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Impact assessment of cluster frontline demonstrations (CFLD) oil seeds on increasing yield of linseed (*Linum usitatissimum* L.) under rainfed conditions in tribal district of Mandla, Madhya Pradesh

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Abstract
The study was carried out by Krishi Vigyan Mandla district of Madhya Pradesh to know the yield gaps between improved package and practices under cluster front line demonstration (CFLD oilseeds) and farmer's practice (FP) of Linseed crop under rainfed condition. Cluster Front Line Demonstration on Linseed were conducted on farmer's fields during Rabi season of two sequential years i.e. 2018-2019 and 2019-2020 under National Food Security Mission (NFSM), Govt. of India to demonstrate the impact of enriched agro-techniques on production and economic benefits under rainfed conditions. CFLD's were conducted in 30 ha and 20 ha area for two years with active involvement of 125 farmers and scientific staff of KVK. According to analysis of data the highest grain yield was obtained in demonstrated plots with an average of 7.54 q/ha as compared to local check with an average of 4.70 q/ha. An average mean of extension gap, technology gap and technology index were calculated as 2.84 q/ha, 8.47q/ha, 52.91 percent, respectively. Adoption of improved package of practices in Linseed cultivation recorded average higher B:C ratio (2.1) as compared to Farmers Practice (1.54) during the period of study. Thus, the productivity of Linseed could be increased with the adoption of recommended improved package of practices. The study resulted in satisfying the farming community for higher productivity and returns.

Keywords: Linseed, front line demonstration, technology gap, impact, yield, technology index

Introduction
Tribal district of Mandla, Madhya Pradesh in India situated at an elevation of 1,768 feet (539 meters) above sea level an upland plateau at a U- shaped bend in the Narmada River where it is joined by the Banjar River. Mandla district has an area of of 8771 km^2. There are 9 blocks, 4 tehsils and 1214 villages in the district. Linseed is an important rabi oilseed crop of rainfed season of Mandla district of Madhya Pradesh. The productivity 650 kg/ha of oilseed in the district is low as compared to National average mainly due to poor crop management practices ultimately and inadequate availability of quality seed of improved Linseed varieties and other inputs. Linseed (*Linum usitatissimum* L.) belongs to the family Linaceae and the genus Linum. The seed types with branching habit have less harvest index than the fiber types. In general harvest index varies from 0.19 to 0.31. The test weight is about 4.5 g/1,000 seeds. Number of capsules per unit area is the important yield component determining the yield and quality of linseed. Linseed is basically an industrial oilseed crop and its each and every part is important with commercial and medicinal use. It is tolerance to biotic and abiotic stresses that is characteristic of this crop. Because of this property the cultivation of linseed is prevailing in wide range of tropical, sub-tropical and temperate regions. Linseed is an important crop grown both for its seed as well as fibre which is used for manufacture of linen. The seed contains oil varying from 33% to 47% in different accessions of linseed crop. The flax seed contains high level of dietary fibres and high amount of micronutrients. It also contains omega-3-fatty acids (linoleic acid) that make it edible and it is also useful for heart patients. The seed oil content in improved cultivars varies between 40% and 44%. On a very small scale, the seed is directly used for edible purposes and about 20% of the total oil is used and remaining 80% of the oil goes to industries for the manufacture of paints, varnishes and printing ink, oil cloths, soap and water proof fabrics. The oil cake is most valuable feeding cake for animals, it contains 36% protein and 85% of it is digestible fibre. The oil cake is also used as manure; it contains 5% nitrogen (N), 1.4% phosphorus (P2O5) and 1.8% potassium (K2O).

The productivity of linseed in India is lower than the world linseed average productivity (852 kg/ha) and is only 395 kg/ha. Among the rabi oilseed crops in India, linseed happens to occupy the second position i.e., next to rapeseed1mustard in areas as well as production. At present, linseed is cultivated on about 4.36 lakh ha with the contribution of 1.67 lakh tonnes to the annual oilseed production of the country. JLS27 is bold seeded variety crop duration 120-125 days depending on the environmental conditions. It is recommended for rainfed condition it contains 40% oil. KVK's are grass root level organizations meant for spreading of technology through refinement, assessment and demonstration of proven production technologies under different micro-farming situations (Das, 2010) [3]. The main aim of Krishi Vigyan Kendra is to reduce the time lag between generations of technology at the research and its transfer to the farmers for increasing productivity and income from agriculture and allied sectors. The main objective of Cluster Front Line Demonstration under National Food Security Mission was to demonstrate improved crop production technologies of oilseeds on the farmers field and to popularize the newly notified improved varieties auto technologies for varietal diversification and efficient management of of resources the present investigation was undertaken to study the impact of cluster frontline demonstration on yield of Linseed (*Linum usitatissimum* L.) under rainfed condition in Mandla district of Madhya Pradesh with the objective of increasing productivity and executed to narrow down the time lag and insured speedy adoption of technologies in district.

