties resistant biotic and abiotic stresses; Imbalanced nutrient management could be the possible reasons identified.

7. Discussion

Analysis of soybean performance under two production systems viz., IP and FP for individual center and at national level indicated variability over the years. The variability in soybean productivity at each location is due to latitudinal differences particularly photoperiod, annual precipitation and its distribution during the crop growth period in particular years, over years and sufficiency of soil moisture at critical crop growth stages particularly pod fill stage as well as variation in depth of soil of different great soil groups. Moreover, the variation in soybean yield within the location over the years may also be due to use of different varieties released/notified/identified for these regions with differential yield potential and maturity period.

A critical evaluation of data revealed that the yield levels even under IT have stabilized around 1700 to 1900 kg/ha and are declining over the years and similar is the trend with farmers practice (1200 to 1400 kg/ha). This can be justified on the basis of observation of Cassman (1999) who reported that even in case of cereals under best production systems the annual improvement in national crop yield shows a decline and ceases once the crop reaches about 80% of the potential productivity established by the nation's very best producers. However, the stabilization of yield at this level even under IT is a matter of serious concern and offers scientists for introspect as the varietal potentials are touching as high as 3500 to 4000 kg/ha and progressive farmers are harvesting 2500 to 3000 kg/ha. The possible options emerge out of past experience gained are to improve management, particularly nutrient management through integrated approaches. The soils of sub-tropical and tropical climate are by and large deficient in organic carbon, an indicator of soil health, for which management requires regular recycling of organic residues. Moreover, integrated water management will require change in planting pattern after land treatment to ensure water availability during critical growth period to ensure optimum yields. Efficient and integrated weed management along with use of quality seeds and improved production technologies may help in breaking the yield plateau observed in the past. At farmer's level, sincere efforts are needed to make them aware on timely adoption of production technology and care to use appropriate quality of agro-chemicals for crop culture. At national level, the areas under defined agro- ecological regions are to be earmarked considering soil-site suitability for cultivation of soybean based cropping systems.

In most of the cases the cost of cultivation under both the production systems, additional cost and additional returns over FP showed the positive trend, however, the IBCR showed negative trend over the years. Similarly, production efficiency also indicated negative trend over the years and was found more or less identical under both the production systems.

The production efficiency declined over the years in both the production systems. The production efficiency computed for IT as well as FP brought out that it remained same under both the systems (216 and 214 g per Rupee). This might not be appropriate in the present context to meet the challenges of globalization. Sustainable and efficient production system approach with an emphasis on decreasing the cost per unit of the product shall be the immediate objective. This shall be need of time that the objective shifts from more production to more "efficient production". This implies a focus on lowering cost of production per unit of output. Agricultural scientists generally think in terms of output per hectare. The latter is a partial measure of efficiency, which was useful when increasing production from limited land resources was the primary objective of research

(Tiwari et al., 2001). Now the focus is on competitive production and cost of production is the appropriate efficiency indicator (Jha, 1999). Hence, the similar values for production efficiency under both the production systems require in-depth analysis so that the technology turns out to be more cost effective.

The greater variability in FP cost of cultivation attributed to its dependence on farmer's financial status and the profit accrued during previous year. The enhancement in cost over the years is the function of increased price of the inputs like seed, fertilizers, herbicide and plant protection chemicals and their greater use with the adoption of new technology. The negative trend of IBCR and production efficiency might be due to proportional increase/decrease in yield and cost of cultivation, hence the efficiency remained identical in both the production systems.

The information generated through these front line demonstrations all over the country brings out that the research emanated production technology (IT) is effective in enhancing the productivity levels over prevailing FP, which was evidenced from declined trend of yield gap II. It is also decreasing because of decreasing yield under IT over the years. The gap has gradually abridged by adoption of IT by the farmers in parts. As has been reported (Billore et al., 2004) that yield gap II (yield under demonstration plot – yield under farmer's practice) in the front line demonstrations in soybean is hardly one-third of yield gap I (yield at research farm – yield under demonstration plot), which indicates that the yield potential of improved varieties is yet to be capitalized.

8. Summary

Soybean ranks first in generation of edible oil in the world. The commercial cultivation of crop has started taking shape only from 1970 onwards and it experienced phenomenal growth in area and production in India. Area under soybean cultivation has steadily increased over the years from the level of 3000 ha in 1970. Agricultural feasibility and economic viability of soybean as sole as well as in the cropping systems have been established. Soybean has emerged as the second most important oilseed crop in India next only to groundnut. It has resulted in rural economic revolution and improved livelihood of the farming community tremendously. The average national productivity of India is although having around 1.0 t/ha, there is ample scope to further raise it. Soybean in general is contributing to about 27% to total area and 32% of production of nine oilseeds in India.

The primary data were collected from over 14834 frontline demonstrations conducted on farmers' fields over 31 years (from 1989 to 2019) under the supervision of scientist of fifteen cooperating centers of All India Coordinated Research Project on Soybean (AICRPS) under the project on" Frontline Demonstrations in Soybean", which is centrally sponsored Oilseed programme (OPP).

The analysis of the data accrued from the FLDs on soybean indicated that the there is a big commercially untapped yield potential of the soybean even with the currently available technologies. The improved soybean production technology could register, under real farm situations, an additional yield ranging from 19.39 to 50.00% over the prevailing farmer's practices, mean additional returns to the tune of Rs. 2586 to 12118/ha resulted in higher incremental benefit cost ratio varied from 1.37 to 4.50 under a wide range of agro-ecological and crop growing situations. The yield gap II has narrowed down to 434 from 1050 kg/ha.

8.1 Lessons learnt

1. Improved technology (IT) is effective to enhance the productivity levels to the tune of 30.95% over prevailing farmers practice (FP).
2. Improved production technology is comparatively sustainable with less variability in yield levels as compared to FP.
3. Yield levels have stabilized in both the production systems around 1700 to 1900 kg/ha in IT and 1300 to 1400 kg/ha in FP. It is a matter of concern and needs further probing. The decreasing yield level under IT over the years is also of great concern.
4. Gradual narrowing down yield gap II with passage of time indicates adoption of IT by farmers in parts.
5. Production efficiency remained identical in both the production systems, which needs further analysis. The technology developed is to be further refined to meet the present installed capacity of soybean processing units in India as well as to meet the challenges of globalization.
6. The farmers can successfully achieve yield levels of IT, as yield levels achieved by some of the farmers conducting trials are more than double the national productivity.
7. The yield gap II is one third to that of yield gap I, indicating that the full yield potential of improved varieties is yet to be capitalized.

8. Unawareness and farmers resource poorness contribute to non-adoption of improved production technology.
9. The experienced gained makes us to feel that it will be appropriate to demonstrate the technology component by component on priority rather than full technology.
10. The transfer of technology involving no monetary input should go to the resource poor farmers at first hand.

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Annexure I

Center wise Frontline Demonstrations on soybean during 1989 to 2019

Year	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
Madhya Pradesh (6709) Indore (420) 1992-2019										
Range	965-2963	604-2181	8340-70895	5220-62680	5380-52680	4046-21200	1004-51695	527-41680	1.14-5.78	1.00-6.01
Mean	1979	1465	36329	27709	11611	9424	24603	18356	3.14	3.09
SD	519.79	465.22	19718.35	17416.12	5864.11	6100.96	14973.07	12995.14	0.90	1.15
CV (%)	26.27	31.76	54.28	62.85	50.51	64.74	60.86	70.79	28.73	37.41
SYI	0.49	0.46	0.24	0.16	-	-	0.20	0.13	-	-
Sehore (375) 1989-2019										
Range	915-2827	655-1766	8962-49065	4899-38850	4000-19214	2622-17067	4962-30901	2277-22833	1.48-3.38	1.25-3.46
Mean	1707	1145	25588	17265	10032	7958	15557	9307	2.50	2.34
SD	411.53	320.16	13247.63	9451.30	5148.37	5141.58	8657.51	5728.86	0.50	0.68
CV (%)	24.11	27.96	51.77	54.74	51.32	64.61	55.65	61.56	20.13	29.08
SYI	0.46	0.47	0.25	0.20	-	-	0.22	0.16	-	-
Solidaridad (465) 2016-19										
Range	737-1577	359-1388	29500-48896	26349-43035	19992-21099	18174-21574	8932-28474	4781-24057	1.43-2.39	1.22-2.30
Mean	1307	1137	42991	37407	20520	19373	22471	18034	2.10	1.96
SD	394.77	339.05	9083.74	7612.26	456.85	1502.67	9172.22	9042.45	0.45	0.50
CV (%)	30.20	29.82	21.13	20.35	2.23	7.76	40.82	50.14	21.65	25.71
SYI	0.58	0.57	0.69	0.69	-	-	0.47	0.37	-	-
SOPA, Indore (3771) 2002-19										
Range	1007-2558	700-1893	17810-53612	11451-40782	7446-17333	5063-13950	8650-36279	5153-28782	1.94-4.65	1.82-4.17
Mean	1756	1266	37608	27452	13058	9672	24563	17786	2.78	2.83
SD	418.13	254.81	12781.17	9592.04	3684.23	2886.25	10113.73	7355.44	0.63	0.60
CV (%)	23.81	20.13	33.99	34.94	28.22	29.84	41.17	41.35	-	-
SYI	0.58	0.56	0.44	0.44	-	-	0.32	0.36	-	-
NICT, Indore (1150) 2008-15										
Range	851-2104	664-1528	28928-60760	22559-45045	12206-20674	9061-15263	8328-40086	6175-29782	1.40-3.03	1.38-3.17
Mean	1772	1289	44556	32595	16818	12247	27738	20350	2.69	2.72
SD	391.54	263.28	12222.46	9092.02	3817.78	3148.75	10571.14	8028.83	0.54	0.58
CV (%)	22.10	20.42	27.43	27.89	22.70	25.71	38.11	39.45	20.06	21.32
SYI	0.69	0.67	0.53	0.52	-	-	0.43	0.41	-	-
Jabalpur (225) 1989-2003										
Range	548-2293	270-1698	2477-12698	1015-9403	1744-7299	1046-6105	973-6392	825-4220	0.38-2.20	0.29-2.14
Mean	1295	853	6424	4052	6099	4469	3914	1699	1.13	0.93
SD	612.31	468.22	3561.86	2785.42	1618.21	1379.04	2234.87	2021.05	0.63	0.60
CV (%)	47.27	54.90	55.44	68.74	26.53	30.86	57.10	118.92	55.48	64.18
SYI	0.30	0.23	0.23	0.13	-	-	0.26	0.00	-	-
ITC, MP (165) 2010-15										
Range	750-1696	710-1271	16500-54713	15620-43413	3600-18919	3200-16632	10653-37052	7909-25037	1.90-4.58	1.68-4.88
Mean	1248	1016	39104	31500	13167	11944	25936	19556	3.14	2.93
SD	355.12	207.05	17032.40	11768.62	5626.36	5030.51	12028.32	7727.86	0.86	1.07
CV (%)	28.46	20.39	43.56	37.36	42.73	42.12	46.38	39.52	27.30	36.46
SYI	0.53	0.64	0.40	0.45	-	-	0.38	0.44	-	-
HFCL (78) 1998-200										

Year	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
Range	1641-1755	1092-1232	10450-14402	6954-10110	3138-8753	4584-6282	4312-5649	2370-3828	1.65-1.70	1.52-1.61
Mean	1698	1162	12426	8532	7446	5433	4981	3099	1.67	1.56
SD	80.61	98.99	2794.92	2232.07	1849.08	1200.67	945.84	1031.40	0.04	0.07
CV (%)	4.75	8.52	22.49	26.16	24.83	22.10	18.99	33.28	-	-
SYI	0.92	0.86	-	-	-	-	-	-	-	-
COOIT (60) 2010										
Mean	1866	1612	43851	37882	14250	12150	29601	25732	3.08	3.12
Bagli (10 2015										
	1052	1049	-	-	-	-	-	-	-	-
Maharashtra (1758) Amravati (207) 2007-19										
Range	787-2085	662-1845	14175-70234	11925-57144	8695-32544	7100-26996	3945-39254	2755-32096	0.98-3.11	0.96-3.23
Mean	1462	1252	41117	34796	21895	19370	19229	15268	1.90	1.86
SD	523.93	440.78	20697.77	16936.17	8990.34	8461.93	14224.75	11398.25	0.58	0.58
CV (%)	35.83	35.22	50.34	48.67	41.06	43.69	73.98	74.65	30.35	31.07
SYI	0.45	0.44	0.29	0.31	-	-	0.13	0.12	-	-
KVK, Krada (525) 2015-19										
Range	1836-2376	1561-2257	53920-71302	45844-62635	31404-38105	28923-36274	20533-39897	13718-32241	1.62-2.27	1.43-2.11
Mean	2023	1749	65517	56376	33716	32585	31801	23792	1.95	1.74
SD	224.31	299.67	6768.13	6864.29	2727.48	2657.90	7305.06	7237.51	0.26	0.26
CV (%)	11.09	17.14	10.33	12.18	8.09	8.16	22.97	30.42	13.46	15.08
SYI	0.76	0.64	0.82	0.79	-	-	0.61	0.51	-	-
Parbhani (470) 1989-2019										
Range	1194-2437	1034-1834	12176-72605	11561-58479	3069-33154	3282-31950	9395-39702	9084-46518	1.59-5.09	1.38-5.24
Mean	1911	1583	32357	26505	13751	12526	19207	14874	2.79	2.72
SD	316.06	243.70	20332.63	17100.09	10239.98	9922.36	12669.42	10117.97	1.09	1.11
CV (%)	16.54	15.39	62.84	64.52	74.46	79.21	65.96	68.02	39.17	40.89
SYI	0.63	0.66	0.17	0.16	-	-	0.16	0.18	-	-
Sangli (177) 2011-19										
Range	2600-3043	1845-2563	55846-109692	39025-84159	20156-42143	16070-39875	35690-64188	26482-50960	2.16-2.83	1.00-2.65
Mean	2828	2172	93146	55254	38162	34889	55007	36582	2.47	1.69
SD	195.66	239.74	15355.29	19388.23	7321.91	7813.24	9500.97	8212.06	0.23	0.71
CV (%)	6.92	11.04	16.49	35.09	19.19	22.39	17.27	22.45	9.40	42.19
SYI	0.85	0.75	0.75	0.44	-	-	0.71	0.56	-	-
Pune (383) 1989-2019										
Range	1683-2888	1000-2350	13295-95287	8257-78006	3505-33994	1690-31699	3325-61294	588-45854	1.33-4.67	1.08-4.95
Mean	2342	1758	39047	31056	16133	13471	22914	17585	2.46	2.39
SD	179.21	168.13	14226.10	13246.05	2194.22	3100.53	12568.55	10914.51	0.35	0.33
CV (%)	7.65	9.56	36.43	42.65	13.60	23.02	54.85	62.07	14.38	13.77
SYI	0.75	0.68	0.26	0.23	-	-	0.17	0.15	-	-
Rajasthan (1174) Kota (414) 1989-2019										
Range	868-3500	692-2340	8828-58266	4704-51265	2700-30273	2707-27028	5611-40002	4118-33035	1.27-5.68	1.24-6.95
Mean	1753	1384	28294	23281	11962	10092	16332	13021	2.63	2.72
SD	480.33	331.67	16015.77	14480.61	7467.17	6983.71	10369.68	8796.06	1.00	1.38
CV (%)	27.40	23.96	56.60	62.20	62.42	69.20	63.49	67.55	38.11	50.63
SYI	0.36	0.45	0.20	0.17	-	-	0.15	0.13	-	-
SRIJAN (729) 2012-19										

