

Original Research Article

Cluster Frontline Demonstration: An Effective Technique to Transfer the Technology for Enhancing Productivity and Profitability of Linseed (*Linum usitatissimum*) in Sidhi district of Madhya Pradesh

ABSTRACT

Linseed is one of the most important oilseeds crops next to mustard in India, which plays a major role in supplementing the income for small and marginal farmers of the Sidhi district of Madhya Pradesh. The development of Agriculture is primarily depending on the application of ~~the~~ scientific technologies by making the best use of available resources. To increase the production, productivity, profitability and quality of agricultural produce, Cluster Front Line Demonstrations were conducted at various ~~farmers~~~~farmers'~~ ~~field~~~~fields~~ during rabi seasons of three selected blocks of Sidhi district of Madhya Pradesh. Krishi Vigyan Kendra, Sidhi conducted 150 cluster frontline demonstrations of Linseed during two consecutive years from 2016–17 and 2018–19. The critical inputs were identified in existing production technology through meetings and discussions with farmers. Prevailing farmer's practices were treated as a control for comparison with recommended practices. The average yield of recommended practices registered 94 per cent higher ~~over~~~~than~~ the farmers' practice. The average ~~of~~ technology gap, extension gap and technology index were observed 10.59 q/ha, 3.59 q/ha and 58.84 per cent respectively. The highest grain yield (7.67 q/ha) was recorded in the year 2018-19, it was 101.3 per cent more ~~over~~~~than~~ the farmers' practice (3.81 q/ha). Average net profitability of worth Rs. 9037 /ha as compared with farmers practices (Rs. 1785/ha) were obtained ~~and~~~~an~~ average ~~benefit~~~~cost~~ ratio ~~i.e.i.e.~~, 1.68 and 1.19 were recorded in demonstrated plot and farmers practice respectively. The higher additional returns (Rs. 7252/ha) and effective gain (Rs. 3659/ha) obtained under demonstrations could be due to improved technology, timely ~~operations~~~~of crop cultivation~~~~crop cultivation operations~~, and scientific monitoring.

Keywords: *CFLD, Linseed, JLS-27, Yield, technology gap, technology index, net returns, effective gain and BC ratio*

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Introduction

Linseed or flax (*Linum usitatissimum* L., 2n= 30, X = 15) belongs to the family *Linaceae*. It is the second most important *rabi* oilseed crop and stands next to rapeseed-~~mustard~~ in ~~the~~ area of cultivation and seed production in India. The genus *Linum* is composed of approximately 230 species but cultivated linseed ~~+~~~~flax~~ is the only species of economic importance in the genus

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(Tadesse *et al.*, 2010) and is one of the oldest crops cultivated for ~~fiber-fibre~~ and oil. The word 'flax' is used when it is grown for ~~fiberfibre~~, 'linseed' is used when it is grown for oil purposes and '~~dual-dual~~-purpose flax' when grown for both oil and ~~fiberfibre~~. Linseed is popularly known as *Alsi* in Madhya Pradesh. Linseed is an amazing source of essential fatty acids and it can be seen as an alternate source of omega-3 fatty acids for vegetarians. Linseed oil has been used for centuries as a drying oil whose oil content varies from 33-45% (Gill, 1987). About 20% of the total linseed oil produced in India is used by farmers and ~~the~~ rest about 80% goes to industries for the manufacture of paints, varnish, oilcloth, linoleum ~~and~~-printing ink etc. The oil cake is ~~the~~ most valuable feeding cake for animals, it contains 36% protein and 85 % of it is digestible ~~fiberfibre~~. The oil cake is also used as manure; it contains 5 % nitrogen (N), 1.4 % phosphorus (P₂O₅) and 1.8 % potassium (K₂O). ~~Fibers-Fibres~~ obtained from the stem are known for their length and strength and are two to three times as strong as those of cotton (Taylor, 2012). Linseed has an important position in ~~the~~ Indian economy due to its wide industrial utility. But the national average productivity of linseed seed is quite low as compared to other countries. In India, linseed is grown mostly under rainfed (63%), utera (25%), irrigated (17%) and in input starved conditions in major linseed producing states i.e. Madhya Pradesh, Chhattisgarh, Maharashtra, Jharkhand, Uttar Pradesh and Odisha (Srivastava, 2009). Linseed oil is rich in alpha-linolenic acid (ALA) and contains about 55% ALA. It also contains high levels of dietary ~~fiber-fibre~~ as well as lignin. An abundance of micronutrients and omega-3 fatty acids ~~is-are~~ also present. It has a good taste and contains 36% protein out of which, 85% is digestible. It serves as a good source of minerals especially, phosphorous (650 mg/100g), magnesium (350 - 431 mg/100g), calcium (236 - 250 mg/100g) and has a very low amount of sodium (27 mg/100g) (Ganvit, 2019).