Materials and Methods

Cluster Frontline Demonstrations (CFLDs) on improved farm technology (Table 1) were conducted by Krishi Vigyan Kendra Mandla of JNKVV Jabalpur in Linseed (JLS27) during Rabi 2018-2019 and Rabi 2019-2020 under rainfed conditions on 50 ha area of Mandla district covering 125 farmers. The soil of CFLDs was Sandy loam to Sandy clay loam and the pH of soil is near about 6.18 to 7.11. the improved technology such as improved varieties seed (JLS27) method of line sowing with Nari plough and seed drill, seed treatment with thirum and biocontrol agents weed management and integrated pest management practices was maintained during period of study seed treatment was done with thirum 3 gm/kg seed trichoderma at @ 5 gm/kg and PSB @ 5 gm/kg of seed before sowing to protect the crop against fungal diseases up to 15 - 20 days after sowing the seed rate of Linseed was kept 20 kg/ha in demonstrations plot the sowing of Linseed was done during 17th November to 23 November during the study period the spacing between row to row and plant to plant was kept 30x20 for the Cluster Frontline Demonstrations. The fertilizers were also given in the ratio of 20:40:20:10 kg/ha as basal dose spraying of chloropyriphos+ cypermethrin for controlling of insect and pests like aphids and Linseed fly @1250 gm/ha. The data were collected from beneficiary farmers through personal interviews and after that data was tabulated and analysed to find out the findings and conclusions. The yield increase in demonstrations over farmers practice was calculated by using following formula.

$$\% \text{ Yield increase over farmer's} = \frac{\text{Demonstration average plot yield} - \text{Famer's average plot yield}}{\text{Farmer's average plot yield}}$$

Estimation of technology gap, extension gap and technology index

Extension gap should be assigned to adoption of improved transfer technology in demonstrations practices resulted in higher grain yield than traditional farmer's practices. The similarly observations were also obtained in black gram crop by Mahalingam et al., (2018) Bairwa et al., (2013) [1], Hiremath and Nagarju (2010) [5] and also Jamwal Anamika et al. (2020). The estimation of technology gap, extension gap and the technology index were worked out by using following formula (Kadian et al., (1997) [6] Samui et al., 2000) [10]

- Technology yield gap = Potential yield – Demonstration plot average yield
- Extension yield gap = Demonstration plot average yield- Farmer's plot average yield

$$\text{Technology index} = \frac{\text{Technology yield gap}}{\text{Potential Yield}} \times 100$$

Results and Discussion

The findings of the study as well as relevant discussion have been conferred under following points

Grain Yield

Data presented in Table 2 revealed that transfer of improved technology under Cluster Frontline Demonstrations in Linseed resulted in higher yield as compared to farmer's practice. The higher yield in demonstration plot was due to improved variety of seed, seed treatment with bio control agent, integrated pest management practices. The average seed yield of demonstration plots was 7.54q/ha (Table 2) which was higher as compared to farmers practice 4.70 q/ha. The increased yield percentage over control was 60.48% in Cluster Frontline Demonstration over local check. However the seed yield of 7.54 q/ha in CFLD's was low as compared to potential yield 16 quintal per hectare of Linseed variety JLS27 due to attack of Linseed pod fly. The yield enhancement through adoption of improved technology has also been reported in earlier studies of FLD's (Kothyari et al. 2018 and Kumar et al. 2019 and Jamwal Anamika et al. 2020) [7]. Yield of the Frontline Demonstration trials and potential yield of the crop was compared to estimate the yield gaps which were further classified into technology and extension gaps (Hiremath & Nagarju; 2009 and Jamwal Anamika et al. 2020) [5]

Extension Yield gap

An average extension gap between demonstrated practices and farmers practices was recorded 2.84 q/ha (Table2). Higher extension gap in present study suggested that there is a need to motivate and aware the farmers for adoption of improved technologies in Linseed over existing local farm practices. The similar results were also reported by Bairwa et al. 2013 [1] Gangadevi et al. 2018 Jamwal Anamika et al 2020