Year	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
Range	993-2072	664-1550	28907-60367	19308-43387	15677-21564	14137-19440	17727-42813	6965-23947	2.14-3.44	1.61-2.60
Mean	1625	1112	49282	33533	19172	17250	30109	16284	2.61	1.98
SD	385.39	326.61	10121.80	8185.95	4047.29	4117.33	8048.33	6700.30	0.44	0.42
CV (%)	23.71	29.37	20.54	24.41	21.11	23.87	26.73	41.15	16.90	20.99
SYI	0.60	0.51	0.65	0.58	-	-	0.61	0.40	-	-
ITC (31) 2010-11										
Range	533-874	417-789	11733-19236	9167-17362	3600-3600	--3200-3200	8133-14568	5967-14162	3.26-5.34	2.86-5.43
Mean	704	603	15485	13265	3600	3200	11351	10065	4.30	4.15
SD	241.12	263.04	5305.42	5794.74	0.00	0.00	4550.23	5794.74	1.47	1.81
CV (%)	377.02	479.85	376.89	480.55	0.00	0.00	440.97	633.34	376.89	480.55
SYI	0.53	0.43	0.53	0.43	-	-	0.47	0.30	-	-
Chhattisgarh (261) Raipur (261) 1995-2019										
Range	1057-2499	399-1772	4673-58904	2987-45403	6033-18995	4824-14825	4673-88400	2987-45403	0.28-5.78	0.28-6.01
Mean	1853	1250	35404	23191	11541	8119	23364	14657	3.10	3.00
SD	396.83	353.65	21249.55	12773.25	5169.90	3345.84	17694.10	11010.74	1.29	1.54
CV (%)	21.41	28.30	60.02	55.08	44.80	41.21	75.73	75.12	41.46	51.29
SYI	0.58	0.51	0.16	0.23	-	-	0.13	0.11	-	-
Karnataka (1305) Bangaluru (345) 1989-2017										
Range	1324-2452	800-2093	73548-10125	6000-62802	2285-28249	750-24811	6083-45299	3946-37991	2.44-7.67	2.21-9.26
Mean	1672	1361	31332	25808	9511	7787	21281	17432	4.12	4.93
SD	266.42	349.95	18396.38	16939.69	6846.94	6389.14	13354.14	12244.05	4.23	6.60
CV (%)	15.93	25.72	58.71	65.64	71.99	82.05	62.75	70.24	102.77	133.99
SYI	0.57	0.48	0.18	0.14	-	-	0.17	0.14	-	-
Dharwad (375) 1991-2019										
Range	1475-3259	1026-2108	12822-123842	8212-80085	4822-42488	3200-34900	8000-81354	5012-45185	1.41-2.73	1.22-2.76
Mean	2005	1509	39224	29038	14938	12224	24286	17193	3.08	3.03
SD	476.44	323.23	26141.56	17475.11	12525.28	10936.74	16932.78	10728.56	1.25	1.52
CV (%)	23.76	21.42	66.65	60.18	83.85	89.47	69.72	62.40	40.52	50.22
SYI	0.47	0.56	0.11	0.14	-	-	0.09	0.14	-	-
Ugarkghurd (585) 2008-19										
Range	1547-2134	1314-1793	35851-66816	29682-57376	20275-48337	18875-43937	7891-27708	6112-23221	1.21-2.32	1.16-2.05
Mean	1976	1670	51715	43700	32686	29660	19075	14284	1.69	1.56
SD	166.77	139.24	11128.24	10168.62	11945.47	10769.25	6039.69	5122.29	0.38	0.32
CV (%)	8.44	8.34	21.52	23.27	36.55	36.31	31.66	35.86	22.45	20.82
SYI	0.85	0.85	0.61	0.58	-	-	0.55	0.52	-	-
Telengana (110) Adilabad (110) 2008-19										
Range	1244-2785	1324-2352	27869-103320	24598-87255	13453-37256	12109-30668	14416-64275	12053-53313	1.85-4.52	1.67-3.64
Mean	2035	1680	60603	49384	26133	22632	34471	26756	2.41	2.22
SD	468.69	368.54	22039.20	17892.92	9741.27	7716.37	16122.83	12414.49	0.77	0.54
CV (%)	23.03	21.94	36.37	36.23	37.28	34.09	46.77	46.40	31.74	24.10
SYI	0.56	0.56	0.59	0.57	-	-	0.54	0.50	-	-
Andhra Pradesh (236) Lam (165) 1991-2007										
Range	1280-2800	1031-2650	2371-37765	2162-34246	2485-7975	2180-7450	2729-19065	1946-17127	0.77-3.00	0.80-3.02
Mean	1879	1680	13007	11511	6428	6004	6341	5507	1.94	1.90
SD	487.12	535.32	10496.49	9582.03	4436.56	4285.43	6814.33	6027.05	0.93	0.81

Year	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
CV (%)	25.93	31.86	80.70	83.24	69.02	71.38	107.47	109.44	47.78	42.77
SYI	0.50	0.43	0.07	0.06	-	-	-0.02	-0.03	-	-
CRIDA(71) 2005										
	905	642	15416	10936	7621	6674	7795	4262	2.02	1.64
Gujrat (143) KVK, Bharuch (101) 2013-19										
Range	1545-1731	1371-1687	41537-63603	36628-52534	13340-20108	12997-19756	22598-45005	18834-34604	2.19-3.76	2.06-3.43
Mean	1662	1451	51427	44730	17577	16747	33850	27982	2.99	2.72
SD	75.88	114.57	7615.71	5827.53	2512.13	2361.07	8161.15	5973.16	0.65	0.51
CV (%)	4.56	7.90	14.81	13.03	14.29	14.10	24.11	21.35	21.66	18.72
SYI	0.92	0.79	0.69	0.74	-	-	0.57	0.64	-	-
Devgarbaria (42) 2013-19										
Range	1431-2204	939-1108	27588-66125	27588-33250	21155-22075	15335-19800	21730-44050	11793-16640	1.99-3.00	1.68-1.80
Mean	1640	990	49186	29323	21768	17039	27419	13534	2.26	1.72
SD	376.32	79.38	11302.87	2639.67	414.90	1934.05	11088.77	2185.28	0.49	0.05
CV (%)	22.95	8.02	22.98	9.00	1.91	11.35	40.44	16.15	21.85	3.09
SYI	0.57	0.82	0.57	0.80	-	-	0.37	0.84	-	-
Lokbharti (13) 2016										
	1372	-	-	-	-	-	-	-	-	-
Uttarakhand (1035) Almora (628) 2011-19										
Range	1665-2057	1025-1389	81437-88559	60519-67622	44808-46142	44808-45892	31542-42417	15711-21730	1.75-1.92	1.35-1.47
Mean	1839	1255	84315	63852	45806	45223	36309	18630	1.84	1.41
SD	153.48	126.96	3752.18	3571.55	879.91	584.94	5560.02	3013.61	0.08	0.06
CV (%)	8.35	10.11	4.45	5.59	1.92	1.29	15.31	16.18	4.55	4.35
SYI	0.91	0.82	0.91	0.89	-	-	0.72	0.72	-	-
Pantnagar (437) 1989-2019										
Range	571-2440	1138-2107	12195-66145	7649-50326	2468-30768	1266-26362	9472-50805	5181-41320	0.92-8.61	1.43-5.81
Mean	1825	1474	31835	24805	11387	9193	21021	16149	3.21	3.18
SD	379.01	306.18	17097.61	13605.36	8487.67	7654.49	11953.79	8974.61	1.33	0.90
CV (%)	20.77	20.77	53.71	54.85	74.54	83.26	56.87	55.57	41.40	28.36
SYI	0.59	0.55	0.22	0.22	-	-	0.18	0.17	-	-
Himachal Pradesh (864) Palampur (864) 1990-2019										
Range	790-2500	690-1600	6007-73933	4419-57953	5560-39403	3557-34540	1909-35849	2692-25371	1.15-3.15	1.02-3.56
Mean	1664	1220	34695	26569	16340	12738	19373	14774	2.34	2.44
SD	379.94	249.69	20772.84	16732.52	10471.15	9795.12	10932.60	8587.21	0.57	0.69
CV (%)	22.84	20.46	59.87	62.98	64.08	76.90	56.43	58.12	24.51	28.49
SYI	0.51	0.61	0.19	0.17	-	-	0.24	0.24	-	-
Punjab (351) Ludhiana (351) 1990-2019										
Range	1211-2062	1450-1744	21318-71400	15400-36107	6400-30110	12000-13320	8090-46219	5875-19836	1.61-2.80	1.28-3.28
Mean	1620	1542	44534	25761	19125	12102	23748	12781	2.26	2.14
SD	258.06	123.31	16942.65	7920.96	13841.63	743.52	10316.66	6728.22	0.43	0.72
CV (%)	15.927	7.997	38.044	30.748	72.375	6.144	43.442	52.643	19.191	33.529
SYI	0.66	0.81	-	-	-	-	-	-	-	-
Manipur (126) Imphal (126) 2007-19										
Range	1100-1978	537-1177	49500-118704	27923-70611	12483-36710	10317-22154	25655-85159	8640-85159	1.80-5.57	1.57-5.56
Mean	1487	942	76130	47469	26714	17133	49326	28572	2.94	2.86
SD	255.34	198.41	25570.96	15421.83	8525.47	4414.66	19984.59	15193.66	0.90	1.01

Year	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
CV (%)	17.17	21.07	33.59	32.49	31.91	25.77	40.52	53.18	30.75	35.42
SYI	0.62	0.63	0.43	0.45	-	-	0.34	0.27	-	-
Nagaland (50) Medziphema (50) 2015-19										
Range	1367-1800	962 - 1160	82020-108000	57717-69600	28055-33109	7199-10369	53343-74891	35175-46860	2.74-3.26	2.56-3.05
Mean	1552	1051	93097	63045	30569	22303	62528	40742	3.04	2.83
SD	175.38	83.02	10521.10	4981.23	1789.60	818.09	9015.31	4539.08	0.21	0.18
CV (%)	11.30	7.90	11.30	7.90	5.85	3.67	14.42	11.14	6.78	6.33
SYI	0.86	0.83	0.76	0.83	-	-	0.71	0.77	-	-
Jharkhand (304) Ranchi (304) 1992-2019										
Range	920-1588	664-1148	9327-58904	6027-45403	3692-28080	2817-22490	5527-30824	3100-22913	1.22-3.25	1.39-3.00
Mean	1349	984	25661	18705	14204	10775	13700	9631	1.94	2.05
SD	191.71	135.38	15727.03	11859.08	7540.03	6292.57	8226.27	5769.21	0.50	0.47
CV (%)	14.21	13.76	61.29	63.40	53.08	58.40	60.05	59.90	25.66	22.87
SYI	0.73	0.74	0.17	0.15	-	-	0.18	0.17	-	-
Bihar (61) Dholi (61) 2015-19										
Range	1465-1847	1320-1427	51281-73889	53164-57078	24515-26302	22956-24222	26359-49374	28941-34121	2.41-3.01	2.19-2.49
Mean	1646	1367	64083	54803	25426	23807	38657	30996	2.68	2.31
SD	163.53	54.67	9557.47	2032.88	844.53	737.06	9633.02	2750.97	0.31	0.16
CV (%)	9.94	4.00	14.91	3.71	3.32	3.10	24.92	8.88	11.48	6.86
SYI	0.80	0.92	0.74	0.92	-	-	0.59	0.83	-	-
Tamilnadu (291) Coimbatore (291) 1990-2017										
Range	848-1890	687-1480	8135-52404	7756-40566	1750-29908	5055-26740	721-19502	799-14987	0.99-4.28	1.09-4.44
Mean	1390	1129	24021	19011	12818	11697	9505	6258	1.84	1.73
SD	296.14	214.31	14925.71	12143.88	8442.26	7850.07	6215.26	4227.34	0.68	0.70
CV (%)	21.30	18.97	62.13	63.88	65.86	67.11	65.39	67.55	36.73	40.72
SYI	0.58	0.62	0.17	0.17	-	-	0.17	0.14	-	-

Annexure II

Center wise frontline Demonstrations during 1898 to 2019

Year	Yield gap (kg/ha)	% increase	Additional cost (Rs/ha)	Additional returns (Rs/ha)	IBCR	Production efficiency (g/Rs)	
						IP	FP
Madhya Pradesh (6631)							
Indore (420)							
Range	258-1260	10.55-126.00	862-3954	3120-18996	1.42-17.04	62-456	39-431
Mean	514	41.40	2192	8562	4.75	213	212
SD	243.91	26.67	892.53	4305.03	3.58	112.14	120.30
CV (%)	47.46	64.42	40.71	50.28	75.26	52.64	56.86
Sehore (375) 1989-2019							
Range	254-1060	21.08-96.54	752-3262	3422-16617	1.40-12.23	50-503	42-496
Mean	552	44.94	2087	7717	3.83	221	207
SD	225.11	19.57	452.36	4849.56	2.46	123.98	119.96
CV (%)	40.79	43.54	21.68	62.84	64.24	56.12	58.03
Solidaridad (465) 2016-19							
Range	78-214	11.83-19.62	1443-2388	3151-7294	3.13-4.06	36-78	34-86
Mean	170	15.41	1863	5577	3.50	64	69
SD	62.35	3.42	444.21	1741.15	0.50	19.80	23.93
CV (%)	36.62	22.19	23.84	31.22	14.16	31.02	34.77
SOPA (3771) 2002-19							
Range	214-1026	26.42-66.97	1640-4600	4567-14093	2.13-6.13	58-312	57-356
Mean	491	37.21	3391	10077	2.98	153	150
SD	199.89	11.23	1001.34	4247.65	1.01	74.29	75.03
CV (%)	40.75	30.18	29.53	42.15	33.82	48.41	49.88
NICT, Indore (1150) 2008-15							
Range	187-585	30.23-41.86	3145-5948	8640-15312	1.51-2.94	41-172	41-169
Mean	482	37.06	4571	11956	2.61	113	115
SD	131.36	3.85	926.55	3274.07	0.46	43.61	43.57
CV (%)	27.24	10.38	20.27	27.38	17.63	38.43	37.96
Jabalpur (225) 1989-2003							
Range	250-1080	35.00-144.00	698-2585	1127-3607	0.56-5.12	105-1049	52-717
Mean	560	76.86	1529	2390	2.27	293	232
SD	255.67	32.78	584.81	958.16	1.41	267.16	190.52
CV (%)	45.69	42.64	38.24	40.08	62.13	91.29	82.05
ITC, MP (165) 2010-15							
Range	40-425	5.63-34.00	66-2287	880-13607	2.20-42.67	74-208	67-222
Mean	232	21.74	1224	7351	11.43	110	104
SD	148.82	11.34	829.28	5183.60	15.48	49.09	58.70
CV (%)	64.14	52.20	67.77	70.52	135.37	44.69	56.58
HFCL (78) 1998-200							
Range	523-549	39.64-42.55	1553-2479	3496-4292	1.73-2.32	201-267	196-238
Mean	536	41.11	2016	3894	2.03	234	217
SD	18.38	2.04	654.78	562.86	0.42	47.27	29.77
CV (%)	3.43	4.95	32.48	14.45	20.60	20.21	13.71
Maharashtra (1758)							
Amravati (207) 2007-19							
Range	**50-559**	6.13-28.00	1345-5548	1523-13565	1.00-6.81	29-207	29-215
Mean	210	16.72	2525	5493	2.48	77	77
SD	138.20	6.92	1572.39	4207.43	1.60	44.27	46.46
CV (%)	65.67	41.38	62.28	76.60	64.31	57.25	60.30

