The Pharma Innovation Journal 2023; 12(10): 1935-1937

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(10): 1935-1937

www.thepharmajournal.com
Received: 01-07-2023
Accepted: 06-08-2023

Akhilesh Srivastava
Senior Scientist and Head, KVK Aron, Guna, Madhya Pradesh, India

Ranjeet Singh
Research Fellow, CFLD Oilseed, ICAR-ATARI, Jabalpur, Madhya Pradesh, India

Corresponding Author:
Akhilesh Srivastava
Senior Scientist and Head, KVK Aron, Guna, Madhya Pradesh, India

Calculated of soybean (*Glycine max* L. Merril) yield & economic through cluster frontline demonstrations under gird zone

Akhilesh Srivastava and Ranjeet Singh

Abstract
In the Gird region, the principal oilseed crop during the Kharif season is soybean, which is essential for the security of food supply and livelihood. Cluster frontline demonstrations were carried out by Krishi Vigyan Kendra (KVK), Aron, and Guna to determine the yield gaps between the improved package and practices under cluster frontline demonstration (CFLD) and farmer's practice (FP) of soybean crop under rainfed conditions. This was done in consideration of the potential for improving productivity through the improved varieties and recommended production technologies. KVKs are working to determine the causes of productivity gaps in the farmer's fields and looking for solutions to close the production gaps. In Madhya Pradesh's Guna district, during the kharif seasons of 2021 and 2022, cluster frontline demonstrations (CFLDs) were carried out on farmers' fields to show the effect of better agro-techniques on productivity and economic benefits under rainfed circumstances. The technologies used in CFLDs produced more yield than what farmers were using before. The grain yield of soybeans under CFLDs improved over FP by 27.41%. The results of the calculations were 3.03 q/ha, 8.93 q/ha, and 38.82% for the extension gap, technology gap, and technology index, respectively. A greater B:C ratio (3.35) as compared to FP (2.67) was seen in soybean production after the adoption of an upgraded package of techniques. Under CFLDs of enhanced technologies in soybean, increased yield and greater net returns were seen. Technology and techniques, such as the use of an improved variety (JS 20-34), seed treatment, seed inoculation, spacing of 30 cm, balanced fertilizer administration, weed control, plant protection measures, etc., were exhibited in certain plots as part of frontline demonstrations. For the farming community, the study's findings about increased production and returns were quite persuasive.

Keywords: Yield, economics, soybean, cluster frontline demonstration, extension gap, technology gap, technology index

Introduction
Soybean (*Glycine max* L. Merrill) has 18-22% edible oil and is high in protein (38-42%). With a yield of 18.75 million metric tons and a planted area of 12.50 million ha, soybean remains India's most important oilseed crop. (Anonymous, 2022) [1]. Soybeans should therefore be planted in Central India between mid-June and the first week of July. For crop productivity, minimum temperatures should be around 15 °C and roughly 10 °C, respectively. (Dupare *et al.*, 2012) [3]. It's possible that this is because farmers are unable to adopt more advanced equipment for a variety of socioeconomic reasons, or because potential technologies have not yet reached their fields. As a result, an effective mechanism for technology transfer is encouraged, and cluster frontline demonstrations on farmer fields have proven to be successful in raising public awareness and fostering adoption of new technologies (Nainwal *et al.*, 2019) [6]. Keeping this in mind, the present study was carried out to determine the effect of technological interventions on soybean productivity and economics in selected farmers under KVK, Aron districts of Guna.

Materials and Methods
Farmers' fields were used to execute the current experiment cluster frontline demonstration with an upgraded package of techniques on soybean during the Kharif seasons of 2021 and 2022, respectively. In the last week of June of both years, the soybean variety, JS 20-34, was seeded in a line 45 cm (row-row) apart at a seed rate of 75 kg/ha (Table 1). To determine the district's overall yield (under both demonstration and farmers' practice), the sample average approach was utilized. Similar to that, the following method was used to calculate the economics of both the farmers' practices and the demonstrations.

