

Original Research Article

<https://doi.org/10.20546/ijcmas.2020.904.313>

## Evaluation of Yield Performance of Soybean [*Glycine max* (L.) Merrill] through Cluster Front Line Demonstrations

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### ABSTRACT

Soybean had played a pivotal role in socio-economic transformation of majority of small and marginal farming community of central India and continued to contribute significantly to the oil economy of India. The average productivity of soybean presently is staggering around one ton per ha, which is a matter of concern. A study therefore was carried out by Krishi Vigyan Kendra, Chittorgarh (Rajasthan) to know the yield gaps between improved package and practices under front line demonstration (FLD) and farmer's practice (FP) of soybean crop under rainfed conditions. Front line demonstrations (FLDs) were conducted on total 333 farmer's fields each year to demonstrate the impact of improved agro-techniques on production and economic benefits under rainfed conditions of Chittorgarh in Zone 1V A Sub humid Southern and Plain Arawalli Hills region during Kharif seasons of four consecutive years i.e. 2014 to 2017. The technologies demonstrated in FLDs recorded additional yield over farmer's practice. Under FLDs the mean grain yield of soybean was increased by 25.55 per cent over FP. The mean extension gap, technology gap and technology index were calculated as 328.5 kg ha<sup>-1</sup>, 649.25 kg ha<sup>-1</sup> and 29.50 per cent, respectively. Adoption of improved package of practices in soybean cultivation recorded higher mean B: C ratio (1.39) as compared to FP (1.13). Yield enhancement and higher net returns observed under FLDs of improved technologies in soybean. Thus, the productivity of soybean could be increased with the adoption of recommended improved package of practices. The study resulted to convincing the farming community for higher productivity and returns.

### Keywords

Economics, Extension gap, FLD, Technology gap, Technology index, Soybean yield, Satisfaction, Technology dissemination.

### Article Info

Accepted:  
22 March 2020  
Available Online:  
10 April 2020

### Introduction

Soybean [*Glycine max* (L.) Merrill] is the world's most important seed legume crop, which contribute to 25% of the global edible oil, about two-thirds of the world's protein concentrate for livestock feeding. Soybean is recognized as golden or miracle bean due to

its high nutritive value and various usage viz., for feed, oil and soy food products. It is rich in protein (38-42%) and contains 18- 22 per cent edible oil. Soybean ranked first in the world in oil production (57%) and in the international trade markets (Meena *et al.*, 2012). Soybean continues to be number one oilseed crop in India occupying 10.47 million

ha area with production of 10.98 million tonnes and productivity 1049 Kg ha<sup>-1</sup>. Out of which large area of soybean production is in Rajasthan ie.0.89 million ha and 1.07 million tonnes production with 1207 kg ha<sup>-1</sup> productivity (Anonymous, 2018). The acreage of soybean in Chittorgarh district was 0.12 million ha area with productivity 829 Kg ha<sup>-1</sup> in year 2017-18, receptively. This district has greater potential of soybean production due to favourable climatic and soil condition. As an exceptional crop among oilseeds, soybean attained an unparallel glory of its horizontal expansion in very short span of nearly four decades (Dupare *et al.*, 2012). The adoption of recommended production technology among farmers is not very encouraging. The reason may be that either the promising technologies have not yet reached the farmer's fields or farmers are unable to use improved technology due to various socio-economic reasons. Hence, an efficient technology transfer system is advocated and conducting frontline demonstration on farmer fields have proved as an effective means for creating awareness and acceptance of improved technologies. Keeping this in view, the present study was carried out to find out the evaluation of yield performance and effect of technological interventions on soybean productivity and economics. Soybean production has to be increased by adopting improved production practices. There are several constraints of low productivity of soybean in India, out of which poor extension of improved agronomic practices is on the top. Moreover, poor agronomic practices such as higher seed rate, unsuitable varieties, faulty nutrient management as well as negligence of plant protection measures of crop from insect-pest and wild animals are also responsible for low productivity of soybean. Frontline demonstration is the modern concept with the objective to demonstrate newly released crop production and protection technologies and its management practices at farmer's fields under

different farming situations. While demonstrating the technologies in the farmer's fields, the scientists are required to study the various factors contributing higher crop yield, constraints in field production and thereby generate production data and feedback information. Keeping these in view, FLDs of improved production technology on soybean were conducted to enhance the productivity and economic returns and also convincing the farmers for adoption of improved production technologies in soybean crop.