KVK, Karda (525) 2015-19							
Year	**Yield gap (kg/ha)**	**% increase**	**Additional cost (Rs/ha)**	**Additional returns (Rs/ha)**	**IBCR**	**Production efficiency (g/Rs)**	
						IP	**FP**
Range	119-423	5.27-27.39	683-2481	3286-14383	3.20-6.41	48-70	43-67
Mean	275	16.73	1564	8335	4.70	60	54
SD	108.29	7.84	770.44	3950.15	1.33	8.78	10.13
CV (%)	39.43	46.88	49.27	47.39	28.28	14.54	18.77
Parbhani (470) 1989-2019							
Range	220-650	13.00-40.56	322-4134	1593-13272	1.70-11.56	42-504	42-549
Mean	345	21.61	1547	5946	4.38	229	228
SD	111.38	6.49	963.24	3480.14	2.25	154.72	155.49
CV (%)	32.25	30.04	62.25	58.53	51.33	67.47	68.15
Sangli (177) 2011-19							
Range	444-1202	17.45-66.62	1625-4185	14165-64434	3.27-20.66	63-129	47-123
Mean	657	31.31	3273	30210	9.71	78	67
SD	230.11	14.93	776.02	19969.39	6.51	20.67	23.31
CV (%)	35.05	47.69	23.71	66.10	67.01	26.66	34.96
Pune (383) 1989-2019							
Range	221-1621	10.00-162.10	1482-5164	3976-15442	1.25-8.72	74-724	69-618
Mean	583	37.06	2655	7907	3.41	212	206
SD	130.45	6.66	1122.64	3150.02	2.09	4.68	5.20
CV (%)	22.38	17.97	42.28	39.84	61.18	2.21	2.52
Rajasthan (1174)							
Kota (414) 1989-2019							
Range	156-1160	13.25-87.70	492-3245	1943-9900	1.23-8.05	43-887	42-798
Mean	369	27.01	1864	5013	2.96	234	242
SD	211.95	14.68	708.33	2029.61	1.51	198.60	217.56
CV (%)	57.50	54.36	38.01	40.49	51.00	84.97	89.76
SRIJAN (729) 2012-19							
Range	329-762	30.30-83.47	779-3417	9599-23609	6.34-17.45	66-111	40-84
Mean	513	47.21	1922	15752	9.12	86	66
SD	136.12	18.75	778.14	4668.17	3.81	15.48	15.55
CV (%)	26.53	39.72	40.48	29.64	41.83	18.06	23.70
ITC (31) 2010-11							
Range	85-116	10.77-21.87	400-400	1870-2552	4.68-6.38	148-243	130-247
Mean	101	19.29	400	2211	5.53	195	188
SD	21.92	12.05	0.00	482.25	1.20	66.98	82.20
CV (%)	239.92	687.09	0.00	239.92	239.11	377.02	479.85
Chhattisgarh (261)							
Raipur (261) 1995-2019							
Range	300-1593	25.32-164.91	952-8697	1686-56620	2.27-6.72	67-310	36-364
Mean	604	49.93	3422	12072	4.09	191	183
SD	264.85	31.25	2353.78	12357.84	1.32	82.18	91.66
CV (%)	43.85	62.58	68.79	102.37	32.33	43.01	50.19
Karnataka (1305)							
Bengaluru 345) 1989-2017							
Range	193-672	11.59-110.70	625-3438	1932-8419	1.00-7.34	81-758	79-1415
Mean	349	31.74	1746	5189	3.44	260	307
SD	143.31	23.27	760.63	1693.01	1.50	173.18	320.33
CV (%)	41.04	73.31	43.57	32.63	43.62	66.56	104.44
Dharwad (375) 1991-2019							
Range	68-1151	5.17-76.25	1050-8512	2084-56620	1.74-27.81	42-448	38-421

Mean	496	33.49	2729	10473	4.31	204	203
SD	262.04	16.28	2140.18	11426.22	5.13	104.04	108.55
CV (%)	52.84	48.61	78.43	109.10	119.04	50.91	53.57
Ugarkhurd (585) 2008-2019							
Range	232-377	13.74-21.45	1400-5200	6400-9440	2.03-5.92	46-113	39-93
Mean	306	18.36	3027	7978	3.05	76	64
SD	47.58	2.48	1338.17	1285.40	1.24	29.00	23.47
CV (%)	15.53	13.49	44.21	16.11	40.56	38.35	36.90
Telengana (110)							
Adilabad (110) 2008-19							
Range	81-898	4.85-53.68	454-6621	2187-24831	1.00-10.38	55-141	49-119
Mean	355	21.39	3501	8847	3.60	86	80
SD	207.68	12.26	2248.87	6411.18	2.85	29.15	23.82
CV (%)	58.43	57.33	64.24	72.46	79.22	33.96	29.73
Andhra Pradesh (236)							
Lam (165) 1991-2007							
Range	89-560	4.20-25.69	383-1581	770-3525	1.46-4.17	135-569	133-606
Mean	212	12.32	661	2002	2.99	369	360
SD	138.91	7.37	339.44	1059.42	1.07	149.06	152.80
CV (%)	65.39	59.86	51.37	52.93	35.82	40.42	42.50
CRIDA (71) 2005							
	263	43.33	947	4480	3.73	119	96
Gujrat (143)							
KVK, Bharuch (101) 2013-19							
Range	38-299	2.25-21.07	352-1519	1121-10401	3.18-17.75	84-118	78-105
Mean	211	14.92	830	6123	9.02	96	88
SD	91.55	6.64	450.76	3280.66	6.49	14.25	11.46
CV (%)	43.33	44.53	54.32	53.58	71.97	14.81	13.04
Devgarbaria (42) 2016-19							
Range	490-1096	33.60-98.92	2275-5820	9823-22875	1.69-14.45	66-100	56-60
Mean	650	50.59	4729	14865	5.29	75	58
SD	297.84	32.23	1659.81	6243.85	6.15	16.41	2.51
CV (%)	45.84	63.70	35.10	42.00	116.23	21.82	4.30
Uttarakhand (1035)							
Almora 628) 2011-19							
Range	414-834	33.36-68.19	250-1500	18021-22431		38-40	27-30
Mean	583	48.21	583	20463		39	29
SD	138.86	12.74	803.64	2242.88		1.37	1.66
CV (%)	23.81	26.42	137.77	10.96		3.53	5.73
Pantnagar (437) 1989-2019							
Range	75-576	11.00-86.53	391-4406	1266-15819	1.07-7.90	49-672	47-645
Mean	351	27.59	2210	5801	2.88	243	257
SD	149.66	15.65	1035.08	3540.55	1.46	161.86	167.88
CV (%)	42.70	56.70	46.83	61.03	50.66	66.55	65.27
Himachal Pradesh (864)							
Palampur (864) 1990-2019							
Range	186-1396	17.74-126.39	1627-3000	1588-13981	0.98-4.23	32-363	29-379
Mean	465	39.31	3555	7876	2.33	143	152
SD	270.25	24.43	1434.51	3410.82	0.99	90.58	96.77
CV (%)	58.12	62.14	40.36	43.31	42.59	63.18	63.83
Punjab (351)							
Ludhiana (351) 1990-2019							
Range	86-561	5.80-38.42	500-6000	1936-6000	4.42-13.46	100-165	116-147
Mean	344	22.89	1545	5098	9.98	140	128
SD	178.89	12.69	2202.18	1706.49	3.37	23.73	13.19

CV (%)	52.078	55.468	142.521	33.476	33.734	16.894	10.318
Manipur (126)							
Imphal (126) 2007-19							
Range	300-801	25.88-118.40	2166-14556	6000-38021	1.25-5.59	41-117	29-112
Mean	545	61.68	9604	20796	2.91	62	60
SD	156.21	23.75	4523.51	9790.35	1.45	24.70	26.05
CV (%)	28.65	38.50	47.10	47.08	49.72	40.02	43.46
Meghalaya (50)							
Medziphema (50) 2015-19							
Range	394-694	40.49-55.20	7199-10369	20424-24421	2.53-3.28	52-54	43-51
Mean	501	47.66	8266	22755	2.79	51	47
SD	94.20	5.45	1219.13	1501.41	0.36	3.44	2.98
CV (%)	18.81	11.43	14.75	6.60	12.82	6.78	6.33
Jharkhand (304)							
Ranchi (304) 1992-2019							
Range	140-513	17.95-55.80	873-5590	1680-13501	1.80-4.20	52-406	50-376
Mean	378	38.92	3429	7336	2.30	134	130
SD	88.79	9.28	1536.83	3739.06	0.80	106.44	93.89
CV (%)	23.49	23.84	44.82	50.97	34.64	79.32	72.18
Bihar (61)							
Dholi (61) 2015-19							
Range	257-420	19.47-29.45	1559-2080	10236-15364	4.92-9.86	60-75	54-62
Mean	339	24.65	1786	12491	7.23	67	58
SD	81.50	5.00	266.76	2619.38	2.49	7.82	4.09
CV (%)	24.04	20.29	14.93	20.97	34.40	11.69	7.12
Tamilnadu (291)							
Coimbatore (291) 1990-2017							
Range	131-538	12.16-32.00	892-3168	1691-10760	0.97-4.92	132-538	40-274
Mean	267	23.07	1886	4551	2.46	166	136
SD	98.22	5.70	818.67	2887.56	1.05	137.49	73.62
CV (%)	36.73	24.71	43.41	63.45	42.58	82.73	53.98

Annexure III

Varietal performance under frontline demonstrations of Soybean during 2011-2019

Variety	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C Ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
JS 95 60 (3793)										
Range	1148-1695	996-1373	30909-55631	25567-43032	13472-20490	11413-19194	22091-38528	18033-28357	2.01-3.25	1.61-2.99
Mean	1476	1176	46904	36555	18061	15639	29087	21605	2.39	2.19
SD	199.32	199.22	7619.82	6386.09	2588.31	2627.57	5673.65	4970.24	0.46	0.45
CV (%)	13.51	16.95	16.25	17.47	14.33	16.80	19.51	23.00	19.31	20.54
SYI/SVI	0.72	0.71	0.72	0.70	-	-	0.61	0.59	-	-
JS 93 05 (816)										
Range	1402-2019	1055-1698	47636-61478	35788-50164	14672-32630	12317-29806	21842-40089	11846-28531	1.56-2.99	1.13-2.70
Mean	1685	1362	52000	41547	24692	21910	27954	20165	2.10	1.90
SD	205.73	205.39	9274.80	7749.65	5309.99	5293.98	6236.06	5455.98	0.42	0.48
CV (%)	12.21	15.08	17.84	18.65	21.51	24.16	22.31	27.06	20.14	25.47
SYI/SVI	0.73	0.68	0.69	0.67	-	-	0.73	0.52	-	-
JS 335 (384)										
Range	1480-3217	835-2533	55323-94530	32990-70933	19251-34031	14752-27574	26024-68225	13154-53150	1.67-3.14	1.36-3.10
Mean	1960	1424	70095	48985	27851	21614	42251	27384	2.21	2.01
SD	532.40	496.81	16281.50	11854.46	5068.90	4035.49	14951.64	12350.45	0.48	0.56
CV (%)	27.16	34.90	23.23	24.20	18.20	18.67	35.39	45.10	21.75	27.65
SYI/SVI	0.44	0.37	0.57	0.52	-	-	0.40	0.28	-	-
RKS 18 (157)										
Range	1474-2080	932-1527	36882-90384	28620-65991	17417-33172	12861-24252	19465-56566	15726-42506	1.73-2.55	1.62-2.47
Mean	1770	1350	67792	49273	26198	19879	41593	29393	2.17	2.10
SD	164.95	179.21	19922.78	11891.07	5658.72	3738.46	14336.30	8339.58	0.23	0.25
CV (%)	9.32	13.28	29.39	24.13	21.60	18.81	34.47	28.37	10.53	11.87
SYI/SVI	0.77	0.77	0.53	0.57	-	-	0.46	0.50	-	-
NRC 7 (64)										
Range	1128-1574	860-1212	13300-50180	10100-38617	29820-16306	13387-22701	16520-33227	12601-105319	0.45-2.96	0.44-2.88
Mean	1374	1051	35821	27411	21026	16907	25808	47717	2.03	1.87
SD	226.53	177.91	19748.35	15207.17	7622.41	5056.05	8508.87	50283.14	1.38	1.27
CV (%)	16.49	16.93	55.13	55.48	36.25	29.90	32.97	105.38	67.92	67.91
SYI/SVI	0.73	0.72	0.32	0.32	-	-	0.52	-0.10	-	-
MUUS 81 (24)										
Range	1480-2400	1264-2088	47848-48552	40857-41412	18700-28425	15928-26031	19426-31700	14826-27141	1.68-2.60	1.57-2.60
Mean	1940	1676	48200	41135	23563	20980	25562	20984	2.14	2.08
SD	650.54	582.66	497.80	392.44	6876.61	7143.90	8681.15	8708.02	0.65	0.73
CV (%)	33.53	34.76	1.03	0.95	29.18	34.05	33.96	41.50	30.17	34.95
SYI/SVI	0.54	0.52	0.98	0.98	-	-	0.53	0.45	-	-
VLS 47 (151)										
Range	1872-2245	1382-1493	49188-78909	30625-61226	17000-45642	11000-44892	27600-34552	15644-21500	0.73-2.89	0.35-3.09
Mean	1977	1424	68201	49104	37964	35714	32109	17626	1.78	1.55
SD	128.17	46.67	14403.06	15381.95	13991.70	16490.01	3080.30	2727.49	0.88	1.14
CV (%)	6.48	3.28	21.12	31.33	36.86	46.17	9.59	15.47	49.57	73.35
SYI/SVI	0.82	0.92	0.68	0.56	-	-	0.84	0.69	-	-
Hara soya (166)										