The productivity of linseed in the Sidhi district is very poor (305 kg/ha) than the national productivity, it can be increased by following the appropriate agronomic practices along with high yielding varieties, integrated nutrient management, integrated pest management, proper irrigation management etc. Farmers are using old and degenerated seeds local varieties with higher seed rate i.e. 30-35 kg/ha, growing in marginal lands, rainfed conditions, no insect management and insufficient plant nutrients; especially farmers are not applying Sulphur, although most of the linseed area of the district is Sulphur deficient.

Keeping this in view, the present investigation was carried out to study the awareness level of farmer's regarding linseed cultivation, ~~the~~ extent of adoption of improved practices, to find out the yield gap in linseed production technology. Krishi Vigyan Kendra ~~are-is grass-roota grass-root~~ level organization meant for ~~the~~ application of technology through assessment, refinements and dissemination of proven technologies under ~~the~~ different ~~micro-micro~~-farming situations in the district (Das, 2007). Frontline Demonstration has been proved a successful tool in enhancing the production and productivity of linseed crops ~~by changing farmers' knowledge, attitude, and skill through changing the knowledge, attitude and skill of farmers~~-(Singh *et al.*

2018). Cluster frontline demonstrations were conducted on linseed during 2016-17 and 2018-19 to disseminate the technology in the district.

Materials and Methods

The present study was carried out in the Sidhi district of Madhya Pradesh, which is located ~~on-in~~ the North-East part of Madhya Pradesh state and lies at 24.395603 latitude and 81.882530 longitudes with an altitude of 272 m above the mean sea level. Cluster frontline demonstrations were conducted during 2016-17 and 2018-19 with ~~evaluation-evaluating~~ the performance of JLS-27, ~~the~~ variety of linseed in Sidhi, Majhauri and Sihawal blocks of the district. In this study, 75 farmers were selected from aforesaid blocks during ~~the~~ study period under cluster frontline demonstration of linseed. Total 150 front line demonstrations under real farming situations were conducted during *rabi* seasons of 2016-17 and 2018-19 in three blocks under ~~the krishi Krishi Vigyan Vigyan~~ Kendra operational area.

The area under each demonstration was 0.4 ha. The soil was sandy clay-loam in texture with moderate water holding capacity, low to medium in organic carbon (0.034-0.055%), low in available nitrogen (118-212 kg/ha), medium in available phosphorus (10-14 kg/ha), low to medium in available potassium (206-303 kg/ha) and soil pH was slightly acidic to neutral in reaction (6.5-7.1). The treatment comprised of recommended practice (Improved variety JLS-27, integrated nutrient management-@ 60:40:20:25 kg NPKS/ha + Azotobacter + PSB @ 5 g/kg seed, integrated pest management + seed treatment with *Trichoderma viridae* @ 5 g/kg seed + Profenophos @ 750 ml/ha etc. v/s ~~farmersfarmers'~~ practice.

~~Crop-The crop~~ was sown between 20 October to 15 November with a spacing of 30 cm x10 cm and ~~the~~ seed rate was 20 kg/ha. An entire dose of P through Diammonium Phosphate (DAP), K through Muriate of Potash and Sulphur through bentonite sulphur was applied as basal during sowing. The seeds were treated with *Trichoderma viridae* @ 5 g/kg seeds then seeds were inoculated by *Azotobacter* and phospho-solubilizing bacteria biofertilizers each 5g/kg of seeds. Hand weeding was done once ~~at~~-30 days after sowing. One sprays of Profenophos @ 750 ml/ha + ready mix combination of Carbendazim+ Mancozeb @ 2.5g/lit water was applied at 30 DAS. Fields were irrigated ~~prior-to~~~~before~~ sowing and pre-flowering (35 DAS).