### **Materials and Methods**

The present study was carried out by Krishi Vigyan Kendra and demonstrations were conducted in its adopted village's viz. Amarpura, Laxmipura, Kherpura, Nahargarh, Kanoj, Sukhwara, Ram nagar, Naga keda *etc.*, district Chittorgarh (Rajasthan) in Kharif season of 2014-15, 2015-16, 2016-17 and 2017-18 on the selected farmers' fields. Each demo was conducted in 0.4 ha (one acre) and thus, 333 demonstrations were conducted 2014-15 to 2017-18 year. For the adoption of villages PRA technique and for the selection of farmers the purposive sampling design from frequently organized group meetings was exercised in each village. The soils of the farmer fields were rainfed and clay loam in texture and low to medium in NPK. FLD plots were kept for assigning farmers practices. Prior to conducting FLDs, group meeting and specific skill training was given to the selected farmers regarding package of practices of soybean crop. To popularize the improved soybean agro techniques for enhancing the production, constraints in soybean production were identified through participatory approach. Preferential ranking technique was utilized to identify the constraints faced by the respondent farmers in soybean production. Farmers were also asked to rank the constraints they perceive as

limiting factor for soybean cultivation in order of preference. Based on top rank of farmer's problems identified, front line demonstrations were planned and conducted at the farmer's fields. The improved production-techniques selected for FLDs given in (Table 1). The soybean crop was sown at 30 cm (row-row) apart in line using seed rate of 80 kg ha<sup>-1</sup> in month of Mid June and First week of July during the years, respectively. The average yield of FLD and farmer practice has been taken in the years for interpretation of the results. The extension gap, technology gap and technology index were calculated using the following formula as suggested by Samui *et al.*, (2003).

Extension gap (Kg ha<sup>-1</sup>) = Demonstration yield (Kg ha<sup>-1</sup>) – Yield of local check (Kg ha<sup>-1</sup>)

Technology gap (Kg ha<sup>-1</sup>) = Potential yield (Kg ha<sup>-1</sup>) – Demonstration yield (Kg ha<sup>-1</sup>)

$$\text{Technology index \%} = \frac{(\text{Potential yield} - \text{Demonstration yield})}{\text{Potential yield}} \times 100$$

The satisfaction level of participating farmers for the performance of improve demonstrated technology was also assessed. Total 20 farmers each year were selected to measure satisfaction level for the performance of improved technology. The selected respondents were interviewed personally with the help of a pre-tested and well-structured interview schedule. Client Satisfaction Index was calculated as below.

Client satisfaction index = (Individual score obtained / Maximum score possible) x 100.

The data on yield were recorded and analysed for interpretation of the results. The economic-parameters (gross return, net return and B: C ratio) were worked out on the basis of prevailing market prices of inputs and minimum support prices of outputs.

## Results and Discussion

### Constraints in soybean production

Problems faced by the farmers in soybean cultivation were documented during the study. Perusal of the data from (Table 2) indicated that non-availability of improved varieties of soybean (82%) was given the top most rank followed by low technical knowledge (75%), seed treatment (72%), incidence of insect and damage caused by wild animals (68%), use of higher seed rate (35%), low fertility status (32%), weed infestation (27%) and plant diseases (18%) were the major constraints to soybean cultivation. Dhruw *et al.*, (2012), Meena *et al.*, (2014) and Singh *et al.*, (2014) have also reported similar constraints.

### Soybean yield

The data on Soybean yield (Table 3) indicated that the FLDs given a good impact on the farming community of Chittorgarh district as they were motivated by the new agricultural technologies adopted in the demonstrations. Average soybean yield under front line demonstrations was observed as 1550 Kg ha<sup>-1</sup> which was higher by 25.55% over the prevailing farmers practice (1222 Kg ha<sup>-1</sup>). The results clearly indicated that the yield of soybean could be increased over the yield obtained under farmer's practices by accelerating the adoption of recommended production technology for the Chittorgarh districts. Deshmukh *et al.*, (2010), Singh *et al.*, (2014) and Sharma *et al.*, (2016) also found similar findings.

### Extension gap

More and more use of latest production technologies with high yielding varieties will subsequently change different this alarming trend of galloping extension gap. The new technologies will eventually lead to the

farmers to discontinuance of old varieties with the new technology. From these results the extension gap 591 kg ha<sup>-1</sup> in year 2014-15, 241 kg ha<sup>-1</sup> in 2015-16, 226 kg ha<sup>-1</sup> in 2016-17, 256 kg ha<sup>-1</sup> in 2017-18 and average 328.5 kg ha<sup>-1</sup> was reported (Table 3).

During the period of study which emphasized the need to educate the farmers through various means for the adoption of improved agricultural production technologies to reverse this trend of wide extension gap.

The technology gap observed may be attributed to the dissimilarity in the soil fertility status and weather conditions. Hence, variety wise location specific recommendation appears to be necessary to minimize the technology gap for yield level in different situations. These finding of studies were in agreement with Singh *et al.*, (2014) and Morwal *et al.*, (2018).