Variety	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C Ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
Range	1172-1793	893-1359	43458-72970	32890-57833	17000-39403	11000-34972	23538-35849	16340-27055	1.04-2.95	0.80-3.46
Mean	1396	1077	59250	45980	28684	24392	30566	21589	1.65	1.55
SD	216.58	152.67	10721.22	9432.06	8659.56	8991.03	4331.65	3719.80	0.72	0.93
CV (%)	15.52	14.18	18.09	20.51	30.19	36.86	14.17	17.23	43.75	60.01
SYI/SVI	0.66	0.68	0.67	0.63	-	-	0.73	0.70	-	-
JS 97 52 (140)										
Range	1280-2109	813-872	24957-85061	18869-52854	10200-32633	6800-22257	14757-52428	12069-30598	1.30-4.81	1.20-4.97
Mean	1530	1015	58499	38334	21542	15197	36957	23134	2.18	2.09
SD	297.06	143.53	19610.61	11640.51	7922.63	5876.38	13689.30	7350.42	1.05	1.19
CV (%)	19.41	14.14	33.52	30.37	36.78	38.67	37.04	31.77	48.23	56.96
SYI/SVI	0.58	0.68	0.46	0.51	-	-	0.44	0.52	-	-
VLS 63 (87)										
Range	1936-2266	1378-1660	49325-87330	31306-68060	44058-45642	43308-44892	35333-41688	13187-23168	0.91-1.80	0.52-1.30
Mean	2068	1484	68174	47331	44850	44100	38511	18178	1.36	0.91
SD	132.66	111.05	18081.86	17914.80	1120.06	1120.06	4493.66	7057.63	0.63	0.55
CV (%)	6.41	7.48	26.52	37.85	2.50	2.54	11.67	38.83	46.44	60.61
SYI/SVI	0.91	0.83	0.57	0.43	-	-	0.82	0.48	-	-
MACS 450 (19)										
Range	2070-2625	1602-2250	41400-78750	32040-70667	24800-34827	21255-31575	16600-47661	10785-42483	1.67-2.54	1.51-2.51
Mean	2384	2020	66272	56736	30211	27004	36061	29731	2.16	2.05
SD	284.74	362.61	21540.11	21445.62	5060.55	5259.99	16957.32	16732.16	0.44	0.51
CV (%)	11.94	17.95	32.50	37.80	16.75	19.48	47.02	56.28	20.57	24.66
SYI/SVI	0.80	0.74	0.57	0.50	-	-	0.40	0.31	-	-
MAUS 2 (35)										
Range	1550-2503	1305-2139	31000-75096	26100-64164	12476-28373	9195-24920	18524-46723	16205-39245	2.44-3.37	2.38-3.29
Mean	2007	1737	53761	46587	19563	17070	34197	29418	2.76	2.76
SD	278.27	243.13	14921.73	13039.34	5445.31	5210.51	10218.02	8627.56	0.33	0.30
CV (%)	13.86	13.99	27.76	27.99	27.83	30.52	29.88	29.33	12.06	10.85
SYI/SVI	0.69	0.70	0.52	0.52	-	-	0.51	0.53	-	-
SL 525 (25)										
Range	1339-2140	1571-1836	31030-80750	26622-35184	12613-26903	12218-15996	18418-53847	14404-19188	1.86-3.00	2.18-2.20
Mean	1849	1704	53609	30903	21457	14107	32142	16796	2.27	2.19
SD	340.35	187.38	21752.95	6054.25	6164.37	2671.45	16830.55	3382.80	0.48	0.01
CV (%)	18.40	11.00	40.58	19.59	28.73	18.94	52.36	20.14	21.16	0.67
SYI/SVI	0.71	0.83	0.39	0.71	-	-	0.28	0.70	-	-
SL 744 (18)										
Range	1474-1900	1815-1815	42560-58200	40656-40656	17888-25181	16950-16950	24673-33019	23706-23706	1.31-2.38	2.40-2.40
Mean	1664	1815	50786	40656	22750	16950	28036	23706	1.91	2.40
SD	216.80	-	7851.55	-	4210.62	-	4402.34	-	0.55	-
CV (%)	13.03	0.00	15.46	0.00	18.51	-	15.70	0.00	28.62	0.00
SYI/SVI	0.76	-	0.74	*	-	-	0.72	-	-	-
PS 1347 (36)										
Range	1383-2500	1223-2000	37122-75000	33727-60000	12500-31325	9600-27239	24550-49490	24127-42896	1.51-4.43	1.46-4.83
Mean	1789	1502	55067	46039	22059	18716	34478	28656	2.62	2.71
SD	376.09	297.07	12967.86	9539.61	8149.62	7778.66	12159.40	10171.40	0.93	1.15

Variety	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C Ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
CV (%)	21.02	19.78	23.55	20.72	36.94	41.56	35.27	35.49	35.56	42.32
SYI/SVI	0.57	0.60	0.56	0.61	-	-	0.45	0.47	-	-
CO3 (42)										
Range	1268-2534	1030-2043	49410-55743	39477-44935	25750-29908	23500-26740	13082-19502	7826-12737	1.64-1.68	1.33-1.56
Mean	1532	1233	47058	37862	29120	26308	17937	11676	1.61	1.44
SD	493.28	398.14	5583.18	4448.97	3389.15	2556.10	2560.66	2433.71	0.06	0.08
CV (%)	32.19	32.28	11.86	11.75	11.64	9.72	14.28	20.84	3.80	5.40
SYI/SVI	0.41	0.41	0.74	0.74	-	-	0.75	0.61	-	-
PS 1092 (27)										
Range	1235-1903	948-1555	34580-54413	26620-43200	12500-28200	9600-24700	20480-39040	15420-35900	0.51-3.64	0.50-3.78
Mean	1471	1188	45040	35904	19990	16768	26715	21311	2.30	2.28
SD	235.58	208.80	8339.93	6543.68	6832.40	6516.30	8258.89	8158.38	0.92	1.02
CV (%)	16.02	17.58	18.52	18.23	34.18	38.86	30.92	38.28	40.13	44.84
SYI/SVI	0.65	0.63	0.68	0.68	-	-	0.47	0.37	-	-
Bragg (7)										
Range	1292-1888	975-1450	38750-47188	29250-36250	17000-20500	11000-16000	18250-30188	13250-25250	1.89-2.78	1.83-3.30
Mean	1590	1213	42969	32750	18750	13500	24219	19250	2.33	2.56
SD	421.44	335.88	5966.57	4949.75	2474.87	3535.53	8441.44	8485.28	0.63	1.04
CV (%)	26.51	27.70	13.89	15.11	13.20	26.19	34.85	44.08	26.84	40.50
SYI/SVI	0.62	0.60	0.78	0.77	-	-	0.52	0.43	-	-
RKS 24 (6)										
Range	1938-2395	1625-2100	52690-63938	46200-53625	14218-20933	12888-18000	38472-43005	33312-35625	3.05-3.71	2.98-3.58
Mean	2167	1863	58314	49913	17576	15444	40739	34469	3.38	3.28
SD	323.15	335.88	7953.54	5250.27	4748.22	3614.73	3205.32	1635.54	0.46	0.43
CV (%)	14.92	18.03	13.64	10.52	27.02	23.41	7.87	4.75	13.63	13.05
SYI/SVI	0.77	0.73	0.79	0.83	-	-	0.87	0.92	-	-
DSb 1 (4)										
Range	1608-2563	1125-1550	48240-62100	33750-50940	12500-33430	10000-28368	28670-49000	22572-36200	1.86-4.92	1.80-3.72
Mean	1965	1363	57280	40630	20143	16456	37137	27174	3.37	2.86
SD	425.30	177.31	6396.94	7425.08	9430.50	8432.94	8640.23	6382.76	1.25	0.80
CV (%)	21.64	13.01	11.17	18.27	46.82	51.25	23.27	23.49	37.13	27.93
SYI/SVI	0.60	0.77	0.82	0.65	-	-	0.58	0.57	-	-
PS 1042 (10)										
Range	1425-2000	1225-1562	40135-71533	35926-56100	12500-28083	9600-25500	19490-61142	17200-47100	0.76-3.97	0.85-3.90
Mean	1658	1396	49814	41380	20449	17245	32313	26830	2.55	2.60
SD	257.95	169.14	13126.98	8341.32	7890.78	7980.73	17410.05	12739.60	0.88	1.01
CV (%)	15.56	12.12	26.35	20.16	38.59	46.28	53.88	47.48	34.44	38.96
SYI/SVI	0.70	0.79	0.51	0.59	-	-	0.24	0.30	-	-
Shivalik (2)										
Range	1000-1750	775-1400	35000-43750	27125-35000	17000-19920	11000-16550	15080-26750	10575-24000	0.76-2.57	0.64-3.18
Mean	1375	1088	39375	31063	18460	13775	20915	17288	1.67	1.91
SD	381.88	326.28	5448.62	5414.58	4324.25	4678.94	5892.72	6712.69	1.05	1.41
CV (%)	27.77	30.00	13.84	17.43	23.42	33.97	28.17	38.83	62.82	73.83
SYI/SVI	0.57	0.54	0.75	0.68	-	-	0.56	0.44	-	-
SL 688 (2)										
Range	1525-	1450-	30088-	25738-	12775-	12445-	17313-	13293-	2.06-	2.05-

Variety	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C Ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
	2075	1775	34160	32480	16545	15865	17615	16615	2.36	2.07
Mean	1800	1613	32124	29109	14660	14155	17464	14954	2.21	2.06
SD	388.91	229.81	2879.34	4767.31	2665.79	2418.31	213.55	2349.01	0.21	0.01
CV (%)	21.61	14.25	8.96	16.38	18.18	17.08	1.22	15.71	9.30	0.72
SYI/SVI	0.68	0.78	0.86	0.75			0.98	0.76		
MAUS 61 2 (18)										
Range	1626-2555	1399-2170	49804-60910	43147-51461	16754-33154	14499-31950	24158-34955	19116-29610	1.85-2.97	1.73-2.98
Mean	1977	1689	54238	46349	24258	22127	29980	24221	2.38	2.29
SD	405.53	339.79	4734.80	3571.92	7825.26	8336.55	4933.47	5682.86	0.63	0.72
CV (%)	20.51	20.12	8.73	7.71	32.26	37.68	16.46	23.46	26.28	31.48
SYI/SVI	0.61	0.62	0.81	0.83			0.72	0.63		
BSS 2(13)										
Range	1057-1543	740-1140	26187-52454	18506-38760	11200-24370	8400-20150	13170-28084	8830-18610	0.71-2.34	0.66-2.20
Mean	1263	907	36787	26489	18040	13973	18747	12515	1.40	1.26
SD	251.16	208.01	13847.19	10786.59	6599.80	5898.19	8136.96	5316.56	0.84	0.83
CV (%)	19.88	22.93	37.64	40.72	36.58	42.21	43.40	42.48	60.19	65.51
SYI/SVI	0.66	0.61	0.44	0.41			0.38	0.39		
DSb 21 (142)										
Range	1478-2905	1158-2065	48188-110390	34734-78740	14500-47362	11000-42962	13966-67902	7781-43570	1.50-2.60	1.30-2.25
Mean	2114	1612	68883	52501	35825	30973	33195	21528	2.13	1.95
SD	437.98	295.99	20031.80	13010.09	9448.06	8990.71	20444.15	14561.98	1.06	1.17
CV (%)	20.72	18.36	29.08	24.78	26.37	29.03	61.59	67.64	49.57	59.84
SYI/SVI	0.58	0.64	0.44	0.50			0.19	0.16		
MACS 1188 (60)										
Range	1647-2996	1360-2438	56832-98882	46907-81281	18631-34416	17112-32130	38201-64466	27847-50978	2.05-2.85	1.74-2.51
Mean	2516	2134	79248	67199	30101	27485	49147	39714	2.55	2.37
SD	426.76	364.60	12763.96	11142.29	5609.23	5739.25	9337.99	8236.25	0.37	0.49
CV (%)	16.97	17.09	16.11	16.58	18.63	20.88	19.00	20.74	14.48	20.57
SYI/SVI	0.70	0.73	0.67	0.70			0.62	0.66		
KDS 344 (139)										
Range	2481-3013	1845-2358	84114-109692	39025-66519	36072-42143	31887-39875	42222-67550	27494-44284	2.11-2.43	1.70-2.11
Mean	2780	2118	94870	54684	40835	37527	54036	34574	2.32	1.92
SD	200.90	193.99	9580.90	17809.42	2282.45	2988.10	8816.39	5979.89	0.21	0.16
CV (%)	7.23	9.16	10.10	32.57	5.59	7.96	16.32	17.30	9.10	8.29
SYI/SVI	0.85	0.82	0.83	0.44			0.67	0.65		
MACS 1281 (28)										
Range	1739-3245	1462-2600	60384-107085	49989-85800	22580-35746	20752-33159	37804-71339	29238-52641	2.26-3.01	2.01-2.70
Mean	2645	2145	83542	67767	31152	28788	52391	39046	2.68	2.36
SD	607.87	423.15	17840.67	13841.58	5307.50	4962.87	13572.35	10610.30	0.28	0.30
CV (%)	22.98	19.72	21.36	20.43	17.04	17.24	25.91	27.17	10.49	12.79
SYI/SVI	0.63	0.66	0.61	0.63			0.54	0.54		
PS 1225 (13)										
Range	1310-2040	1100-1780	39955-64925	33550-53795	14100-31325	11200-27239	11955-43020	8050-38640	1.15-4.05	1.18-4.45
Mean	1738	1428	54904	45045	24063	20440	30841	24605	2.35	2.35
SD	255.57	226.02	9689.94	7730.88	7853.72	7387.02	10303.64	9821.30	1.12	1.27
CV (%)	14.70	15.82	17.65	17.16	32.64	36.14	33.41	39.92	47.57	54.19

