Asian Research Journal of Agriculture

Volume 17, Issue 1, Page 86-92, 2024; Article no.ARJA.114290
ISSN: 2456-561X

Performance of Frontline Demonstration on Productivity and Profitability of Utera Cropping of Linseed (*Linum usitatissimum* L.) under Rainfed Conditions in Tribal District Balaghat of Madhya Pradesh, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/ARJA/2024/v17i1428

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/114290

Received: 14/12/2023
Accepted: 19/02/2024
Published: 20/02/2024

Original Research Article

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ABSTRACT

The study was carried out during rabi season 2016-17 by the College of Agriculture Waraseoni (Balaghat), Madhya Pradesh to assess the yield gap between front-line demonstration (FLD) and farmer's practice (FP) of Utera cropping of Linseed crop under rainfed condition of the Chhattisgarh plains. FLD's were conducted in 11.20 ha with the active involvement of 28 farmers and scientific staff of the Institution. The findings of the present study revealed that the highest grain yield was obtained in demonstrated plots with an average of 7.25 q/ha as compared to local check with an average of 4.94 q/ha. The average of extension gap, technology gap and technology index was computed as 2.31q/ha, 2.75q/ha, and 27.53% respectively. The implementation of the enhanced package of practices in Linseed cultivation yielded a significantly higher average IBCR ratio (2.99) compared to traditional farmer practices during the study period, indicating the potential for increased productivity. This outcome underscores the effectiveness of adopting the recommended improved practices, ultimately satisfying the farming community by producing higher yields and returns.

Keywords: FLD's; linseed; extension gap; grain yield.

1. INTRODUCTION

"Linseed (*Linum usitatissimum* L.) is one of the oldest cultivated plants in the world" [1]. "It belongs to the family Linaceae and the genus Linum. Linseed is an industrial oilseed crop. A well-distributed rainfall of 450 to 500 mm is sufficient to grow a good crop of linseed, hence fit well in the rainfed cropping system. It is tolerance to biotic and abiotic stresses, which makes it suitable for a wide range of tropical, sub-tropical and temperate regions. It is a dual-purpose crop and is grown for seeds and fibre which is used for the manufacture of linen" [2]. "The oil content of the seed varies from 33-47%. Linseed oil is an excellent drying oil used in manufacturing paints and varnishes, oilcloth, waterproof fabrics and linoleum and as edible oil in some areas. Linseed cake is a very good manure and animal feed. Linseed is used in making paper and plastics. Linseed is an important crop grown both for its seed as well as fibre which is used for the manufacture of linen" [1].

Linseeds are an excellent source of dietary fibre and amounts of micro-nutrients. With its omega-3 fatty acids, particularly linoleic acid, Linseed stands as a versatile resource, not only catering to the dietary needs of heart patients but also serving as a cornerstone in various industries. While a fraction of its seed directly fulfils edible purposes (20%), and approximately 80% of its oil contributes to the production of paints, varnishes, printing ink, and more. Moreover, the oil cake derived from the extraction process emerges as a highly prized animal feed, boasting a remarkable 36% protein content and 85% digestible fiber. Additionally, its dual utility extends to agricultural realms, where it enriches soil as strong manure, boasting a nutrient profile comprising 5% nitrogen (N), 1.4% phosphorus (P_2O_5) and 1.8% potassium (K_2O) [3].

"In India, Linseed is grown on a 174.87 thousand hectare area and produces111.36 thousand tonnes with the productivity of 637 kg/ha. However, in Madhya Pradesh only 47.00 thousand hectare area is used for linseed cultivation that contributes 36.80 thousand tonnes with a productivity of 783 kg/ha. Linseed is an important Rabi oilseed crop of the rainfed season of Balaghat district of Madhya Pradesh grown on an area of 6015 hectares and producing 2346 tonnes with productivity of 390 kg/ha" [4].

"The productivity of oilseed in the district is low as compared to the national average mainly due to poor crop management practices and inadequate availability of quality seeds of improved Linseed varieties and other inputs. To increase the productivity of linseed in the Balaghat district an adequate and balance supply of plant nutrients along with high-yielding varieties is of critical importance" [2]. Employing a strategic approach, the systematic conduct of Front-line Demonstrations (FLDs) directly on farmers' fields proves to be an effective tool for extension, facilitating the unspoiled transfer of knowledge and skills among peers. "The productivity of linseed per unit area could be increased by adopting recommended scientific and sustainable management practices using a suitable high-yielding cultivar. Taking into account the above considerations, Front-line

Demonstrations (FLDs) were carried out systematically on farmers' fields to show the worth of new varieties and application of balance nutrients and convince farmers to adopt improved production management for enhancing the productivity of Linseed" [2].