The yield were evaluated in comparison to a comprehensive set of techniques, including variety, seed treatment, seed inoculation, spacing, balanced fertilizers, weed management, and plant protection measures. Both the farmer's practice and the demonstration's yield data were gathered, and their extension gap, technology gap, and technology index were calculated. (Samui *et al.*, 2000) [7] as given below.

Extension gap (q/ha) = Demonstration yield (q/ha) – Yield of local check (q/ha).

Technology gap (q/ha) = Potential yield (q/ha) – Demonstration yield (q/ha).

Technology index (%) = [(Potential yield – Demonstration yield) / Potential yield] x 100.

Technological Interventions under CFLD Oilseeds:

- High yielding, improved variety seeds.
- Seed treatment.
- Integrated Nutrient Management.
- Integrated pest management.
- Integrated weed management.
- Line sowing.

Table 1: Comparison of cluster frontline demonstrations (CFLDs) and existing farmer's practice (FP) for soybean cultivation in Grid Zone

Input/practices	Production technology capsule (FLD)	Farmer's practice (FP)
Variety	JS 20-34	Local
Planting time	Last week of June	June end
Planting	45 x 5 cm	30 x 3-5 cm
Seed rate	75 kg/ha	125-150 kg/ha
Seed treatment	Carboxin + Mencozeb 2.5 g/kg seed	Nil
Manure and fertilizer	20:60:20 Kg N:P:K	50 kg DAP ha^{-1}
Weed control	One hand weeding at 20 DAS or Pendimethalin @ 1 kg a.i./ha	One hand weeding

Results and Discussion

The high-yielding soybean variety JS 20-34 performed better than their local cultivars, increasing their profits, and as shown by the soybean yield (Table 2 and Fig. 1), the CFLDs had a better impact on the farming community of the Guna district. As a result, they were motivated by the new agricultural technologies used in the demonstrations. The cluster frontline demonstrations' average soybean yield was 14.07 q/ha, which was 27.31% greater than the standard farming practice of 11.05 q/ha. The findings suggested that adopting the suggested production method could boost soybean output relative to yield produced by farmer practices (Sharma *et al.*, 2016) [8]. In this regard, a total of 25 demonstrations were conducted at the selected farmer's field under KVK, Aron.

Extension and technology gaps

The high-yielding JS 20-34 soybean variety outperformed their native cultivars, boosting their earnings. As evidenced by the soybean yield (Table 2 and Fig. 1), the CFLDs also had a greater positive influence on the Guna district's farming community. They were inspired as a result of the innovative farming technologies employed in the demos. The average soybean yield for the cluster frontline demonstrations was 14.07 q/ha, 27.31% more than the yield obtained using conventional farming methods, which was 11.05 q/ha. The results indicated that, in comparison to the yield provided by farmer practices, implementing the suggested production method could increase soybean output (Sharma *et al.*, 2016) [8].

Technology index

The technology index shows whether or not advanced technology can be used in agricultural fields. The technology's practicability has a lower technology index (%) score. The information (Table 2) revealed that the technology index value of 43.28% was observed in the year 2021, while the value for 2022 was 34.35%. The technology index value was recorded at 38.82% on average, which may have been caused by the area's erratic and uneven rainfall. Dhaka *et al.* (2010) [2] and Singh *et al.* (2014) [9] also found similar results.

Economic analysis

According to the results of the current study, the cost of cultivation per ha was greater in CFLDs—at Rs. 18928—than it was in farmer practices—at Rs. 18635 (Table 3). As compared to gross returns (Rs. 49703 per ha), net returns (Rs. 31068 per ha), and benefit-cost ratio (2.67) with farmer practice, the CFLDs plots produced higher mean gross returns (Rs. 63326 per ha) and net returns (Rs. 44398 per ha) with a higher benefit-cost ratio (3.35). In contrast to the findings of the current study, which also indicated better net returns through CFLDs on improved technologies, Joshi *et al.* (2014) reported higher net returns and a B: C ratio in the FLDs on improved technologies. Similar results were also recorded by. Nainwal *et al.* (2019) [6].

