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Shweta Masram
Programme Assistant, Department of Agronomy, JNKVV, Krishi Vigyan Kendra, Dindori, Madhya Pradesh, India

Dr. Nidhi Verma
Scientist, Department of Agronomy, JNKVV, Krishi Vigyan Kendra, Narsinghpur, Madhya Pradesh, India

Dr. Satendra Kumar
Scientist, Department of Fisheries, JNKVV, Krishi Vigyan Kendra, Dindori, Madhya Pradesh, India

Megha Dubey
Scientist, Department of Fisheries, JNKVV, Krishi Vigyan Kendra, Dindori, Madhya Pradesh, India

Corresponding Author:
Shweta Masram
Programme Assistant, Department of Agronomy, JNKVV, Krishi Vigyan Kendra, Dindori, Madhya Pradesh, India

Front line demonstration of high yielding varieties of linseed (*Linum usitatissimum* L.) in Dindori district for livelihood and nutritional security of tribal community

Shweta Masram, Dr. Nidhi Verma, Dr. Satendra Kumar and Megha Dubey

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Abstract
Linseed (*Linum usitatissimum* L.) is a traditional oilseed crop in Dindori district that represents a valuable alternative for cropping systems because of the high quality of the seed oil, which is being increasingly appreciated by consumers, food, cosmetic and ecomaterials industries. The aim of this study was to evaluate the influence of linseed variety and year of production in relation to weather conditions on seed yields, oil content and its quality, with a focus on human nutrition value, through a field study carried at 3 different locations in Dindori district *viz*. Russamal, Ghundisrai, Dhanras. The seed yield was significantly affected by the year of production (523 kg/ha higher in 2020 compared to 2019), the location and the variety. The environmental factors that negatively affect seed yield are high temperatures in summer, water shortage and wet and cold soil in spring. The highest seed yield was reached at mid-heavy soil in the region with higher precipitation amount, while the lowest on light soil in the region with a lower precipitation amount. JLS66 would be recommendable for Dindori environmental conditions. JLS 66 variety gave the significantly highest oil yield.

Keywords: *Linum usitatissimum* L., linseed, seed yield, nutrition quality, oil, field production, growth conditions

Introduction
Front line demonstration (FLD) is an effective extension methodology to demonstrate the performance of high yielding varieties (HYVs) of crops and improved production technologies under farmers field conditions. FLDs are conducted in collaboration with farmers on their own fields, which provides an opportunity to compare the HYVs with the local varieties and traditional practices. This helps farmers to make informed decisions about adopting the new technologies. Linseed is an important oilseed crop cultivated in India. It is a good source of omega-3 fatty acids, which are essential for human health. Linseed is also a good source of protein and fiber. Dindori district in Madhya Pradesh has a significant tribal population. Tribal communities are often marginalized and have limited access to improved agricultural technologies. FLDs on HYVs of linseed can help tribal farmers in Dindori district to improve their livelihood and nutritional security. Here are some of the benefits of conducting FLDs on HYVs of linseed in Dindori district for livelihood and nutritional security of tribal community:
Here are some of the benefits of conducting FLDs on HYVs of linseed in Dindori district for livelihood and nutritional security of tribal community:

- **Increased yield:** HYVs of linseed have the potential to produce significantly higher yields
- than the local varieties this can help tribal farmers to increase their income and improve their livelihood.
- **Improved quality:** HYVs of linseed also produce better quality seeds with higher oil content. This can help tribal farmers to get better prices for their produce.
- **Nutritional security:** Linseed is a good source of omega-3 fatty acids, protein, and fiber. Consuming linseed can help tribal people to improve their nutritional status.
- **Income generation:** Linseed oil can be used for various purposes, including cooking, making biodiesel, and manufacturing paints and varnishes. Tribal farmers can generate additional income by selling linseed oil.