2. MATERIALS AND METHODS

The Balaghat district of Madhya Pradesh is located in the extreme South-West of the state and occupies the southeastern portion of the Satpura Range and the upper valley of the Wainganga River. The district extends from 21°19' to 22°24' North latitude and 79°31' to 81°3' East longitude with quadrangle shape. The Balaghat district is characterized by varying soil types ranging from mixed red and yellow to shallow and moderately deep soil strata with low water holding capacity. The average annual rainfall of Balaghat district is 1250 mm. [5].

The constraints in production were identified through participatory approach such as farmer's meetings, training programmes and field diagnostic visits during crop growth period. Low yield of Linseed was conceived due to lack of suitable variety of Linseed, imbalance use of fertilizers, drought, infestation of weeds and improper crop geometry. Based on the farmer's problems, The College of Agriculture, Waraseoni (Balaghat) conducted FLD's on Linseed during season of *Rabi* 2016-17 by Utera sowing method on varieties JLS-27 (High Omega-3 content, moderately resistant to powdery mildew and bud fly), Indira-32 (Erect plant, Blue flower, brown seeded, medium size) and Kartika (moderately resistant to rust, wilt & Alternaria blight and resistant to Powdery mildew) [6] under Rainfed ecosystem at Waraseoni Block of Balaghat District of Madhya Pradesh

In India, a substantial 63% of the linseed cultivation area is rainfed, with Utera practices accounting for 25% of this total. Utera, deeply rooted in tradition, involves the broadcast sowing of linseed in standing rice fields roughly 15 to 20 days prior to rice harvest, coinciding with the final irrigation cycle. This method capitalizes on the wet conditions of the field during this critical phase. The inherent advantage of linseed's mucilaginous seed coat, which prevents adhesion to rice plants, renders it the preferred choice for Utera cultivation. [7]. To manage the identified problems, JLS-27, Indira-32 and Kartika varieties seeds wereprovided to the farmers as critical inputs and scientifically recommended technologies (Table 1) were followed as an intervention during the course of frontline demonstration program.

In case of local check (control plots), existing farmers' practices were followed by the farmers. Well before conducting the demonstrations, a training programme was organized for the selected farmers of the respective villages for the season to impart the technological knowledge of Linseed production techniques. All other steps like site selection, the layout of demonstrations, farmers' participation etc. were followed. The grain yield of demonstrations as well as farmers' practice (local check) were recorded and analysed according to different parameters. The details of these parameters are as:

Extension gap = Demonstration yield– Farmer's yield

Technology gap = Potential yield - Demonstration yield

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

Table 1. Technological intervention and farmer's practice under FLD

Particulars	Technological intervention	Farmers practices
Farming Situation	Rainfed	Rainfed
Variety	JLS-27, Indira-32 and Kartika	Local
Seed rate (kg/ha)	25	30-35
Seed treatment	Carbendazim 12% + Mancozeb 63% (2g/Kg)	NO
Time of sowing	15^{th} to 25^{th} October	15^{th} to 25^{th} October
Sowing Method	Utera	Utera
Fertilizer (NPK) Kg/Ha	40:25:00	Nil or 30:00:00
Weed management	Pendimethalin 30 EC (2.5 lt/ha) One manual weeding at 30-35 DAS	One manual weeding at 30-35 DAS
Insects	Pod Fly: Profenofos 50% EC (1 lt/ha)	Nil
Diseases	Powdery mildew: Hexaconazole(750ml/ha)	Nil
Harvesting	5^{th} to 15^{th} March	1^{st} to 10^{th} March

Table 2. Gap in grain yield production of Linseed varieties under FLDs

Season-Year variety	Potential Yield (q/ha)	Demonstration Yield (q/ha)	Farmer`s practice Yield (q/ha)	Increase over Farmer`s practices (%)	Extension gap (q/ha)	Technology gap (q/ha)	Technology index (%)
Rabi -2016-17 JLS-27	10.00	7.49	5.14	45.72	2.35	2.51	25.10
Rabi-2016-17 Indira-32	10.00	7.16	4.90	46.12	2.26	2.84	28.40
Rabi-2016-17 Kartika	10.00	7.09	4.78	48.33	2.31	2.91	29.10
Average	10.00	7.25	4.94	46.72	2.31	2.75	27.53