Technology Yield gap and Technology Index

The technological gaps generally appear even if the CFLD'S were conducted under the strict direction of farm scientists on the farmers field the data presented in table 2 showed that the value of technological gap was higher 8.35 to till per hectare during the year 2019-20 while during 2018-19 the technological gap was 8.58 per ha the technology gap

observed may be attributed to the decimal dissimilarity in soil status, lake of irrigation facilities non congenial weather conditions, disease and pest attacks and change in the position of demonstrations plots every year. Technology index specified the feasibility of the generated Technology at the farmer's fields under existing agro climatic conditions (Vedna et al. 2007). The results of table 2 revealed that value of technology index was 53.63% and 52.19% during 2018-2019 and 2019-20 respectively. Whereas the average value of technology index was recorded 52.91%. Lower the value of the technology index more is the feasibility and applicability of the tested technology. This showed that a gap existed between technology evolved and technology adopted at farmer's field. The similar results were also observed by Gangadevi et al. 2018, Chaudhari et al. 2019 and Jamwal Anamika et al. 2020

Table 1: Technology demonstrated in CFLD's and Farmer's practices

S/No.	Practice	Demonstrated practice	Farmers practice
1	Field preparation	2 ploughings	Single plough
2	Method of sowing	Line sowing by seed drill & Nari	Broad casting
3	Variety	JLS27	Local
4	Seed treatment	Thirum @ 2,5 gm/kg of seed, PSB & Trichoderma @ 5gm/kg of seed	No seed treatment
5	Seed rate and spacing	20kg/ha	30-40 kg/ha
6	Manures and fertilizers	PSB 500ml, Rhizobium 500gm with 100kg vermicompost and sulphor 20:40:20:10	Nil
7	Weed management	Pendimethaline @ 2,5-3.5 lit/ha	No pre emergence used
8	IPM measures	IPM practices like spraying of Neem oil need based pesticides and pheromone traps, yellow traps	Indiscriminate usage of pesticides
9	Technical guidance	Time to time	Nil

Table 2: Year wise productivity, extension gap, technology gap and technology index of Linseed as grown under CFLD's and existing package of practices.

Year	Yield q/ha		Increase yield % over Control	Extension gap (q/ha)	Technology gap (q/ha)	Technology Index %
	Demo	Farmer's Practice				
2018-19	7.42	4.65	59.56%	2.77	8.58	53.63
2019-20	7.65	4.74	61.39%	2.91	8.35	52.19
Mean	7.54	4.70	60.48%	2.84	8.47	52.91

Table 3: Cost of cultivation, Gross return and B:C ratio of Linseed as grown under CFLD's and existing package of practices.

Year	Cost of Cultivation (Rs/ha)		Gross Return (Rs/ha)		Net Return (Rs/ha)		B:C Ratio	
	Demo	Farmer's Practice	Demo	Farmer's Practice	Demo	Farmer's Practice	Demo	Farmer's Practice
2018-19	18500	16500	38584	24180	20084	7680	2.08	1.47
2019-20	18700	16650	39780	26648	21080	9948	2.12	1.60
Mean	18600	16575	39182	25414	20582	8814	2.1	1.54

Economic analysis of Cluster Front Line Demonstrations

Average cost of cultivation of demonstration plot (Rs18600/ha) is more as compared to Farmer's practice (Rs 16575/ha). The data in table 3 clearly clarified the implication of Cluster Frontline Demonstration at Farmer's field during the period of study in which higher average net return rupees 20582 were acquired under Demonstration plots as compared to farmer's practice (Rs 8814/ha). Benefit cost ratio recorded was also higher in demonstration plots (2.1) as compared to farmer's practice (1.54) increased monetary returns as well as Benefit cost (B:C) ratio through improved farm technology have also been reported by various scientists (Vedna et al 2007 [11], Bairwa et al. 2013 [1] and Jamwal Anamika et al. 2020)

Conclusion

The present study indicated that the incorporation of improved farm technology practices along with active participation of farmer's of the area has positive effect on increasing the grain yield and economic return of Linseed in Mandla district the economic viability of suitable technology for increasing the productivity of Linseed motivated the farmers towards adoption of technologies demonstrated at farmer's field.

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