The crop was harvested ~~from~~ 10th March to 20th ~~of~~ March during years of cluster front line demonstrations. Farmer's practice constituted local variety with degenerated seed was used, ~~the~~ crop was sown between 10 to 20 October, broadcasting method of sowing, higher seed rate (35 kg/ha), imbalance dose of fertilizers applied (10 kg DAP/ha), no seed treatment, no biofertilizers, no hand weeding, no irrigation and no plant protection measures were adopted. ~~Crop-The crop~~ was harvested ~~on-at~~ the same time ~~of-as~~ harvesting of cluster front line demonstration plots.

Harvesting and threshing operations were done manually; 5m x 3m plot harvested in 3 locations in each demonstrations and average grain weight taken at 12% moisture level. ~~Similar~~ A similar procedure was adopted on the Farmers Practices plot under each demonstration then grain weight was converted into quintal per hectare (q/ha).

Before conducting the demonstrations trainings to farmers of respective villages were conducted with respect to concerning technological interventions. All other steps like site selection, farmers selection, the layout of demonstration, farmers participation etc. were followed as suggested by Choudhary,1999. Visits of farmers and extension functionaries were organized at demonstration plots to disseminate the technology at a large scale. The data output were was collected from both CFLD plots as well as farmer's practices plot and finally the extension gap, technology gap, technology index along with the benefit-benefit-cost ratio were worked out (Samui *et al.*, 2000) as given below:

$$\text{Harvest index (\%)} = \text{Grain yield} / \text{Biological yield} \times 100$$

$$\% \text{ increase in yield} = \{ \text{Demo yield} - \text{Farmers practices} \} / \text{farmers practices} \times 100$$

$$\text{Technology gap} = \text{Potential yield} - \text{Demonstration yield}$$

$$\text{Extension gap} = \text{Demonstration yield} - \text{Farmers yield}$$

$$\text{Technology index} = [(\text{Potential yield} - \text{Demonstration yield}) / \text{Potential yield}] \times 100$$

$$\text{Additional cost in improved technology (Rs./ha)} = \text{Cost of improved technology (Rs/ha)} - \text{Cost of farmers practice (Rs./ha)}$$

$$\text{Additional returns (Rs/ha)} = \text{Net returns of improved technology (Rs./ha)} - \text{Net returns of farmers practice (Rs./ha)}$$

$$\text{Effective gain (Rs./ha)} = \text{Additional returns} - \text{Additional cost of improved technology}$$

$$\text{Benefit cost ratio (BCR)} = \frac{\text{Gross returns (Rs./ha)}}{\text{Cost of cultivation (Rs./ha)}}$$

The techniques which were part of the package of practices were emphasized. However, it was left to the farmers to adopt and practice them depending on the individual farmer's resource availability and preference as to inputs (fertilizers and pesticides). Table 1 gives a comparison between the existing practice and those that were recommended.

Results and Discussion

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Gap analysis of Recommended and Existing practices

The gap among the existing and recommended technologies of linseed crop in district Sidhi has been depicted in table-1. ~~Full~~ The full gap was observed in the case of use of HYVs, seed treatment & fertilizer application, sowing method, weed control, irrigation and plant protection measures, while a partial gap was observed in seed rate and field preparation, which definitely may be the reason of not achieving potential yield and demonstrated yield by farmers practices. Farmers were not aware ~~about of~~ recommended technologies. Farmers ~~in general, in general,~~ used degenerated seeds of local or old-age varieties instead of the recommended high yielding resistant varieties. Unavailability of seed in time & at the local level and lack of awareness were the main reasons ~~of for~~ this gap in farmer's practices. Farmers applied a higher seed rate than the recommended and they were not using seed treatment techniques for the management of seed born diseases and also not aware of the application of micronutrients ~~i.e.i.e.~~, sulphur and zinc for enhancement of yield and quality of linseed because of lack of knowledge and interest. Sharma *et al.*, 2011 and Balai *et al.*, 2012 also reported that there is a technological gap between improved practices and existing practices.