Variety	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C Ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
SYI/SVI	0.73	0.68	0.70	0.74			0.48	0.38		
NRC 37 (90)										
Range	1046-1965	923-1448	40775-63603	27588-52534	14712-21930	14091-19778	21730-45005	11793-34604	2.00-2.77	1.54-2.18
Mean	1545	1149	49597	36992	19587	16697	30010	21009	2.31	1.91
SD	293.52	256.24	8951.36	9724.80	2703.98	1819.58	10055.99	8801.85	0.32	0.25
CV (%)	18.99	22.30	18.05	26.29	13.80	10.90	33.51	41.90	13.73	12.89
SYI/SVI	0.64	0.62	-0.64	-0.52	-	-	0.44	0.35	-	-
NRC 86 (8)										
Range	1215-2098	633-1650	40145-81822	22167-64350	17995-20005	15495-17333	20141-63827	4833-11964	2.01-4.55	1.28-4.15
Mean	1522	1080	54831	38570	19267	16686	35564	21710	2.90	2.38
SD	396.94	519.54	23405.45	22600.83	1106.06	1032.46	24510.26	23329.69	1.43	1.55
CV (%)	26.09	48.11	42.69	58.60	5.74	6.19	68.92	107.46	49.13	65.26
SYI/SVI	0.54	0.34	0.38	0.25	-	-	0.17	-	-	
MAUS 162 (161)										
Range	892-2020	783-1706	29436-74905	25839-60325	25568-32903	24483-31779	3868-42002	3356-28546	1.15-2.27	1.05-1.92
Mean	1598	1330	54280	45134	30040	28595	24011	16343	1.77	1.55
SD	495.66	396.98	18344.20	14529.54	3144.81	3155.24	15421.68	11671.20	0.45	0.36
CV (%)	31.02	29.84	33.80	32.19	10.47	11.03	64.23	71.41	25.24	23.42
SYI/SVI	0.55	0.55	0.48	0.51	-	-	0.20	0.16	-	-
MAUS 158 (345)										
Range	1257-2376	1056-2257	43995-72568	36960-59958	26408-35504	25323-34027	16023-37064	10940-25932	1.57-2.06	1.42-1.87
Mean	1788	1559	58140	50472	31326	29955	26814	20517	1.85	1.68
SD	376.93	398.27	10496.00	9879.36	3520.17	3645.36	7480.43	6742.50	0.18	0.17
CV (%)	21.08	25.54	18.05	19.57	11.24	12.17	27.90	32.86	9.74	10.19
SYI/SVI	0.59	0.51	0.66	0.65	-	-	0.52	0.47	-	-
PS 1368 (9)										
Range	1352-2138	1100-1800	36143-74200	33105-60800	14500-28000	11700-25500	8143-58200	8050-47300	1.29-2.79	1.32-2.83
Mean	1633	1381	53753	45364	24003	20750	32751	27614	2.00	2.05
SD	441.20	341.84	18350.49	14173.97	6442.83	6512.30	21075.75	16791.66	0.73	0.68
CV (%)	27.03	24.75	34.14	31.25	26.84	31.38	64.35	60.81	36.48	33.39
SYI/SVI	0.56	0.58	0.48	0.51	-	-	0.20	0.23	-	-
SL 958 (50)										
Range	1559-2250	-	53332-81000	-	25181-34398	-	26144-55819	-	1.68-2.45	-
Mean	1843	-	62404	-	29052	-	34957	-	2.03	-
SD	254.84	-	10038.75	-	3187.51	-	13057.62	-	0.27	-
CV (%)	13.83	-	16.09	-	10.97	-	37.35	-	13.45	-
SYI/SVI	0.71	-	0.65	-	0.75	-	0.39	-		-
RVS 2001-4 (26)										
Range	743-1410	670-1043	41786-48522	20100-31286	18164-24922	16017-16017	23622-30358	4083-15269	2.30-2.67	1.25-1.95
Mean	1182	864	44204	25786	18164	16017	26040	9769	2.43	1.61
SD	380.28	186.95	3748.20	5595.34	0.00	0.00	3748.20	5595.34	0.21	0.35
CV (%)	32.17	21.64	8.48	21.70	0.00	0.00	14.39	57.27	8.45	21.80
SYI/SVI	0.57	0.65	0.83	0.65	-	-	0.73	0.27	-	-
JS 20 29 (104)										
Range	1306-2383	813-1976	45697-71481	28438-59276	19200-22600	17205-21200	25897-52281	10225-42071	2.31-3.72	1.55-3.45

Variety	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C Ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
Mean	1691	1324	55723	43389	20882	19361	34841	24029	2.68	2.26
SD	425.18	442.71	9498.88	11103.59	1413.19	1736.77	10103.73	11696.01	0.59	0.72
CV (%)	25.14	33.44	17.05	25.59	6.77	8.97	29.00	48.67	21.82	31.92
SYI/SVI	0.53	0.45	0.65	0.54	-	-	0.47	0.29	-	-
JS 20 34 (111)										
Range	1143-2377	590-1886	40005-71308	20650-56565	19200-21255	17205-21399	19928-52108	3174-39360	1.93-3.71	1.18-3.29
Mean	1541	1139	51198	37905	20208	18441	30990	19458	2.54	2.06
SD	487.28	478.96	12615.88	13377.12	930.80	1767.10	13172.99	13873.48	0.72	0.81
CV (%)	31.62	42.06	24.64	35.29	4.61	9.58	42.51	71.30	28.20	39.43
SYI/SVI	0.44	0.35	0.54	0.43	1.00	0.97	0.34	0.14	0.49	0.38
JS 20 69 (19)										
Range	1195-2330	983-2175	46154-78987	38062-73733	21900-22743	21000-23099	23412-57087	14964-52733	2.06-3.61	1.70-3.51
Mean	1763	1579	62571	55898	22322	22050	40250	33849	2.84	2.61
SD	802.57	842.87	23216.44	25223.21	596.09	1484.22	23811.82	26706.72	1.10	1.28
CV (%)	45.54	53.38	37.10	45.12	2.67	6.73	59.16	78.90	38.66	49.13
SYI/SVI	0.41	0.34	0.50	0.42	-	-	0.29	0.14	-	-
Basar (30)										
Range	1988-2785	1708-2352	69715-103320	59945-87255	31350-39503	25282-33943	36381-63816	31215-53313	2.09-2.62	2.06-2.52
Mean	2405	2043	81407	69164	34850	30005	46558	39160	2.33	2.31
SD	332.53	277.71	14934.51	12313.89	3479.89	3815.92	12023.52	9859.57	0.24	0.27
CV (%)	13.83	13.59	18.35	17.80	9.99	12.72	25.83	25.18	10.50	11.66
SYI/SVI	0.74	0.75	0.64	0.65	-	-	0.54	0.55	-	-
DSb 19 (23)										
Range	1511-1881	916-1270	90647-116310	54933-75000	31624-36710	20975-23812	53937-84686	32061-54025	1.47-2.78	1.40-2.71
Mean	1690	1095	100053	64044	34222	22415	65831	41629	2.20	2.12
SD	158.84	144.96	11217.29	8749.03	2087.06	1211.92	13208.13	9362.22	0.64	0.63
CV (%)	9.40	13.24	11.21	13.66	6.10	5.41	20.06	22.49	28.96	29.55
SYI/SVI	0.81	0.75	0.76	0.74	-	-	0.62	0.60	-	-
PUSA 97 12 (28)										
Range	1514-1847	1278-1427	60560-73889	51100-57078	24515-25969	22956-24243	34591-49374	27226-34121	2.33-3.01	2.14-2.49
Mean	1685	1353	67403	54115	25482	23691	41921	30424	2.65	2.29
SD	166.68	74.51	6671.67	2989.35	837.74	662.87	7392.28	3474.48	0.34	0.18
CV (%)	9.89	5.51	9.90	5.52	3.29	2.80	17.63	11.42	12.90	7.95
SYI/SVI	0.82	0.90	0.82	0.90	-	-	0.70	0.79	-	-
GJS 3 (27)										
Range	1575-1695	1377-1495	41534-43322	36628-37871	18714-18938	17552-17794	22598-24608	18834-20319	1.31-2.19	1.16-2.06
Mean	1635	1436	42430	37250	18826	17673	23603	19577	1.75	1.61
SD	84.85	83.44	1262.19	878.93	158.39	171.12	1421.28	1050.05	0.62	0.64
CV (%)	5.19	5.81	2.97	2.36	0.84	0.97	6.02	5.36	35.56	39.53
SYI/SVI	0.91	0.90	0.95	0.96	-	-	0.90	0.91	-	-
RVS 24 (12)										
Range	1281-1734	766-1244	45938-52013	29089-37313	18164-19214	16017-17067	27774-32799	12022-20246	2.53-2.70	1.70-2.19
Mean	1515	1006	48880	32227	18864	16717	30016	15510	2.59	1.93
SD	226.91	239.01	3042.03	4444.83	606.22	606.22	2555.92	4251.81	0.10	0.25
CV (%)	14.97	23.75	6.22	13.79	3.21	3.63	8.52	27.41	3.79	12.82
SYI/SVI	0.74	0.62	0.88	0.74	-	-	0.84	0.56	-	-

Variety	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C Ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
KDS 726 (28)										
Range	2637-3107	1972-2573	90023-105633	39025-39025	42143-42143	39025-39025	47880-63490	28154-48472	2.14-2.51	1.72-2.24
Mean	2940	2349	100083	39025	42143	39025	57940	40885	2.38	2.05
SD	262.86	328.42	8727.72	0.00	0.00	0.00	8727.72	11092.60	0.21	0.28
CV (%)	8.94	13.98	8.72	0.00	0.00	0.00	15.06	27.13	8.65	13.90
SYI/SVI	0.86	0.79	0.86	1.00	-	-	0.78	0.61	-	-
MACS 1460 (8)										
Range	2100-2596	1185-2125	85682-126000	70125-71100	32888-33545	19175-31120	52794-92455	39005-51925	2.60-2.76	2.25-2.71
Mean	2348	1655	105841	70613	33217	25148	72625	45465	2.68	2.48
SD	350.72	664.68	28509.13	689.43	464.57	8446.39	28044.56	9135.82	0.11	0.33
CV (%)	14.94	40.16	26.94	0.98	1.40	33.59	38.62	20.09	4.22	13.12
SYI/SVI	0.77	0.47	0.61	0.98	-	-	0.48	0.70	-	-
VL Bhatt 201(191)										
Range	1256-1275	833-854	89194-90528	67503-69146	47142-50406	47892-48906	40122-42052	19611-20240	0.89-1.80	0.41-1.41
Mean	1266	844	89861	68325	48774	48399	41087	19926	1.35	0.91
SD	13.44	14.85	943.28	1161.78	2308.00	717.01	1364.72	444.77	0.64	0.71
CV (%)	1.06	1.76	1.05	1.70	4.73	1.48	3.32	2.23	47.84	77.70
SYI/SVI	0.98	0.97	0.98	0.97	-	-	0.99	0.96	-	-
JS 20 98 (8)										
Range	1425-	1025-	54150-	38950-	20557-	19034-	33593-	19917-	2.60-	1.99-
Mean	1686	1313	60116	46628	21122	19121	38994	27508	2.83	2.40
SD	369.11	406.59	8436.49	10857.62	799.03	123.04	7637.46	10734.59	0.32	0.58
CV (%)	21.89	30.98	14.03	23.29	3.78	0.64	19.59	39.02	11.26	24.16
SYI/SVI	0.68	0.57	0.78	0.66	-	-	0.71	0.48	-	-
RKS 113 (35)										
Range	1304-	1148-	48372-	42597-	22089-	19717-	18099-	15569-	1.60-	1.58-
Mean	1581	1392	55679	49029	26181	23373	29498	25656	1.73	1.70
SD	391.74	345.07	10333.66	9095.51	5786.96	5169.66	16120.62	14265.17	0.18	0.16
CV (%)	24.78	24.79	18.56	18.55	22.10	22.12	54.65	55.60	10.25	9.59
SYI/SVI	0.64	0.64	0.72	0.72	-	-	0.33	0.32	-	-
PS 24 (8)										
Range	1770-	1400-	65667-	51940-	30945-	26703-	34722-	24701-	2.12-	1.91-
Mean	1977	1468	69950	52077	31135	26971	38815	25106	2.25	1.94
SD	292.04	96.17	6057.08	193.04	268.70	379.01	5788.38	572.05	0.18	0.04
CV (%)	14.78	6.55	8.66	0.37	0.86	1.41	14.91	2.28	7.87	1.83
SYI/SVI	0.77	0.89	0.86	0.99	-	-	0.77	0.96	-	-
RKS 18 (8)										
Range	1237-	737-958	44350-	28021-	19214-	17067-	25136-	10954-	2.31-	1.64-
Mean	1358	848	45686	28386	19214	17067	26472	11319	2.38	1.66
SD	170.41	156.27	1888.68	515.48	0.00	0.00	1888.68	515.48	0.10	0.03
CV (%)	12.55	18.44	4.13	1.82	0.00	0.00	7.13	4.55	4.16	1.70
SYI/SVI	0.80	0.72	0.99	0.97	-	-	0.98	0.92	-	-
RKS 45 (25)										
Range	1596-	1352-	52668-	44616-	19777-	18005-	32891-	26611-	1.57-	1.53-

Variety	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C Ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
Mean	1634	1412	54680	47242	20933	18861	33747	28381	2.12	2.00
SD	53.74	84.15	2845.40	3713.02	1634.83	1210.57	1210.57	2502.45	0.77	0.67
CV (%)	3.29	5.96	5.20	7.86	7.81	6.42	3.59	8.82	36.52	33.45
SYI/SVI	0.95	0.90	0.91	0.87	-	-	0.94	0.86	-	-
Himsoy (45)										
Range	1290-	1024-	46354-	34300-	17000-	11000-	28967-	19294-	1.10-	0.89-
Mean	1530	1171	61097	47058	28589	23764	32509	23293	2.08	2.11
SD	243.77	167.38	13551.25	11329.71	11016.94	12043.20	4254.76	2314.66	0.71	1.03
CV (%)	15.94	14.30	22.18	24.08	38.54	50.68	13.09	9.94	34.27	49.08
SYI/SVI	0.69	0.70	0.62	0.60	-	-	0.73	0.85	-	-
VLS 65 (87)										
Range	1189-	604-840	48720-	16912-	46308-	47808-	24740-	18302-	0.83-	0.42-
Mean	1387	738	69307	43728	46725	47850	31843	19225	1.40	0.90
SD	226.10	93.69	22242.07	27118.63	589.73	59.40	10045.16	1305.32	0.80	0.68
CV (%)	16.30	12.70	32.09	62.02	1.26	0.12	31.55	6.79	57.28	75.42
SYI/SVI	0.68	0.77	0.52	0.24	-	-	0.56	0.89	-	-
VLS 59 (31)										
Range	1875-	1358-	55625-	36080-	45156-	43656-	31708-	15880-	00.83-	0.43-
Mean	2037	1505	72043	53329	45399	44274	34853	17679	1.27	0.90
SD	144.20	124.99	14616.48	15132.06	343.65	873.98	4447.70	2544.17	0.62	0.66
CV (%)	7.08	8.31	20.29	28.38	0.76	1.97	12.76	14.39	48.63	73.48
SYI/SVI	0.85	0.84	0.69	0.59	-	-	0.80	0.78	-	-
CGS 1 (10)										
Mean	1725	1231	63836	45551	18095	14825	45741	307267	3.53	3.07
DSb 23 (5)										
Mean	3613	2150	137294	81700	42488	34900	94806	46800	3.23	2.34
MAUS 612 (15)										
Mean	1843	1492	68375	55353	32903	31779	35472	23574	2.07	1.74
PS 23 (1)										
Mean	2050	1600	69700	54400	31325	26703	38375	27697	2.23	2.04
RVS 2002 4 (3)										
Mean	1558	992	46750	29750	19214	17067	27536	12683	2.43	1.74
Palam soy (7)										
Mean	1403	1089	72949	56606	38200	34540	34749	22066	1.91	1.64
VLS 89 (1)										
Mean	2590	1880	106190	77080	45642	44892	60548	32188	1.33	0.72
VLS 77 (86)										
Mean	1956	1555	80184	63757	45156	43656	35028	20101	1.78	1.46
PS 1477(2)										
Mean	1410	1213	43005	36981	28500	25500	14505	11481	1.51	1.45
Pusa 12 (8)										
Mean	1617	1344	65175	54343	26510	24421	38665	29922	2.46	2.22
MAUS 71 (10)										
Mean	854	730	28438	24309	26769	24200	1669	109	1.07	1.00

Variety	Yield (kg/ha)		Gross returns (Rs/ha)		Cultivation cost (Rs/ha)		Net returns (Rs/ha)		B:C Ratio	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
Ankur (18)										
Mean	1465	-	51281	-	24922	-	26359	-	1.95	-
DS 228 (4)										
Mean	2730	2028	58534	43591	20156	15554	38378	28037	2.90	2.80

Annexure IV

Agro-ecological sub-zones for different cooperating Centers.

