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Increasing the Productivity and Profitability of Lentil (*Lens culinaris* L. Medik) through Front Line Demonstrations under Rainfed Agro Ecosystem of Bundelkhand

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A B S T R A C T

Front line demonstrations on improved lentil varieties were conducted on farmers' fields in district of Sagar (Madhya Pradesh) during rabi 2013-14 to 2015-16. An average 29.55% higher grain yield was recorded under demonstrations over the farmers' practices. The extension gap and technology index were observed to be 187 kg per ha and 18.47%, respectively. An average additional return of Rs 5889 per ha was obtained with an additional investments of Rs 1368 per ha coupled with scientific monitoring of demonstrations and use of other non-monetary factors. On average basis, the incremental benefit: Cost ratio was found to be 4.64.

Introduction

Lentil (*Lens culinaris* L. Medik) is an important *rabi* pulse next to chickpea. It is an important part of vegetarian diet being a rich source of protein and essential amino acid. It is being grown on an area of 1.42 m ha with annual production of 1.13 m tonnes. (Anonymous, 2020)

In the last three decades, the area under lentil across the country has increased by 85%, production by 151% and productivity by 34 %. Bundelkhand region is known as 'Lentil Bowl' of the country. It is an ideal pulse crop for rainfed condition of *Baghelkhnad* and *Mahakoshal* region. Scarcity of water is a severe environmental constraint to plant productivity. Drought-induced loss in crop yield probably exceeds losses from all other causes, since both the severity and duration of the stress is critical (Farooq *et. al*., 2008). Coupled with this, disease like wilt and root rot and sucking insect like aphid severely affect the yield performance of Lentil crop (Tiwari *et al*., 2020). The major causes of low productivity of lentil in Madhya Pradesh includes several biotic and a biotic stresses besides unavailability of quality seeds of improved varieties in time, non adoption of recommended production and plant protection technologies. Therefore, it is important to demonstrate the high yielding lentil varieties and their production technologies to boost lentil production. A wide gap exists between the available techniques and its actual application by the farmers which is reflected through poor yield in the farmer's fields. There is a tremendous opportunity for increasing the production and productivity of lentil crops by adopting the improved technologies. A range of lentil production technologies have been generated at agricultural universities and research stations, but the productivity of lentil is still very low due to poor transfer of technologies from research farms to farmer's fields. To achieve the target of pulse production and productivity, it is necessary to concentrate efforts on scientific cultivation of lentil and conduct FLDs trials on lentil varieties that may be helpful for improving productivity of farmer's fields. To demonstrate the scientific cultivation of lentil front line demonstrations should be laid out at farmer's field. The basic objective of FLDs is to demonstrate the proven technology at farmer's field. Keeping these objectives in view, station had laid out demonstrations of lentil crop on farmers field under irrigated situations during *rabi* 2013 to 2016 to demonstrate the performance of recommended high yielding lentil variety with complete package of practices along with the objective to assess the performance of FLD fields with local check and finally to analyze the economics of FLDs on lentil.

Materials and Methods

The present study carried out for evaluate the economic feasibility of technology transfer to increase the productivity of lentil, the front line demonstrations were conducted on 35 farmers field of villages of Sagar districts Madhya Pradesh viz., Gadakota, Rehli, Sattadhana, Khurai, Jarvans, Bhapel and Somla during rabi seasons of 2013-14 to 2015-16 three year in low irrigated condition on medium to heavy soil with medium fertility status under Soybean – lentil cropping system.

The area under front line demonstration conducted on farmers field was 0.4 ha (1 acer). Each farmer kept control plot where farmers practices was carried out. The full package of practices of improved production technologies included viz., wilt resistant variety JL-3 in 2013-14, JL-3 and DPL-62 in 2014-15 and JL-3 in 2015-16, fertilizer dose NPK 20:40:20 as basal application. Both the chemical and biological agent were used for seed treatment i.e. seed treatment @ 2.5 g per kg with Carbendazim and *trichoderma* @ 6 g per kg respectively and also seed inoculated with *Rhizobium* and PSB @ 10g per kg seed.