Yield attributing characteristics

The yields attributing parameters like the number of capsule/plant and harvest index (%) of linseed obtained over the years under recommended practice as well as farmers practice are depicted in Table 2. The Number of capsules/plants of linseed ranged from 56 to 62 with a mean of 59 under recommended practice on ~~farmersfarmers'~~ fields as compared to range from 30 to 32 with a mean of 31 recorded under farmers' practice. The higher values of ~~the numberamount~~ of capsules/plant in recommended practice as compared to farmers ~~practice-practice~~ was may be due to the use of high yielding varieties, integrated nutrient management, ~~and~~ integrated pest management ~~eteetc.~~ (Singh *et al.*, 2021).

Seed yield

The yield performance of recommended practices and farmers practices are depicted in Table 2. The data revealed that under the demonstration plot, the performance of linseed yield was found higher than that under farmers practice during both consecutive years of demonstrations (2016-17 and 2018-19). The yield of linseed under demonstration was recorded 7.15 & 7.67 q/ha during 2016-17 & 2018- 19, respectively over farmers practice 3.83 & 3.81 q/ha. The yield enhancement due to technological intervention was observed at 86.7 % & 101.3 % over ~~farmersfarmers'~~ practice. The cumulative effect of the technological intervention of both the years, revealed ~~on an~~ average yield of 7.41 q/ha, 94 % higher ~~over than~~ farmers practice (3.82 q/ha). The ~~year to year~~ year-to-year variations in yield can be explained ~~on the basis of based on~~ variations in prevailing social, economic and climatic conditions of the particular villages (Singh *et al.*, 2021 and Singh *et al.*, 2022).

Economic Parameter

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Economic performances of linseed under cluster front line demonstrations were depicted in table 3. The inputs and outputs prices of commodities prevailed during both the years of demonstrations were taken for calculating cost of cultivation, net returns and ~~benefit-benefit~~-cost ratio. The investment ~~on-in~~ production by adopting recommended practices ranged from Rs.1113 to 13425/ha with a mean value of Rs.13269/ha over the farmers practice Rs. 9870/ha and Rs.9480/ ha during the demonstrations period. Cultivation of linseed under recommended practices gave a higher net return of Rs.8337- Rs. 9737 compared to Rs.1620- Rs. 1950/ha under farmers practice during 2016-17 & 2018-19, respectively. The average ~~benefit-benefit~~-cost ratio of recommended practices was 1.68, varying from 1.63 to 1.73 during the study period and in farmers practice was 1.19, varying from 1.16 & 1.21. This may be due to higher yields obtained under recommended practices compared to farmers practices. Similar results have been reported earlier by Tomar, 2010, Patel *et al.*, 2014 and Singh *et al.*, 2016.

Technology gap, Extension gap and Technology Index

Technology Gap

The technology gap shows the gap in the demonstration yield over potential yield and the average technology gap was 10.59 qt/ha during the study period (Table 2). The trend of technology gap ranging between 10.85 and 10.33 qt/ha in 2016-2017 and 2018-2019, respectively and it reflects the farmers' cooperation in carrying out such demonstrations with encouraging results in subsequent years. The frontline demonstrations were laid down under the supervision of KVK Scientists s at the farmer's field. The technology gap observed might be ~~attributing-attributed~~ to the dissimilarity in soil fertility status, local climatic situations, varietal suitability and adoption of technological practices. The technology gap ~~imply-implies~~ researchable issues for the realization of potential yield, while the extension gap ~~imply-implies~~ what can be achieved by the transfer of existing technologies. Mukharjee (2003) have also opined that depending on identification and use of the farming situation, specific interventions may have greater implications in enhancing system productivity. Similar findings were also recorded by Katare *et al.* (2011) and Singh *et al.*, 2022.

Extension Gap

~~Extension-~~The extension gap is a parameter to know the yield differences between the demonstrated technology and farmer's practice and observed data was depicted in table 2. The extension gap ~~ranging-ranged~~ between 3.32 – 3.86 q/ha during the study period with an average of 3.59 q/ha which emphasized the need to educate the farmers through various means for the adoption of improved high yielding variety and improved agro technologies to reverse this trend of wide extension gap. More and more use of new HYV's by the farmers will subsequently change this alarming trend of developing extension gap. The new technologies will eventually

lead to the farmers to disenchantment discontinuance of old varieties with the new technology. The results are in agreement with research worker Patel *et al.*, (2013), who stated that, location-based problem identification and thereby specific interventions may have great implications in the enhancement of crop productivity.