Center	**Indore and Kota**
Eco-region	5. Central highlands, Gujarat plains, Kathiawar, Peninsula
Sub-eco-region	5.2. Hot, moist semi –arid (15Dm4) -Madhya Bharat plateau, West Malwa Plains, Eastern Gujarat Plains, Vindhayan and Satpura range and Narmada velley. Annual temperature (degree C) range = 24-25, maximum= 40 and minimum = 9
Area covered	Jhabua, Ratlam, Mandsour, Ujjain, Indore, Dewas, East and West Nimar, Dhar, Parts of Rajgarh and Shajapur, Godhra, Bharuch, Vadodra, Kheda, Surat, Bundi, Kota, Banaswara, Chittorgarh, Jhalawar, Baran
Annual rainfall (mm)	800-1000
Moisture index	-35 to -49
LGP (Days)	120-150
Major soil groups	Gently sloping to very gently sloping Ustochrepts with association with Chromusterts and Pellusterts: Ustochrepts- chromusterts, Ustorthents-Ustochrept, Chromusterts- Ustchrepts- Ustorthents, Chromusterts-Pellusterts and Haplustalfs-Chromusterts
Major issues	1. Narrow range of workable soil moisture 2. Heavy run off 3. Surface water stagnation 4. Inter dry spells 5. Imperfect drainage 6. Salinity and sodicity 7. Swell-shrink soil pose severe limitation to work

Center	**Parbhani**
Eco-region	6. Deccan plateau- Hot semi-arid
Sub-eco-region	56.2. Hot, moist semi-arid (K4Dm4)- Central and Western Maharashtra plains, North Karnataka plains, North-western Telangana plains. Annual temperature (degree C) range = 26-27, maximum= 41 and minimum =15
Area covered	Nashik, Dhule, Aurangabad, Jalana, Nanded, Parbhani, Latur, Northern hillypart of Ahmednagar, Jalgaon, Bidar, and Gulbarga, Nizamabad, Adilabad
Annual rainfall (mm)	700-1000
Moisture index	-36 to -59
LGP (Days)	120-150
Major soil groups	Moderate to gently sloping Ustorthents in association with Chromusterts: Ustropepts- Chromusterts, Ustorthents- Ustropepts, Ustorthents- Rockout crop, Chromusterts-Ustifluvents, Haplustalfs- ustorthents
Major issues	1. Inter dry spells 2. High run off 3. N, P and Zn deficiency leads nutrient imbalance

Center	**Pune and Dharwad**
Eco-region	6. Deccan plateau- Hot semi-arid
Sub-eco-region	6.4. Hot dry sub-humid (K4Cd5)- North Sahyadris and West Karnataka plains. Annual temperature (degree C) range = 24-25, maximum= 37 and minimum= 14
Area covered	Eastern part of Kolhapur, Western part of satara, Sangli and Pune, Belgaum, Dharwad
Annual rainfall (mm)	1000-1200
Moisture index	-27 to -30
LGP (Days)	150-240
Major soil groups	Moderately steep to gently sloping Ustorthents: Ustorthents- Ustropepts, Ustorthents- Rockout crop, Ustropepts- Chromusterts, Haplustalfs-Chromusterts, Chromusterts- Pellusterts-Ustropepts
Major issues	1. Narrow range1.High run off with heavy soil loss 2. Intermittent dry spells 3. P and Zn deficiency 4. Poor workable soil moisture

Center	**Coimbatore**
Eco-region	8. Hot semi humid-Eastern ghats, Tamilnadu uplands and Deccan plains
Sub-eco-region	8.1. Hot, semiarid (H6Dd3)- Tamilnadu uplands and leeward flanks of South Sahyadris. Annual temperature (degree C) range = 26-29, maximum= 32 and minimum =24
Area covered	Coimbatore, Madurai, Thirunelveli, Dindigal, Virudnagar, Tuticorin, Nagarcoil
Annual rainfall (mm)	600-900
Moisture index	-42 to -62
LGP (Days)	120-130
Major soil groups	Moderately to gently sloping Ustorthents and haplustalfs: Haplustalfs- Rhodustalfs-Ustorthents, Rhodustalfs-Ustorthents, Rhodustalfs-Pellusterts, Haplustalfs-Ustropepts, Haplustalfs- Ustifluvents and pockets of Chromusterts, Chromusters-Ustropepts-Ustorthents
Major issues	1. Saline water

Center	**Bangalore**
Eco-region	8. Hot semi humid-Eastern ghats, Tamilnadu uplands and Deccan plains
Sub-eco-region	8.2. Hot, moist, semiarid (K1Dm4)- Central Karnataka plateau. Annual temperature (degree C) range = 23-25, maximum= 38 and minimum = 20
Area covered	Hassan, Tumkur, Bangalore, Mysore, Mandye, Kolar, Chickmanglur, Eastern part of Shimoga, Central and Southern part of Chitradurga
Annual rainfall (mm)	550-1100
Moisture index	-24 to -54
LGP (Days)	120-150
Major soil groups	Gently sloping to very sloping , Moderately deep to deep Haplustalfs, Rhodustalfs and Pallustalfs: Rhodustalfs- Ustropepts- Haplustalfs, Pellustalfs-Haplustalfs, Haplustalfs-ustorthents and Tropopsamments- Tropoprthents, Pellstalfs-Rhodustalfs, Haplustalfs-Ustorthents
Major issues	1.Low to medium AWC 2. N,P and Zn deficiency

Center	**Pantnagar and Ludhiana**
Eco-region	9. Northern plains-hot sub-humid
Sub-eco-region	9.1. Hot, dry, sub humid (N8Dm(Cd)4)- Punjab and Rohilkhand plains Annual temperature (degree C) range = 24-26, maximum= 40 and minimum = 4
Area covered	Gurdaspur, Southern part of Hoshiarpur, Rupnagar, Northern half of Patiala, Jalandhar and Ludhiana, Chandigarh territory, Ambala, Kurukshetra, Karnal, Yamunanagar,
Annual rainfall (mm)	700-1000
Moisture index	-30 to 48
LGP (Days)	120-150
Major soil groups	Deep to moderately deep, Loamy and developed on Alluvium: Ustochrepts-Calciorthids, Ustorchrepts-Ustipsamments, Ustochrepts-Ustorthents, Haplustalfs-Ustochrepts
Major issues	1. Narrow range1.High run off with heavy soil loss 2. Intermittent dry spells 3. P and Zn deficiency 4. Poor workable soil moisture

Center	**Sehore and Jabalpur**
Eco-region	10.Central highlands (Malwa, Bundelkhand and eastern Satpura range)- hot, sub humid (dry/moist)
Sub-eco-region	10.1. Hot, sub humid (15Cd5)- Malwa plateau, Vindhyan scarpland, Narmada velley Annual temperature (degree C) range = 24-25, maximum= 40 and minimum = 9
Area covered	Guna, Rjgarah, Raisen, Sagar, Bhopal, Sehore, Shajapur, Hoshangabad, Jabalpur, Narsimpur, Vidisha, Damoh and Dewas
Annual rainfall (mm)	1000-1500
Moisture index	-3 to -22
LGP (Days)	150-180
Major soil groups	Gently to very gently sloping, shallow to moderately deep- Ustorthents, Ustochrepts: Ustochrepts-Chromusterts, Chromusterts-Ustochrepts-Usterthents, Usterthents-Ustochrepts-Rhodustalfs with patches of Ustorthents-Rockout crops and Haplustalfs-Ustochrepts
Major issues	1. Narrow workable soil moisture 2. N, P and Zn deficiency 3. Inter dry spells 4. Risk of inundation of low laying areas

Center	**Raipur**
Eco-region	11.Chattisgarh, Mahanadi basin
Sub-eco-region	11. Hot, moist, sub humid (J3Cd (Cm) 5)- Eastern plateau of Chattisgarh and Mahanadi basin. Annual temperature (degree C) range = 25-28, maximum= 42 and minimum = 8
Area covered	Hazaribagh, North-West Ranchi, Lohadaga, Gumla, Palam, Ambikapur, Bilaspur, Raigarh, Durg, Rajnandgaon, Raipur, Northern Jagadalpur
Annual rainfall (mm)	1200-1600
Moisture index	-4 to 13
LGP (Days)	150-180
Major soil groups	Red and Yellow group: Ustochrepts- Chromusterts, Haplustalfs-Ochraquafs-Ustochrepts, Ustorthents- Rockout crops, Haplustalfs-Ustochrepts, Rhodustalfs-Haplustalfs-Ustochrepts and Ustochrepts-Chromusterts-Haplustalfs, Haplustalfs-Rhodustalfs-Ochraqualfs, Ustochrepts-Halaquepts-Natrustalfs, haplustalfs-Ustochrepts-Ustorthents
Major issues	1. Severe erosion 2. Limits root ramification 3. N, P and Zn deficiency

Center	**Ranchi**
Eco-region	12.Hot, sub humid- Eastern (Chhotanagpur) plateau and Eastern Ghats (J2Cd5)
Sub-eco-region	12.3. Hot, dry, moist sub humid transitional (J2Cd3)- Chhotanagpur plateau and Gujarat hills. Annual temperature (degree C) range = 25-26, maximum= 40 and minimum = 9
Area covered	Ranchi, Dhanbad, Giridih, Devghar, Santhal Pargana, Singhbhum, Parts of Shibganj, Purulia, Siuri, West part of Birbhum, Bankura, Bardhuman
Annual rainfall (mm)	1200-1500
Moisture index	-3 to -22
LGP (Days)	180-210
Major soil groups	Ustorthents and Ustochrepts: Haplustalfs-Rhodustalfs-Ustochrepts, Haplustalfs-Rhodustalfs-Ustorthents, Haplustalfs- Paleustalfs-Ustochrepts, Haplustalfs-Ustochrepts-Haplaquepts, Haplustalfs-Rhodustalfs-Ochraqualfs and Ustochrepts-Haplaquent-Ustifluvents, Ustorthents-Ustochrepts-Rhodustalfs
Major issues	1. Severe erosion 2. Hogh bulk density, low AWC limit optimum root ramification 3. Intermittent dry spells 4. High P fixation and 5. Mo and S deficiency

Center	**Medziphema**
Eco-region	17. Warm per-humid ecoregion with brown and red hill soils (D2A9)
Sub-eco-region	17.1. warm to hot per-humid ecosystem. Annual temperature (0C) range = 16-24
Area covered	Kohima, Phek, Zunhebhoto, Eastern part of Wokha Mokakchung, hensung
Annual rainfall (mm)	>2500
Moisture index	-
LGP (Days)	270-300
Major soil groups	Dystrochrepts, Hapludults, Hapludalfs, paleudalfs, Hapludolls
Major issues	1.High rainfall leading to intense leaching 2. Excessive moisture leading to water stagnation Low temperature during post- monsoon period

Center	**Imphal**
Eco-region	17. Warm per-humid ecoregion with brown and red hill soils (D3A10)
Sub-eco-region	17.2. warm to hot per-humid ecosystem Annual temperature (0C) range = 16-25,
Area covered	Eastern range (Purvachal)
Annual rainfall (mm)	>3000
Moisture index	-
LGP (Days)	>300
Major soil groups	Dystrochrept, Hapludalfs, Hapludults, Paleudalfs
Major issues	1. High rainfall leading to intense leaching 2. Excessive moisture leading to water stagnation Low temperature during post- monsoon period

Center	**Almora**
Eco-region	14. Hot subhumid (moist) ecoregion with alluvium-derived soils (A15Cd)
Sub-eco-region	14.2. warm to hot dry to moist subhumid ecosystem. Annual temperature (0C) range = 8-10,
Area covered	South Kashmir & Kumaun Himalayas
Annual rainfall (mm)	500-600
Moisture index	-
LGP (Days)	180-210
Major soil groups	Eutrochrepts, Ustorthents, Hapludalfs, Hapludolls, Argiudolls, Udifluvents, Haplaquepts
Major issues	1. Flooding and imperfect drainage 2. Salinity and/or sodicity and 3. Deficiency of N, P and Zn

Center	**Amravati**
Eco-region	6. Hot semi-arid ecoregion with medium and deep black soils (K5Dm4)
Sub-eco-region	6.3. hot semi-arid ecosystem Annual temperature (0C) range = 26-27
Area covered	Deccan (NW. Maharashtra) Plateau
Annual rainfall (mm)	800-1000
Moisture index	-
LGP (Days)	150-180
Major soil groups	Ustorthents, Chromusterts, Ustochrepts
Major issues	1. The intermittent dry spell periods. 2. Imperfect drainage. 3. Salinity and alkalinity hazards under irrigated agriculture

Center	**Sangli**
Eco-region	ecoregion with medium and deep black soils (K4Dd3)
Sub-eco-region	6.1. hot semi-arid ecosystem. Annual temperature (0C) range = 26-27
Area covered	Deccan (Western Maharashtra) Plateau
Annual rainfall (mm)	600-750
Moisture index	-
LGP (Days)	120-150
Major soil groups	Ustorthents, Ustropepts, Chromusterts
Major issues	1. The intermittent dry spell periods. 2. Imperfect drainage. 3. Salinity and alkalinity hazards under irrigated agriculture

Center	**Lokbharti**
Eco-region	5 hot semi-arid ecoregion with alluvium-derived soils (L4Dd3)
Sub-eco-region	5.1. hot semi- arid ecosystem Annual temperature (0C) range = 24-25
Area covered	Kathiawar Peninsula
Annual rainfall (mm)	600-700
Moisture index	-
LGP (Days)	190-120
Major soil groups	Ustorthents, Ustochrepts, Chromusterts, Salorthids
Major issues	1. Coarser soil texture and low plant available water capacity (AWC). 2. Low water table 3. At places, imperfect drainage and subsurface soil salinity

Center	**Bundi**
Eco-region	5. Hot semi-arid ecoregion with alluvium-derived soils (L4Dd3)
Sub-eco-region	5.2. hot semi-arid ecosystem (I5Dm4). Annual temperature (0C) range = 24-25
Area covered	Central Highlands
Annual rainfall (mm)	800-1000
Moisture index	-
LGP (Days)	120-150
Major soil groups	Ustochrepts, Chromusterts, Pellusterts
Major issues	1. Coarser soil texture and low plant available water capacity (AWC). 2. Low water table and 3. At places, imperfect drainage and subsurface soil salinity /or sodicity

Center	**Hyderabad**
Eco-region	7. Hot semi-arid ecoregion with shallow and medium (dominant) black soils (K6Dm4)
Sub-eco-region	7.2.hot semi- arid ecosystem (K6Dm4) Annual temperature (0C) range = 25-29
Area covered	Deccan (Telengana), Plateau
Annual rainfall (mm)	700-1000
Moisture index	-
LGP (Days)	120-150
Major soil groups	Rhodustalfs, Haplustalfs, Pellusterts, Ustropepts, Chromusterts, Pellusterts
Major issues	1. Prolonged dry spells. 2. High runoff. Deficiency of N, P and Zn.