### **Technology gap**

Data presented in (Table 3) revealed that the maximum technology gap was found in the year 2015-16 (924 kg ha<sup>-1</sup>) and lowest in the year 2014-15 (305 kg ha<sup>-1</sup>). However, overall average technology gap in the study was 649.25 kg ha<sup>-1</sup>. It was further reported that the technology gap was reduced with respect to succeeding years of experimentation and observed 924 kg ha<sup>-1</sup> in year 2015-16, 812 kg ha<sup>-1</sup> in year 2016-17, 556 kg ha<sup>-1</sup> in year 2017-18 and 305 kg ha<sup>-1</sup> in 2014-15 respectively. It may be attributed to difference in the soil fertility status, agricultural practices, local climate conditions, rainfed agriculture and timeliness of availability of inputs. Hence, variety wise location specific recommendation appears to be necessary to minimize the technology gap for yield level in different farming situations. Hence, location specific recommendations are necessary to bridge the gap. These results are in agreement

with Tomar *et al.*, (2003) and Singh *et al.*, (2014).

### **Technology index**

The technology index indicates the feasibility of evolved technology at the farmer's field. The lower the value of technology index more is the feasibility of the technology. Result of study depicted in (Table 3) revealed that the technology index value was 13.86 per cent in year 2014-15, 42.00 per cent in year 2015-16, 36.90 per cent in year 2016-17 and 25.27 per cent in 2017-18. On the basis of four years study, the overall technology index 29.50 per cent was recorded, whereas highest technology 42.00 per cent was recorded during 2015-16 and lowest (13.86%) during 2014-15. Hence, it can be inferred that awareness and adoption of improved varieties with the recommended scientific package of practices have increased during the advancement of the study period. These results are corroborating with the findings of Dhaka *et al.*, (2010), Raj *et al.*, (2013) and Bhargav *et al.*, (2015).

### **Economic analysis**

The mean higher cost of cultivation Rs. 22047.5 ha<sup>-1</sup> involved in FLDs as compared to Rs. 20007.5 ha<sup>-1</sup> under Farmers practice (Table 4). The FLDs plots fetched higher mean gross returns (Rs. 52325.5 ha<sup>-1</sup>) and net returns (Rs. 30278.0 ha<sup>-1</sup>) with higher benefit: cost ratio (1.39) as compared to (gross returns Rs. 42394.75 ha<sup>-1</sup>), (net returns Rs. 22387.25 ha<sup>-1</sup>) and (benefit: cost ratio 1.13) with farmers practice. Joshi *et al.*, (2014) also reported higher net returns and B: C ratio in the FLDs on improved technologies compared to the farmers practices and are at par with results of the present study which also resulted in higher net returns through FLDs on improved technologies.

**Table.1** Comparison between technological intervention under FLDs and local check on soybean

S.No.	Particulars	FLDs	FP	Gap
1.	Farming situation	Rainfed	Rainfed	No gap
2.	Variety	Use short duration variety J.S. 95-60, moderately resistant to YMV disease	Use long duration variety JS- 335, susceptible to YMV	Gap (50 %)
3.	Land preparation	Summer deep ploughing followed by rotavator	Summer deep ploughing followed by rotavator	No gap
4.	Time of sowing	Mid June to July	Mid June to July	No gap
5.	Seed rate	Use optimum seed rate (80 kg ha <sup>-1</sup> )	Higher seed rate (100 kg ha <sup>-1</sup> )	10-20% more than recommendation
6.	Seed treatment	Seed treatment with trichoderma and bio-fertilizer culture	No seed treatment	Full gap (100 %)
7.	Method of sowing	Line sowing	Line sowing	No gap
8.	Nutrients application	Use of SSP fertilizer (250kg ha <sup>-1</sup> ) & Urea(50 kg) at sowing time (20 kgN :40 kg P <sub>2</sub> O <sub>5</sub> ha <sup>-1</sup> )	Use of SSP fertilizer(100 kg ha <sup>-1</sup> ) at sowing time and top dressing of urea ( 50 kg ha <sup>-1</sup> )	Not use as per recommendation
9.	Hoeing &weeding	Application Post-emergence herbicides Imazethapyr 10EC at 15-20 DAS and Manual	Manual weeding	Gap (50%)
10.	Plant protection	Use Trizophos against girdle beetle insect	Lack of awareness about pesticides selection and time of spray.	Gap (60%)

**Table.2** Ranks for different constraints given by farmers

S.N.	Constraints	Percentage	Rank
1	Improved Varieties of Soybean	82	I
2	Low technical knowledge	75	II
3	Seed treatment	72	III
4	Insect &Damage by wild animals	68	IV
5	Use of higher seed rate	35	V
6	Low soil fertility	32	VI
7	Weed infestation	27	VII
8	Plant protection	18	VIII