FLDs on HYVs of linseed can also help tribal farmers to become more resilient to climate change. Linseed is a relatively drought-tolerant crop, which can help tribal farmers to maintain their production even during dry years. Here are some of the key steps for conducting FLDs on HYVs of linseed in Dindori district:

1) **Select the right HYVs:** Select HYVs of linseed that are suitable for the agro-ecological conditions of Dindori district.
2) **Identify the target farmers:** Identify tribal farmers who are willing to participate in the FLD program.
3) **Provide training to farmers:** Provide training to farmers on the best practices for cultivating HYVs of linseed.
4) **Provide inputs and support to farmers:** Provide farmers with the necessary inputs, such as seeds, fertilizers, and pesticides. Also, provide technical support to farmers throughout the cropping season.
5) **Monitor and evaluate the FLDs:** Monitor the FLDs regularly to assess the performance of the HYVs and the impact of the improved production technologies. Also, evaluate the FLDs at the end of the cropping season to identify the areas for improvement

FLDs on HYVs of linseed can be a very effective way to improve the livelihood and nutritional security of tribal communities in Dindori district. By following the key steps outlined above, FLDs can be conducted successfully and efficiently. Technology transfer on high yielding varieties of Linseed (*Linum usitatissimum* L.) through Front line demonstration technique in Dindori district for livelihood and nutritional security of tribal community. can be done in the following steps:

1) **Identify the target villages and farmers:** Identify villages and farmers where linseed is a major crop and where there is a high concentration of tribal people.
2) **Select the high yielding varieties (HYVs) of linseed:** Select HYVs of linseed that are suitable for the agro-ecological conditions of Dindori district.
3) **Organize training for farmers:** Organize training for farmers on the best practices for cultivating HYVs of linseed, including seed selection, sowing, fertilizer and pesticide application, and harvesting.
4) **Establish FLD plots:** Establish FLD plots on the fields of farmers who are willing to participate in the program. The FLD plots should be large enough to represent the actual farming conditions in the area.
5) **Provide inputs and support to farmers:** Provide farmers with the necessary inputs, such as seeds, fertilizers, and pesticides. Also, provide technical support to farmers throughout the cropping season.
6) **Monitor and evaluate the FLDs:** Monitor the FLDs regularly to assess the performance of the HYVs and the impact of the improved production technologies. Also, evaluate the FLDs at the end of the cropping season to identify the areas for improvement.
7) **Disseminate the results of the FLDs:** Disseminate the results of the FLDs to other farmers in the area through field days, farmer meetings, and other extension activities.

Here are some additional tips for conducting FLDs on HYVs of linseed in Dindori district for livelihood and nutritional security of tribal community:

- Involve tribal farmers in all aspects of the FLD program, from planning to implementation to evaluation.
- Use local languages and communication channels to reach out to tribal farmers.
- Make sure that the FLD plots are located in easily accessible areas.
- Provide farmers with financial assistance to cover the costs of participating in the FLD program.
- Link farmers with markets to sell their produce at a good price.

By following these steps, FLDs on HYVs of linseed can be used to effectively transfer technology to tribal farmers in Dindori district and improve their livelihood and nutritional security.

Methods and Materials

The Front line demonstration were carried out in linseed with different location of Dindori district, Madhya Pradesh India to evaluate the difference between demonstrated technologies vis-a-vis practices followed by the local farmers in linseed crop at randomly selected villages of Dindori during rabi 2019 and 2020. Before conducting FLD's a list of farmers was prepared from group meeting and specific skill training was imparted to the selected farmers regarding different aspects of cultivation. The selected farmers of the demonstration area were of small and marginal in nature. Front line demonstration of linseed variety JLS 66 was conducted in 20 ha area in each year 2019 and 2020. 50 farmers were selected from different villages in each year 2019 and 2020. The soil samples from each adopted farmer were analyzed. It was found to be sandy to clay-loam in texture with pH 5.9, medium in organic C high in available nitrogen and medium in available phosphorus. No. of capsules/plant, plant height at maturity (cm) was measured and branches (No.) were counted. The purpose of this FLD'S was to know the yield gap between improved practice and farmers practice, to determine the difference in their yield attributing characters, to find out the extension gap and to know reasons for low yield and specific constraints with the practicing farmers. Finally, the extension gap, technology gap along with the benefit cost ratio were worked out. The technology gap, extension gap and technology index were calculated using the following formula.

Extension gap = Demonstration yield - farmers practices yield

Technology gap = Potential yield of variety – Demonstration yield

Technology index (%) = Technology gap x 100/Potential yield.