Center	**Dholi**
Eco-region	13. Hot subhumid ecoregion with red and lateritic soils (O8Cd)
Sub-eco-region	13.1. hot dry to moist subhumid ecosystem (O8Cd (cm)6). Annual temperature (^{0}C) range = 25-26
Area covered	Eastern (North Bihar and Avadh) Plain
Annual rainfall (mm)	1200-1500
Moisture index	-
LGP (Days)	180-210
Major soil groups	Paleustalfs, Haplustalfs, Ustorthents, Ustochrepts, Haplaquepts, Haplaquents, Udifluvents, Pssamaquents
Major issues	1. Subsoil graveliness and coarse soil texture, low AWC. 2. Deficiency of N, P and Zn and B

Annexure V

Average yield, yield gap and economics of soybean under different zones (2010-11 to 2019-20)

Soybean growing zones	Yield and economics of soybean								
	Grain yield (kg/ha)			Cost of cultivation (Rs/ha)		Gross returns (Rs/ha)		Net returns (Rs/ha)	
	IP	FP	YGAP	IP	FP	IP	FP	IP	FP
Northern Plain Zone	1740	1417	323	28360	19610	53911	38867	25551	19257
Eastern Zone	1544	1030	515	26876	16832	40192	28987	13316	12155
North eastern hill Zone	1496	969	526	34899	23796	80014	52068	45114	28272
Central Zone	1575	1275	300	27486	24104	42144	34368	11672	8372
Southern Zone	2036	1648	388	34904	29796	51747	42074	16434	11955
Northern Hill zone	1700	1228	473	38740	35260	61297	45041	30808	18120

Annexure VI

State wise % yield gaps and reasons thereof in soybean as identified through frontline demonstrations (2016-21)

S. No.	Name of states	Total frontline demonstrations conducted	Average yield gap (%)	Reasons for yield gaps
1	Maharashtra	833	21.0	Rainfed crop, yield completely depends on quantity and distribution of rainfall during cropping season; Low photo synthetically active radiation levels during overcast days of the monsoon; Timely non-availability of improved quality seeds (seed replacement is low); Lack of availability improved location specific new varieties resistant biotic and abiotic stresses; Imbalanced nutrient management.
2	Madhya Pradesh	2196	41.7	
3	Gujrat	349	30.3	
4	Karnataka	241	31.4	
5	Uttarakhand	655	30.7	
6	Rajasthan	450	23.4	
7	Telangana	50	17.2	
8	Manipur	73	62.6	
9	Punjab	49	-	
10	Himachal Pradesh	173	26.1	
11	Chhattisgarh	40	45.9	
12	Jharkhand	100	33.2	
13	Tamilnadu	20	25.2	
14	Nagaland	10	40.5	
15	Bihar	35	51.2	
16	Meghalaya	30	47.0	

Annexure VII

Latest released soybean varieties (10 years old)

Variety Name	Year of release	Maturity (days)	Yield (kg/ha)	Oil content (%)	Salient features	Recommended regions/areas
VL Soya 65	2010	-	1542	-	Resistant to frog eye leaf spot, pod blight and leaf blight No incidence of Hairy caterpillar, Sucking Bug and girdle beetle	Uttarakhand
MAUS 158	2010	-	2190-2260	-	Tolerant to Bacterial pustules, *Rhizoctonia* root rot and aerial blight, collar rot and charcoal rot	Marathwada region of Maharashtra
RKS 24	2011	-	3000-3500	-	Moderately resistant to bacterial pustule, collar rot and YMV. Moderately resistant to girdle beetle, stem fly and defoliators.	Rajasthan
SL 744	2012	-	1842 2142	-	Resistant to yellow mosaic virus and soybean mosaic virus	Punjab
Pant Soybean-19 (PS 1368)	2013	117-125	2121	20	Tall sturdy plant; Resistant major foliar diseases, YMV, Bacterial pustule and *Rhizoctonia* aerial blight.	Uttarakhand
MACS-1188	2013	101	2500-3950	19.1	Resistant to Bacterial Pustules, Rhizoctonia aerial blight and Charcoal rot. Resistant to defoliator, pod borer, leaf folder and leaf miner.	Southern Zone (MH, AP, KT and TN)
Pratap Soya 45 (RKS 45)	2013	95-98	3000-3500	21	Moderately resistant to Bacterial pustules and YMV	Rajasthan
Pusa12	2013	124-131	2,290	19.6%	Determinate growth habit; yellow seed and black hilum; resistant to YMV, Rhizoctonia aerial blight and bacterial pustules protein content 37.8%	North Plains Zone
JS- 20-29	2014	93-96	2125	20.9	semi- determinant growth habit, brown pods black hilum, large seeded protein content 41.1%resistant to yellow mosaic virus YMV and charcoal –rot	Madhya Pradesh, Maharashtra, Rajasthan and Utter Pradesh
JS 20-34	2014	86-88	2052	20.3	Determinate growth habit, globous, yellow pods black hilum, medium, sized seeds protein content 40.8% resistant to charcoal-rot; moderately resistant to girdle beetle	Madhya Pradesh, Maharashtra, Rajasthan and Utter Pradesh
Raj Vijay Soybean 2001-4	2014	94	2500	21.5	Determinate growth habit, glabrous, Yellow pods black hilum, medium sized seeds	Madhya Pradesh

					protein content 40.8% resistant to charcoal rot; moderately resistant to girdle beetle and semilooper	
MAUS-2 (POOJA)	2014	100-105	2721	20.0	Semi determinate growth habit Yellow seeded light brown hilum, protein content 41.5%resistant to bacterial pustule and leaf spots moderately resistant to leaf miner stem fly and blue beetle	Karnataka
MAUS -162	2014	100-103	2000-3000	21.37	Semi determinate growth habit oblong pale yellow seeds blackish hilum protein content 41.95% tolerant to charcoal rot cotyledonary spot *Rhizoctonia* root- rot and aerial blight	Maharashtra
Dsb 21	2015	90-95	2807	18.2	Semi determinate growth habit, yellow seed coat and brown hilum, resistant to rust	Karnataka
NRC 86 (Ahila-6)	2015	95-97	2128	19.08	Highly resistant to charcoal- rot, moderately to highly resistant for girdle beetle and moderately resistant to bacterial pustule pod blight, 40.60% protein content	Maharashtra Madhya Pradesh Rajasthan Chhattisgarh
Phule Agran (KDS 344)	2015	105-110	2555	18.6	Tolerant to rust moderately resistant to stem-fly pod borer and leaf roller 34.6% protein content	Karnataka ,Andhra Pradesh, Telangana
Pusa 12 (DS 12-13)	2015	124-131	2286	19.6	Resistant to yellow mosaic virus, Rhizoctonia aerial blight and bacterial pustules 37.8%protein content	Punjab, Haryana, Delhi, Uttarakhand, Utter Pradesh
SL 958	2016	142	2282	1908	Light yellow oval seeds with black hilum; suitable for timely sown irrigated areas; resistant to yellow mosaic virus (YMV) and soybean mosaic virus (SMV)	Punjab JS
JS 20-69	2016	93-95	2300-2500	20-22	Medium-sized spherical yellow and shiny seed with black hilum; resistant to YMV, charcoal rot, bacterial pustules Alternaria leaf spot pod blight Indian bud blight , leaf spot	Madhya Pradesh
VL Soya77	2016	112-127	1970	18.6	Large seeds yellow seeds with black hilum; suitable for rainfed organic conditions moderately resistant to frog eye leaf spot pod blight	Uttarakhand Hills
VL Bhat 201	2016	117	1642	15.42	Black and large seeded resistant to frog eye leaf spot girdle beetle	Uttarakhand Hills
MACS 1281	2016	96	2519	187.15	Round yellow seeds and black hilum; moderately resistant to	Southern Maharashtra,

					bacterial pustules bacterial leaf blight	Karnataka ,Telengana, Andhra Pradesh, Tamil Nadu
Raj Soya 24	2017	96	1905	21-22.5	Tolerant to major leaf pod and root rot diseases girdle beetle and semi looper attacks	Madhya Pradesh, Maharashtra, Rajasthan and Utter Pradesh
Pant Soybean 24	2017	113	2560	20.50	Multiple disease resistant free from lodging and shattering tolerant to drought to some extent	Utter Pradesh and Uttarakhand
Pant soybean 21	2017	123-126	2057	19.25	Resistant to yellow mosaic virus (YMV) and bacterial pustule , tolerant to RAB, rained/irrigated cultivation in plains and lower hills of Uttarakhand	Uttarakhand
Pant soybean 23	2017	112-115	1915	19.8	Resistant to lodging and shattering, rained/ irrigated cultivation in plains and lower hills of Uttarakhand	Uttarakhand
Raj Soya 18 (Pragya)	2017	92	1911.78	21.55	Resistant YMV and charcoal rot, erect plant type suitable for intercropping	Madhya Pradesh
Jawahar Soybean 20-98	2018	96-101	2094	19.3	Suitable for medium to high rainfall normal sowing conditions, resistant to charcoal rot and YMV disease.	MP, Bundelkhand region of Utter Pradesh, Rajasthan, Gujarat, Marathwada and Vidarbha region of Maharashtra.
Chhattisgarh Soybean-1	2018	95-100	2445	20-23	Resistant to Indian bud blight ,Mesothelium leaf spot and bacterial pustule disease	Chhattisgarh
Kota Soya 1	2018	100-102	1893	20	Suitable for rainfed condition under assured rainfall in kharif, resistant to YMV disease, good germ inability and tolerant to pod shattering	Assam, WB, Jharkhand , Chhattisgarh and North Eastern States
Dsb 23	2018	95	3900	18.63	Suitable for tainted and irrigated conditions, highly resistant to soybean rust caused.	Karnataka, Tamil Nadu, Telangana, Andhra Pradesh, And Southern Maharashtra
KS -103	2018	91-95	2537	18.10	Suitable for irrigated and rainfed kharif resistance to field rust and pest complex	Southern Maharashtra, Andhra Pradesh, Karnataka, Telengana, Tamil Nadu
MAUS -612	2018	91-95	2531	20.49	Suitable for assured rainfall of	Maharashtra and

					700 to 1000 mm with medium to heavy Soli, resistant to charcoal rot.	Southern India.
Basra (ASb - 22)	2018	105-115	2663	19051	Suitable for rain fed kharif	Telangana
NRC 127	2018	104	1807	18.5-20	Suitable for rain fed, normal sowing time yield shown promising resistance against pod bore, Lepidopteran defoliators and pest complex	Madhya Pradesh, Rajasthan, Bundelkhand region of Uttar Pradesh, Gujarat, Marathwada and Vidarbha region of Maharashtra
Phule Sangam	2019	96-97	2442	18.42	Resistant to purple seed stem and tolerant to pest complex	Maharashtra Karnataka, Telangana, Andhra Pradesh, Tamil Nadu
VL Soya89	2019	116	2324	19.07	Suitable for timely sown rain fed conditions of northern hills zone. Moderately resistant to frog eye leaf spot and pod blight diseases promising against bugs an leaf hopper	Himachal Pradesh And Uttarakhand
Jawahar soybean 20-94	2019	97.3	2104.8	20.35	Resistant to YMV and Charcoal rot, Rhizoctonia aerial blight and Alternaria leaf spot	Madhya Pradesh, Bundelkhand region of Uttar Pradesh, Rajasthan Gujarat and Marathwada and Vidarbha region of Maharashtra.
Shalimar Soybean 2019	140-145	2030	2560	13.56	Resistant to yellow mosaic Virus as well as Alternaria blight	Jammu and Kashmir,
Jawahar soybean 20-116	2019	100.9	2122.45	16.32	Resistant to YMV and charcoal rot	Assam and North Eastern states, Madhya Pradesh, Bundelkhand region of Uttar Pradesh Rajasthan Gujarat Marathwada and Vidarbha region of Maharashtra Bihar west Bengal, Jharkhand, Chhattisgarh and Odisha.
AMS 1001 (PDKV)Yellow Gold)	2019	95-100	2173	18.93	Resistant to root rot, YMV Alternaria leaf spot	Maharashtra.
Pant Soybean	2020	-	-	-		Uttar Pradesh

-1572						
MACS 1407	2021	-	-	-		Eastern Zone
MACS 1460	2021	-	3800	-	Moderate field resistance to Aphids, Stem Fly, Defoliators, Bihar Hairy Caterpillar and Leaf miner and suitable for mechanical harvesting	Eastern and Southern Zone
MACS 1520	2021	-	2900	--	Absolute Resistance (AR) to Charcoal Rot at and Moderately resistant to Alternaria Leaf Spot. Field resistance to Stem Fly, Girdle Beetle and *Spodoptera litura*.	Central Zone
NRC 132	2021	99-105	2955	19.2	Nul lipoxygenase 2 free	Sothern and Eastern Zone
NRC 147 [Indore Soy (IS) 147]	2021	96-100	3360	19	High oleic acid content (42%)	Sothern and Eastern Zone
NRC 128 (IS 147)	2021	106-118	2800	19.95	Moderately Resistant to Mungbean Yellow Mosaic Virus (MYMIV) and charcoal rot diseases. It has exhibited high degree tolerance to water logging conditions when challenged through artificial conditions. Highly resistant to anthracnose (pod blight) resistance	Northern plain Zone and Eastern Zone
NRC 130 (IS 130)	2021	92	3000	17.8	Early maturity and less photoperiod sensitivity	Central Zone
NRC 136 (IS 136)	2021	107	3000	17.5	Drought tolerant	Eastern Zone
NRCSL1	2021	-	2508	-	YMV resistant	Eastern Zone
RSC 11-07	2021	-	3000	-	Moderately resistant to Indian Bud blights, pod blight and stem borers. Highly resistance to Purple seed strains and susceptible to rust	Eastern and Southern Zone
RSC 10-46	2021	-	-	-	Resistant to charcoal rot, stem borers, and defoliators	Eastern and Central Zone
RSC 10-52	2021	-	-	-	Multiple resistant for biotic stresses like charcoal rot and Target leaf spots, stem borers. Moderately resistant to yellow mosaic virus, and *Rhizoctonia* aerial blight	Central Zone
DSb 34	2021	-	3200	-	Rust resistant	Sothern Zone
AMS 2014-1 (PDKV Purva)	2021	-	2400-3200	-	Moderately resistance to stem fly, girdle beetle and pest complex. It has pod shattering resistance up to 10 days from harvest maturity	Eastern Zone

AMS-MB-5-18 (Suvarn Soya)	2021	-	-	-	Moderately resistance reaction to charcoal rot, moderately resistance to biotic stresses like YMV, SMV, bacterial pustules, RAB and ALS, girdle beetle, stem borers, defoliators and stem fly	Central Zone

Annexure VIII

State wise technological interventions (package) recommended for conducting FLDs on soybean.