The sowing of front line demonstration trails were completed between first fortnight during all three year with a seed rate of 40 kg/ha in line sowing by seed drill with row to row spacing of 30 cm and plant to plant 10 cm. Recommended dose of balance fertilizers (18:46:60 kg/ha N:P_2O_5:K_2O) was applied through DAP and Murate of potash. Weed control was done at 20-25 DAS by hand weeding and hand hoe. For the control of aphid foliar spray of Imidacloprid was done during pest infestation. The trial was harvested between mid February to mid March when the leaves turn yellow and start dropping.Gap analysis and returns were calculated by using the procedure of Khande and Mahajan, 2018

I. Extension gap = Demonstration Yield - Farmers Practice Yield

II. Technology gap = Potential Yield - Demonstration Yield

$$\text{III. Technology Index} = \frac{\text{Potential Yield- Demonstration Yield}}{\text{Potential Yield}} \times 100$$

IV. Additional Return = Demonstration Return - Farmers Practice Return

V. Effective Gain = Additional Return - Additional Cost

$$\text{VI. Incremental B: C Ratio} = \frac{\text{Additional Return}}{\text{Additional Cost}}$$

Results and Discussion

During the period of study, a total number of 30 FLDs were conducted at farmer's field as per the allotment by ICAR, New Delhi at the seven villages of Sagar district of *Bundelkhand* region of Madhya Pradesh during *rabi* seasons of 2013-14 to 2015-16 under low irrigated condition on medium to heavy soil with medium fertility status under Soybean – lentil cropping system. Out of 30 demonstrations, 10 (33 per cent) in range of > 5 q/ha and remaining 20 (67 per cent) were found in the high yield category i.e. more than 5 q/ha which might be attributed to variations in biotic and abiotic stresses observed across different time horizon (Table 1).

Plant health

The data on wilt disease incidence, aphid population, yield and yield attributing characters of lentil for 3 years presented in Table-2 revealed that occurrence of wilt disease in improved technology (use of wilt resistant variety and seed treatment by vitavax power) was 6.4, 4.8 and 3.6 per cent as against farmers practice having 21.4, 22.4 and 18.4 per cent during the years 2013-14, 2014-15 and 2015-16, respectively. Average reduction in wilt incidence 20.7 to 4.9 per cent (76.3 per cent). Which may due to protection from *Fusarium oxysporium* f.sp. lentis in seed as well as in soil. Earlier Maheshawari et. al. (2008) also found reduction in wilt incidence with the seed treatment of systemic fungicide significantly. Balance fertilizer application showed better number of pods per plant. Numbers of pods per plant under improved production technology were 22, 26 and 27 as in farmer's practice were 17, 21 and 21 per plant during the years The results revealed that integrated crop management practices reduced the wilt disease incidence in lentil from 20.7 to 4.9 per cent (76.3 per cent), spray of systemic insecticide imidacloprid 17.8 SL reduced the aphid population from 17.0 to 7.6 per plant (55.2 per cent) in various years. The average 94 pods per plant were obtained under improved technology over to farmer's practices

Grain yield

The increase in grain yield under demonstration over the farmer's local practices was in the range of 28.41 to 31.43 per cent. On the average basis 29.55 per cent yield advantage was recorded under FLD demonstrations as compared to farmers practices (FP) of lentil cultivation.

Gap analysis

An extension gap ranging from 125-220 kg per hectare was found between FLD demonstration and farmers practices during the different time line and on average basis the extension gap was observed to be 187 kg per hectare (Table 2). The extension gap was lowest (125 kg/ha) in year 2014-15 and was highest (220 kg/ha) in year 2015-16. Such gap might be attributed to adoption of improved technology in demonstrations which resulted in higher grain yield than that in the farmer's practices.