Results and Discussion

Yield of linseed under improved practices was 6.2 and 6.7 q/ha, whereas yield under farmers practices was 3.9 and 4.7 q/ha during 2019 and 2020 respectively. The yield enhancement due to technological intervention was 58.97% and 42.96% during 2019 and 2020 respectively over farmers practice. Grain yield was found positively correlated with yield-attributing traits. Use of improved variety, seed treatment before line sowing, soil test based optimal supply of nutrients and other agro-techniques might have helped in better crop growth and portioning of photosynthates. Higher gross returns (Rs. 28520 and 30820/ha), net returns (Rs. 13716 and 16510 /ha) and returns per rupee invested (1.93 and 2.15) were recorded with technological intervention during 2019 and 2020, respectively. Innovative practices increased the gross returns by 58.97 and 42.55%, net returns by 72.27 and 64.12% and B: C ratio by 7.22 and 14.9%

during 2019 and 2020 respectively compared to farmer's practice. The higher profitability under innovative practices was attributed to higher values of yield attributes and grain yield of linseed compared to farmers practice. Costs of cultivation were higher under innovative practice during both the year owing to sowing by seed drill, costs of improved seed and fungicides used for seed treatment. Higher growth and yield attributes, grain yield and economics of linseed with response to line seeding, seed treatment, balanced fertilization and other agro-techniques has also been advocated.

Table 1: Particulars showing the details of linseed grown under FLD and existing Farmers Practices

S. No.	Operation	Existing Practices	Improved practices demonstrated
1	Variety	Local seed	Improved variety JLS 66 Released by JNKVV, Jabalpur 2010
2	Sowing method	Broadcasting	Line sowing by seed cum fertilizer drill or Narri equipment with inter-row spacing of spacing 30 cm
3	Technology Charcteristics	Farmers used local variety having low yield potential they are prone to powdery mildew	Suitable for Intercropping with pulses, high Omega-3 content (55.96) moderately resistant to powdery mildew and bud fly, moderately susceptible to *Alternaria* blight
4	Seed treatment	No Seed treatment	Seed treatment with carbendazim @ 3g/kg seed and trichoderma harzianum @ 4-6 g/kg seed
5	Fertilizer application	Imbalanced use of fertilizers	Balanced fertilization on the basis of soil testing

Table 2: Mean Values of growth and yield attributing characters under improved and farmers practice

S. No.	Characters	Improved practices	Farmers practices	% increase
1	Plant height at maturity (cm)	56.35	51	10.49
2	No. of branches/plant	14.6	11	32.72
3	No. of capsules/plant	63	43	46.51

Table 3: Technological impact of improved variety and agro-techniques on yield of Linseed

Crop Season	Variety	No. of FLD	Area	Yield		Yield Gap	Extension Gap	Technology Gap
Rabi 2019	JLS 66	50	20	6.2	3.9	58.97	2.3	5.8
Rabi 2020	JLS 66	50	20	6.7	4.7	42.96	2.0	5.3
Mean		50	20	6.45	4.3	50.96	2.2	5.5

Table 4: Economic performance of improved practices over farmers practices

Crop season	Cost of cultivation (Rs/ha)		Cost returns (Rs./ha)		Net return (Rs./ha)		Benefit cost ratio	
	IP	FP	IP	FP	IP	FP	IP	FP
1	14804	9978	28520	17940	13716	7962	1.93	1.80
2	14310	11560	30820	21620	16510	10060	2.15	1.87
Mean	14557	10769	29670	19780	15113	9011	2.04	1.84

Conclusion

The above results showed that the integration of improved technology along with active participation of farmers has a positive effect in increase the seed yield and economic return of Linseed crop production. The suitable technology for enhancing the productivity of Linseed crop and need to conduct such demonstration may lead to the improvement and empowerment of farmers. The demonstration traits also enhance the relationship and confidence between farmers and KVK scientists. The recipient farmers of FLD's also play an important role as source of information and quality seeds for wider dissemination of the improved varieties of Linseed for other nearby farmers. It is concluded that the FLD's programme is a successful tool in enhancing the production and productivity of Linseed crop through changing the knowledge, attitude and skill of farmers.

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