Zone-wise Production Technology Capsule

S. No.	Input/ practices	North Hill Zone (HP, Hills of Uttarakhand)	North Plain Zone (Punjab, Haryana, Delhi, NE Plains of UP, Western Bihar)	Central Zone (MP, Raj., Guj., Bundelkhand Region of UP, Western Maharashtra)	Southern Zone (Karnataka, TN, AP, Kerala, Southern Maharashtra)	North Eastern Hill and Eastern Zone (Assam, W. Bengal, Meghalaya, Manipur, Nagaland, Eastern Bihar, Orissa, Chhattisgarh)
1.	Variety	As given below in the table				
2.	Planting time	Last week of May to June end	15th June to 5th July	20th June to 5th July	15th June to30th June	15th June to 30th June
3.	Planting geometry	45 x 5 cm	45 x 5 cm	45 x 5 cm	30 x 5 cm	45 x 5 cm
4.	Plant population	0.4 million/ha	0.4 million/ha	0.4-0.6 million/ha	0.4-0.6 million/ha	0.4-0.6 million/ha
5.	Depth of sowing	3 to 5 cm	3 to 5 cm	3 to 5 cm	3 to 5 cm	3 to 5 cm
6.	Manure and Fertilizer (kg/ha)	10t FYM/ha+ 20:80:20:20 $N:P_2O_5:K_2O$: S kg/ha	5 t FYM/ha + 25:75:25:37.5:1 $N:P_2O_5:K_2O$:S:B kg/ha	5 t FYM/ha + 20:60: 40: 20:1 $N:P_2O_5:K_2O$:S: B kg/ha	5 t FYM/ ha + 20:80:20:30:0.5 $N:P_2O_5:K_2O$:S: B kg/ha	5t FYM/ha + 25:100:50:50: 2 $N:P_2O_5:K_2O$:S: B kg/ha
7.	Seed rate	75kg/ha	65 kg/ha	65 kg/ha	65 kg/ha	55 kg/ha
8.	*In-situ* moisture conservation	-	Bed planting 67.5 cm (2 rows per bed)	Conservation furrow each after 6 rows	Conservation furrow each after 3 rows	Ridge and furrow 60 cm
9.	Bio-regulator	-	Cycocel @ 500 ppm at flower initiation	Cycocel @ 500 ppm at flower initiation	Ethrel @ 200 ppm or salicylic acid @ 50 ppm at pod initiation	Ethrel @ 200 ppm at flower and pod initiation
10.	Seed treatment	Thiram 75 WP + Cabendazim 50 WP (2:1) @ 3 g/kg seed or Thiram + carboxin @ 2 g/kg seed or *Trichodermaviride* @ 4-5 g/kg seed for the management of seed and seedling diseases.				
11.	Seed	About 5 g/ kg seed *Bradyrhizobiumjaponicum* culture + PSB/PSM 5 g/ kg seed				

	inoculation	
12.	Weed control	Two hand weedings at 20 and 40 DAS or Pendimethalin + Imazethapyr @ 2.5-3 l/ha **as pre-plant incorporation** OR Diclosulum @ 26 g/ha OR Sulfentrazone @ 750 ml /ha OR Chlomozone50 EC @ 2.00 l /ha OR Pendimethalin 30 EC @ 3.25 l/ha OR Pendimethalin38.7 CS @ 1.5 – 1.75kg /ha OR Flumioxazin @ 250 ml/ha OR Metolachlor 50 EC @ 2 l/ha OR Metribuzin @ 0.75- 1 kg /ha OR Pyroxasulfone @ 150 g /ha OR Sulfentrazone + Clomazone @ 1250 ml/ha as **pre-emergence** OR Chlorimuron ethyl @ 36 g /ha OR Bentazone @2 l/ha as **early post emergence (10-12 DAS)** OR Imazethapyr @ 1 l/ha OR Quizalofop ethyl 5 EC @ 1 l/ha OR Quizalofop ethyl 10 EC @ 375-450 l/ha OR Haloxyfop ethyl @ 1-1.25 l/ha OR Quizalofop-p-tefuryl @ 1 l/ha OR Fenoxaprop-p- ethyl @ 1 l /ha OR Fluazifop-p-butyl @ 1 -2 l/ha OR Imazethapyr 70% WG + Surfactant @ 100 g /ha OR Propaquizafop 10 EC @ 0.5-0.75 l/ha OR Fluthiacet methyl @ 125 ml/ha OR Fluazifop-p-butyl + Fomesafen @ 1 l/ha OR Imazethapyr + Imazamox @ 100 g/ha OR Propaquizafop + Imazethapyer @ 2 l/ha OR Sodium Aceflourofen + ClodinafopPropargyl @ 1 l/ha as **post-emergence (15 –20 DAS)** in 750 to 800 liters water/ha.
13.	Insect control	**Blue beetle-** Quinalphos 25 EC @1500 ml/ha; **Stem fly & white fly-** Thiamethoxam 30 FS (seed treatment) @ 10 ml/kg seed OR Lambda Cyhalothrin+ Thiomethoxam @ 1.25 ml/ kg seed; **White fly-** Betacyfluthrin 8.49% +Imidacloprid @ 350 ml/ha; **Defoliators** (Semiloopers, Tobacco caterpillar, *Helicoverpaarmigera*)- Chlorantraniliprole 18.5 SC @ 150 ml/ha OR Indoxacarb15.8 EC @333 ml/ha OR Profenofos 50 EC @ 1250 ml/ha OR Quinalphos 25 EC @1500 ml/ha OR Spinetoram 11.7 SC @ 450 ml/ha OR Betacyfluthrin + Imidacloprid @350 ml/ha OR Flubendiamide 39.35 SC @150 ml/ha OR Flubendiamide 20 WG @250-300 g/ha OR Thiamethoxam + Lambda Cyhalothrin @125 ml/ha; **Girdle beetle-** Thiacloprid 21.7 SC @750 ml/ha OR Profenophos 50 EC @1250 ml/ha OR Betacyfluthrin +Imidacloprid @350 ml/ha OR Thiamethoxam + Lambda Cyhalothrin @125 ml/ha; **Pod borer** (*Helicoverpa armigera, Cidia ptychora*)- Profenophos 50 EC @1250 ml/ha OR Chlorantraniliprole 18.5 SC @ 150 ml/ha OR Indoxacarb 15.8 EC @333 ml/ha; ***Insecticie + Herbicide combinations:*** **Stem fly**- Chlorantraniliprole + Imazethapyr/ Quizalofop ethyl; **Semi-loopers**- Chlorantraniliprole + Imazethapyr/Quizalofop ethyl OR Indoxacarb + Imazethapyr; **Tobacco caterpillar** – Chloantraniliprole/Quinalphos + Imazethapyr OR Quinalphos + Quizalofop ethyl; **Girdle beetle** – Chlorantraniliprole/ Indoxacarb + Imazethapyr.
14.	Disease control	**Seed Treatment for** Charcoal rot, Anthracnose and Pod Blight, Collar rot Purple seed stain, Frog eye leaf spot: Thiophanate methyl 45% + Pyraclostrobin 5% FS OR Carboxin 37.5% + Thiram 37.5% OR Thiram+Carbendazim (2:1) @ 3 g/kg seed OR Penflufen + Trifloxystrobine 38 FS @ 1 ml/kg seed. **Seed treatment for YMV**, YMIV: Thiamethoxam 30 FS @ 10 ml/kg seed OR Imidacloprid 48 FS @25 ml/kg seed. **First spray during initiation of the disease and second after**

		15 days based on disease severity: Rust- Hexaconazole 5% EC @ 800 ml/ha; Anthracnose and Pod Blight- Tebuconazole + Sulphur @1kg/ha; Charcoal rot- Tebuconazole @ 625 ml/ha OR Pyraclostrobin 20% w/w WG @500 g/ha; **Spray 20-25 days after sowing as preventive spray and immediately after initiation of symptom for** YMV, YMIV- Thiamethoxam 25WG @ 100 g/ha.

Recommended recent soybean varieties state wise

S.No.	States & Centers	Varieties
1.	Madhya Pradesh	NRC 130, JS 20-34, JS 20-69, JS 20-116, RSC 10-52, RVSM 2011-35 (RVSM 35), IS 138 (NRC 138), AMS 100-39 (PDKV Amba), Raj Vijay Soybean [RVS 76], IS 142 (NRC 142)
2.	Maharashtra	AMS-MB-5-18, KLDS 334, JS 20-34, JS 20-69, RVSM 2011-35 (RVSM 35), IS 138 (NRC 138), AMS 100-39 (PDKV Amba), Raj Vijay Soybean [RVS 76], IS 142 (NRC 142), KBVS 1(Karune), MACS-NRC 1667
3.	Rajasthan	JS 20-34, RKS 45, RVSM 2011-35 (RVSM 35), IS 138 (NRC 138), AMS 100-39 (PDKV Amba), Raj Vijay Soybean [RVS 76], IS 142 (NRC 142)
4.	Karnataka	DSb 21, DSb 23, DSb 34, KSB 23, KBVS 1(Karune), IS 142 (NRC 142), MACS-NRC 1667,
5.	Telangana	BASARA, KDS 726, KDS 753, MAUS 158, MACS 1188, IS 142 (NRC 142), KBVS 1(Karune), MACS-NRC 1667,
6.	Chhattisgarh	CG SOYA, RSC 10-52 & RSC 10-46
7.	Jharkhand	CG SOYA, RSC 10-52 & RSC 10-46
8.	Gujarat	NRC 130, JS 20-34, JS 20-69, JS 20-116, RSC 10-52, RVSM 2011-35 (RVSM 35), IS 138 (NRC 138), AMS 100-39 (PDKV Amba), Raj Vijay Soybean [RVS 76], IS 142 (NRC 142)
9.	Bihar	SL 958, NRC 128, NRCSL1
10.	Punjab	SL 958, SL 979, SL 1074, SL 1028
11.	Uttarakhand	PS 1347, PS 1225, PS 25 & PS 26
12.	Himachal Pradesh	VLS 59, VLS 63, VLS 89
13.	Manipur	MACS 1460, DSb 19, DSb 32, JS 20-116, RKS 113
14.	Nagaland	MACS 1460, DSb 19, DSb 32, JS 20-116, RKS 113

Annexure IX

FLDs data collection format

I. Farmer wise particulars of the demonstrations

a) General information

1.	Name of the farmer		
2.	Location of the demonstration		
	Village		
	Taluk/Block/Mandal		
	District		
3.	Size of holding (ha)		
4.	Area of demonstration	**IT**	**FP**
5.	Irrigated/ rainfed (If irrigated mention the source of irrigation, number, stage of the crop, time and method of irrigation)		
6.	Cropping system followed		
7.	Soil type		
8.	Sowing date		
9.	Crop and variety/hybrid: specify the source from where the seed is procured and type of seed like certified /TFL/ Local		
10.	Spacing (cm)		
11.	Pest		
	Disease		
12.	Fertilizer applied (Give also source of NPK & the specific schedule followed)		
13.	Crop condition		
14.	Harvesting date		
15.	Other management particulars		
16.	Farmer's opinion of the improved technology		

b) Yield and income (per plot)

Particulars	**Yield in quintals/plot**		**Price in Rs./Quintal**		**Total Value in Rs**	
	IT	**FP**	**IT**	**FP**	**IT**	**FP**
Main product						
By Product						
Total						

c) Material costs (per plot)

S. No.	Name of the material	Quantity used		Rs./Unit		Total Amount (Rs.)	
		IT	FP	IT	FP	IT	FP
1.	Seed in kgs.						
2.	Fertilizers						
	a. Basal						
	1.						
	2.						
	3.						
	b. Top dressing						
	1.						
	2.						
	3.						
3.	FYM/Compost in quintal or cart loads						
4.	Plant protection chemical						
5.	Irrigation						
6..	Others						
Total							

d) Labour costs (per plot)

S. No.	Operation	No. of operation	Implements used	Hours used		Human labour				Bullock labour			
				IT	FP	Units		Value		Units		Value	
						IT	FP	IT	FP	IT	FP	IT	FP
1.	Land preparation												
	i. Ploughing												
	ii. Harrowing												
	iii. Levelling												
2.	Sowing												
3.	Fertilizers and manures												
	i. Basal												
	ii. Top dressing												
4.	Irrigation												
5.	Pesticide application												
6.	Interculture												
7.	Weeding												
8.	Weedicides												

S. No.	Operation	No. of operation	Implements used	Hours used		Human labour				Bullock labour			
				IT	FP	Units		Value		Units		Value	
						IT	FP	IT	FP	IT	FP	IT	FP
9.	Harvesting												
10.	Threshing and winnowing												
11.	Special operations												
	1. Thinning												
	2. Gap filling												
Total													
Grand total (c+d)													

IP = improved practice plot; LP= local practice plot; male; F= female

II. Final format for submission of FLD Data (Technology-wise)

S. No	Name	Address & mobile number	Technology demonstrated	Yield (kg/ha)		% increase over farmers practices		Gross monetary returns (₹/ha)		Cost of cultivation (Rs./ha)		Additional Net returns		BC ratio
				IT	FP	IT	FP	IT	FP	IT	FP	IT	FP	
1.														
2.														
3.														
4.														
5.														
6.														
7.														
8.														