Technology Index

The technology index showed the feasibility of the evolved technology at the farmer's fields. ~~Higher~~ The higher technology index reflected the insufficient extension services for the transfer of technology. The lower value of the technology index shows the efficacy of the good performance of technological interventions. The average technology index was observed 58.84 per cent under cluster front line demonstration (Table 2). The technology index was observed 60.28 and 57.39 per cent respectively in the year 2016-2017 and 2018-2019. The decreasing trend in the technology index shows that the farmer's interest in adopting technology is increasing. This variation indicates that results differ according to soil fertility status, weather condition, ~~non-non~~-availability of irrigation water and insect-pests attack in the crop. The ~~results of the present study~~ present study results are in consonance with the findings of (Patel *et al.* 2014, Singh *et al.* 2021 & Singh *et al.* 2022).

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Table 1: Comparison between technological interventions and existing farmers practice under cluster front line demonstration programme

S No	Particular	Recommendation	Existing	Gap (%)
1	Variety	Improved variety JLS 27	Old variety and degenerated seed	Full gap
2	Seed rate	20 kg/ha	30-35 kg/ha	Partial gap
3	Field Preparation	Importance of preparing the land to get fine tilth. It needs 2 to 3 ploughing	Ploughing is restricted to one or two, which does not break the soil into fine particles	Partial gap
4	Seed treatment and Fertilizer	Azotobacter + PSB @ 5 g/kg seed, Trichoderma viridae @ 5 g/kg seed and application of micronutrients such as Zinc sulphate. 60:40:20:25 NPKS kg/ ha.	Soil testing is not done. Normally farmers do not apply fertilizer as it is raised as a residual crop. Farmers apply usually DAP at 10 kg per acre.	Full gap
5	Sowing Time	25 October to 10 November	October to November	No gap
6	Sowing method	Line sowing	Broadcasting	Full gap
7	Weed control	Hand weeding was done once at 30 days after sowing.	No weeding	Full gap
8	Irrigation	Fields were irrigated prior to before sowing and at pre-flowering (35 DAS) & seed setting stage (70 DAS)	This is not practiced practiced by farmers	Full gap
9	Plant Protection	One spray s of Profenophos @ 750 ml/ha + ready mix combination of Carbendazim+ Mancozeb @	No preventive measure is followed	Full gap

	2.5g/lit water was applied at 30 DAS.	
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Table 2: Growth and yield parameters, Technology gap, Extension gap and Technology index of linseed as affected by recommended practices as well as farmer's practices

Year	Area (ha)	No. of farmers	No. of capsules /plant		Grain yield (q/ha)			% increase over FP	Straw yield (q/ha)		Harvest index (%)		Technology gap (q/ha)	Extension gap (q/ha)	Technology index (%)
			RP	FP	Potential	RP	FP		RP	FP	RP	FP			
2016-17	30	75	56	32	18	7.15	3.83	86.7	28.4	21.3	20.11	15.24	10.85	3.32	60.28
2018-19	30	75	62	30	18	7.67	3.81	101.3	30.2	21.6	20.25	14.99	10.33	3.86	57.39
Total/Average	60	150	59	31	18	7.41	3.82	94.0	29.3	21.45	20.18	15.12	10.59	3.59	58.84

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Table 3: Effect of cluster frontline demonstrations on economic parameters

Year	Gross expenditure (Rs./ha)		Additional cost (Rs./ha)	Gross return (Rs./ha)		Net return (Rs./ha)		Additional returns (Rs./ha)	Effective gain (Rs./ha)	B:C Ratio	
	RP	FP		RP	FP	RP	FP			RP	FP
2016-17	13113	9870	3242	21450	11490	8337	1620	6717	3475	1.63	1.16
2018-19	13425	9480	3945	23162	11430	9737	1950	7787	3842	1.73	1.21

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Total/ Average	13269	9675	3594	22306	11460	9037	1785	7252	3659	1.68	1.19
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