Table.1 Details of demonstrations under different yield ranges in lentil

Number of demonstrations conducted during 2012-13 to 2015-16		Number of demonstrations in range different yield (q/ha)	
Allotted	Conducted	< 5	>5
30	30	10 (33%)	20 (67%)

Table.2 Grain yield and gap analysis of front line demonstrations of lentil on farmers' field

Years	No. of demonstration	Variety sown	Yield potential (kg/ha)	Wilt incidence		No. of pods/plant		Yield qtl. /ha		Yield increase over farmers practice (%)	Extension gap (qtl. /ha)	Technology gap (qtl./ha)	Technology index (%)
				IP*	FP$	IP	FP	IP	FP				
2013-14	10	JL-2	1000.00	11	30	115	88	961	746	28.82	215.0	215.00	3.9
2014-15	10	DPL-62	1000.00	15	34	90	78	565	440	28.41	125.0	125.00	43.5
2015-16	10	DPL-62	1000.00	12	31	78	72	920	700	31.43	220.0	220.00	8.0
Average	**10**		**1000**	**13**	**32**	**94**	**79**	**815**	**629**	**30**	**187**	**187**	**18**

* IP = Improved Technology
$ FP = Farmers practice

Table.3 Economic analysis of front line demonstrations of lentil on farmers' field

Year	Cost of Cultivation		Gross returns		Net returns		Additional Net returns	B:C ratio	
	IP	FP	IP	FP	IP	FP		IP	FP
2013-14	11970	10970	27888	21634	15913	11449	4464	1.29	1.10
2014-15	10810	9115	17515	13640	6705	4525	2180	0.61	0.49
2015-16	11920	10510	31790	24140	19870	13630	6240	1.26	1.26
Average	11566	10198	25731	19804	14162	9868	4294	1.05	0.95

Wide technology gap were observed during these years and this was lowest (80 kg/ha) during 2015-16 and was highest (435 kg/ha) during 2014-15. On average basis the technology gap of all the 30 demonstrations was found to be 185 kg per hectare. The difference in technology gap during different years could be due to differential feasibility of recommended technologies during different years. Similarly, the technology index for all the demonstrations during different years were in accordance with technology gap. Higher technology index reflected the inadequacy of technology and or insufficient extension services for transfer of technology.

Economic analysis

Different variables like seed, fertilizers, herbicides and pesticides were considered as cash inputs for the FLD demonstrations as well as for farmers practice. It is observed that an average additional investment of Rs. 1368 per ha was made under FLD demonstrations. Economic returns was observed to be a function of grain yield and Minimum Support Price (MSP) or sale price which varied along different years. A maximum additional return of Rs. 7480 per hectare during the year 2015-16 was obtained due to higher grain yield. The higher additional returns 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 2.27 & 6.34 in 2014-15 and 2013-14, respectively (Table 3) which depends on grain yield and MSP or sale price. The gap observed may be attributing to the dissimilarity in soil fertility status and weather conditions. Mukharjee 2003 have also opined that depending on identification and use of farming situation, specific interventions may have greater implications in enhancing system productivity. The front line demonstration on lentil revealed 30 per cent increase in yield over local check. This increase was with an average extra expenditure of Rs.1368/ha which is very less and even small and marginal farmers could also afford. Thus it is not the cost that deters the farmers from adoption of latest technology but ignorance is the primary reason. It is quite appropriate to call such yield gap as extension gap. The extension gap was found to be 186 kg/ ha. The average IBCR (4.64) is sufficiently high to motivate the farmers to adopt the technology. Mahajan 2017 was of the same opinion. Therefore, FLD program was effective in changing attitude, skill and knowledge of farmers towards improved / recommended practices of lentil cultivation. This also led to improvement in the relationship between farmers and scientists and built confidence between them. The FLD demonstration farmers acted as primary source of information about the improved practices of lentil cultivation. They also acted as source of good quality pure seeds in their locality and surrounding area for the next crop. The concept of Front line demonstration may be applied to all farmer categories including progressive farmers for speedy and wider dissemination of the recommended practices to other members of the farming community. This will help in the removal of the cross-sectional barriers among farming community.

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