Additional costs of cultivation and returns

Under integrated crop management demonstrations, the average additional cost of cultivation is Rs. 293 per ha, with additional net returns of Rs. 13331 per ha (Table 3). It was thus amply demonstrated that the soybeans' entire package demonstration was superior for farmers' practices. The cluster frontline demonstration had a positive effect on the district's farmer population, according to the results, since they were inspired by the new agricultural technology used in the CFLDs plots. Kirar *et al.* (2006) [5] reported similar results.

Table 2: Yield performance of soybean under CFLDs

Year	No. of demo.	Area (ha)	Yield (q/ha)		Yield increase (%) over FP	Extension gap (q/ha)	Technology gap (q/ha)	Technology index (%)
			CFLD	FP				
2021	25	10	13.05	10.68	22.14	2.37	9.96	43.28
2022	25	10	15.10	11.41	32.34	3.69	7.90	34.35
Mean	25	10	14.07	11.05	27.41	3.03	8.93	38.82

Table 3: Economics, additional cost and returns in soybean under demonstrations (CFLDs) and framers practice (FP)

Year	Cost of cultivation (Rs./ha)		Gross returns (Rs./ha)		Net returns (Rs./ha)		Additional cost of cultivation (Rs./ha) in FLD	Additional returns (Rs./ha) in FLD	B: C Ratio	
	CFLD	FP	CFLD	FP	CFLD	FP			CFLD	FP
2021	18510	18350	58703	48060	40193	29710	160	10483	3.17	2.62
2022	19346	18920	67950	51345	48604	32425	426	16179	3.51	2.71
Mean	18928	18635	63326	49703	44398	31068	293	13331	3.35	2.67

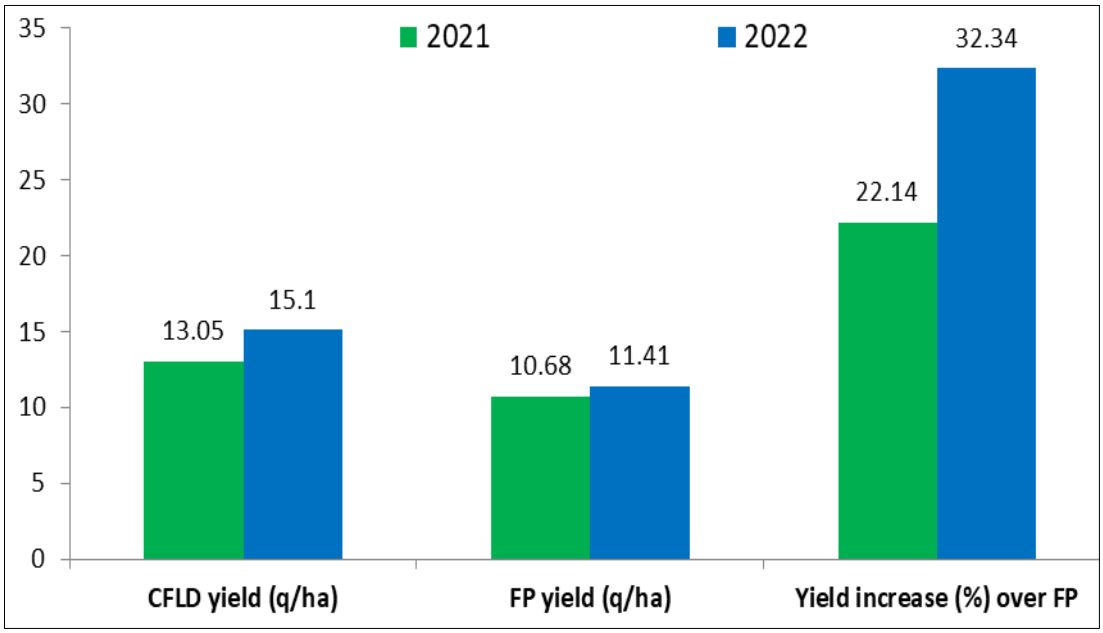

Fig 1: Yield performance of soybean under CFLDs and FP

Conclusion

The findings demonstrate that cluster frontline demonstrations are crucial in promoting the KVKs' recommended technologies in the targeted regions because they highlight the potential of the technologies to improve yields for farmers using their own resources and essential inputs.

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