Table 3. Economic impact of Linseed varieties under FLD

Season-Year variety	Cost of cultivation (Rs/ha)		Additional cost in Demo. (Rs./ha)	Sale price (MSP) of (Rs./q)	Net Return (Rs/ha)		Additional return in Demo. (Rs./ha)	Effective gain (Rs./ha)	IBCR
	Demo.	**FP**			**Demo.**	**FP**			
Rabi -2016-17 JLS-27	12750	10150	2600	4500	20955	12980	7975	5375	3.07
Rabi-2016-17 Indira-32	12750	10150	2600	4500	19470	11900	7570	4970	2.91
Rabi-2016-17 Kartika	12750	10150	2600	4500	19155	11360	7795	5195	3.00
Average	12750	10150	2600	4500	19860	12080	7780	5180	2.99

Additional Cost = Demonstration cost of cultivation - Farmer's cost of cultivation

Additional Return = Demonstration return - Farmer's return

Effective Gain = Additional return - Additional cost

$$\text{Increment B: C ratio} = \frac{\text{Additional return}}{\text{Additional cost}}$$

3. RESULTS AND DISCUSSION

The data of grain yield, extension gap, technology gap and technology index of the present studies are depicted in Table 2 and the results showed that the grain yield of linseed crop highest under demonstrated plots as compared to farmers practice. “The yield enhancement under the technology demonstration was due to the need based use of improved and disease resistant varieties, balanced use of nutrients [8,9], efficient weed management and insect pest management practices”. [10, 11, 12].

Grain yield: “The increase in grain yield under demonstration was 45.72-48.33% than farmers' local practices. On the average basis, 46.42% yield advantage was recorded under demonstrations carried out with improved cultivation technology as compared to farmer's traditional way of linseed cultivation” [13, 14].

Gap analysis: An extension gap of 2.26-2.35 q/ha was found between demonstrated technology and farmer's practices during the year and on an average basis the extension gap was 2.31 q/ha (Table 2). “The extension gap was lowest at 2.26 q/ha for Indira-32 and was highest at 2.35 q/ha for JLS-27 during *Rabi* 2016-17. Such a gap might be attributed to the adoption of improved technology in demonstrations which resulted in higher grain yield than the traditional farmer's practices” [15, 16]. “A wide technology gap was observed during the year and this was lowest at 2.51 q/ha for JLS-27 and was highest at 2.91 q/ha for Kartika during *Rabi* 2016-17. The average technology gap across 28 demonstrations stood at 2.75 q/ha, potentially stemming from variations in the feasibility of recommended technologies. Correspondingly, the technology index mirrored this gap, indicating challenges in transferring proven technologies to farmers, exacerbated by inadequate extension services. A lower technology index value, as depicted in Table 2 with an average of 27.53, underscores reduced feasibility of the variety at farmers' fields, highlighting the need for targeted interventions to enhance technology transfer efficacy. However, the higher technology index reflected the inadequate proven technology for transferring to farmers and insufficient extension services for transfer of technology” [17, 18]. The technology index shows the feasibility of the variety at the farmer's field.

Economic analysis: Different variables like seed, fertilizers and pesticides were considered as cash inputs for the demonstrations as well as farmer's practice and on average an additional investment of Rs. 2600 per ha was made under demonstrations. Economic returns as a function of grain yield and MSP sale price during the year. The maximum net return (Rs. 20955 per ha) by JLS-27 was obtained due to the higher grain yield. The higher additional returns and effective gain obtained under demonstrations could be due to improved technology, non-monetary factors, timely operations of crop cultivation and scientific monitoring. The lowest and highest incremental benefit: cost ratio (IBCR) were 2.91 & 3.07 for Indira-32 and JLS-27, respectively (Table 3) depends on produced grain yield. Overall average IBCR was found as 2.99.

4. CONCLUSION

The findings showed that the Balaghat district's farming community benefited greatly from the Front-Line Demonstration because they were inspired by the innovative agricultural technologies used in the demonstrations. When compared to current techniques, the technologies that were exhibited were superior in every way. Through FLD programme, productivity of Linseed has been increased to 46.72% hence increasing income. The existing technology and extension gap should be minimized by imparting scientific knowledge to the farmers through extension personnel. However, the yield level under FLD was superior to local Linseed variety and the performance & potentiality of this variety could be further improved by adopting recommended management practices. The participating farmers play an important role in disseminating technologies to the neighbouring farmers. The FLD shows great impact on the use of improved varieties.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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DOI: 10.18805/LR-5111

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/114290