**Table.3** Yield performance of soybean under FLDs

Year	No. of demonstrations	Area ( ha)	Yield (kg ha <sup>-1</sup> )		%Yield increase over FP	Extension gap (kg ha <sup>-1</sup> )	Techno logical gap (kg ha <sup>-1</sup> )	Technology index (%)
			FLD	FP				
<b>2014-15</b>	101	40	1895	1304	45.32	591	305	13.86
<b>2015-16</b>	100	40	1276	1035	23.30	241	924	42.00
<b>2016-17</b>	32	20	1819	1162	15.15	226	812	36.90
<b>2017-18</b>	100	40	1644	1388	18.44	256	556	25.27
<b>Mean</b>	<b>83</b>	<b>35</b>	<b>1550</b>	<b>1222</b>	<b>25.55</b>	<b>328.5</b>	<b>649.25</b>	<b>29.50</b>

**Table.4** Economics, additional cost and returns in soybean under frontline demonstrations (FLDs) vs. framers practice (FP)

Year	Cost of cultivation (Rs ha <sup>-1</sup> )		Gross returns (Rs. ha <sup>-1</sup> )		Net returns (Rs ha <sup>-1</sup> )		Additional cost of cultivation (Rs ha <sup>-1</sup> in FLD)	Additiona l returns (Rs ha <sup>-1</sup> ) in FLD	B: C Ratio	
									FLD	FP
	FLD	FP	FLD	FP	FLD	FP				
<b>2014-15</b>	18200	14700	45700	32650	27500	17950	3500	13050	1.51	1.22
<b>2015-16</b>	23090	21430	51030	40295	27940	18865	1660	10735	1.21	0.88
<b>2016-17</b>	22200	20700	62430	54300	40230	33600	1500	8130	1.81	1.62
<b>2017-18</b>	24700	23200	50142	42234	25442	19134	1500	7908	1.03	0.82
<b>Mean</b>	<b>22047. 5</b>	<b>20007.5</b>	<b>52325.5</b>	<b>42394.75</b>	<b>30278.0</b>	<b>22387.25</b>	<b>2040.0</b>	<b>9955.75</b>	<b>1.39</b>	<b>1.13</b>

**Table.5** Extent of farmers’ satisfaction over performance of FLDs

Satisfaction level	Number	Percent
<b>Low</b>	07	8.75
<b>Medium</b>	20	25.0
<b>High</b>	53	66.25

**Additional cost of cultivation and returns**

Data (Table 4) revealed that the average additional cost of cultivation (Rs. 2040 ha<sup>-1</sup>) under integrated crop management demonstrations and has yielded additional net returns of Rs. 9955.75 ha<sup>-1</sup>. The results suggest that higher profitability and economic viability of soybean demonstrations under local agro-ecological situation.

**Farmer’s satisfaction**

Client satisfaction index (CSI) presented in (Table 5) observed that majority of the respondent farmers expressed high (66.25%) and medium (25.0%) level of satisfaction regarding the performance of FLDs, whereas, very few (8.75 %) of respondents expressed lower level of satisfaction. Majority of responding farmers under higher and medium level of satisfaction with respect to

performance of demonstrated technology indicate stronger conviction, physical and mental involvement in the frontline demonstrations which in turn would lead to higher adoption. The results are corroborated with the results of Kumaran and Vijayaragavan (2005) and Dhaka *et al.*, (2010).

Thus, it may be concluded that the yield and returns in soybean crop increased substantially with the improved production technologies. However, the yield level under FLDs was better than the farmer practice and performance of these varieties could be further improved by adopting recommended production technologies. So, there is need to disseminate the improved technologies among the farmers with effective extension methods like training and field demonstrations. The farmers should be encouraged to adopt the recommended agro-techniques for getting maximum returns in specific locations.

Thus, it was clearly showed that the demonstration of soybean with full package was better to farmer's practices. The results indicated that the frontline demonstration has given a good impact on the farming community of the district Chittorgarh (Rajasthan) as they were motivated by the new agricultural technology applied in the FLD plots. Similar findings were reported by Kirar *et al.*, (2006).

### **Acknowledgement**

I am sincerely thankful to all the farmers on whose field frontline demonstration were conducted. The financial assistance provided by Indian Council for Agricultural Research, New Delhi and Director, ICAR –Agricultural Application Research Institute (ATRI), Zone-II, Jodhpur (Rajasthan) India. The opinions expressed in this paper are the author's own and do not necessarily reflect the views of the donor or the authors' institution.

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#### **How to cite this article:**

Ratan Lal Solanki, K. C. Nagar, S. K. Agarwal, Priyanka Swami and Deepa Indoria. 2020. Evaluation of Yield Performance of Soybean [*Glycine max* (L.) Merrill] through Cluster Front Line Demonstrations. *Int.J.Curr.Microbiol.App.Sci.* 9(04): 2617-2624.

doi: <https://doi.org/10.20546/ijcmas.2020.904.313>