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Original Research Article

Increase Lentil (*Lens culinaris*) Production through Cluster Frontline Demonstrations of Maharajganj, Eastern U.P., India

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A B S T R A C T

The pulse cultivation has been drastically reducing in recent years resulting in shortage of pulses in the market. In order to address this short coming the Government of India has devised a programme to promote the pulse cultivation in cluster mode under National Food Security Mission through KVKs. The lentil has been most preferred pulse in Maharajganj, Uttar Pradesh. The present study was conducted to revive the lentil cultivation employing new cultivars by Krishi Vigyan Kendra, Basuli, Maharajganj and carried out during rabi season in different blocks and villages of the district during 2017-18, 2018-19 and 2019-20. The Cluster Front Line Demonstration (CFLD) on lentil variety, Pant Lentil 8 was taken up during each year for 20 and 61 clusters respectively. The results revealed that integrated crop management practices reduced the wilt disease incidence in lentil from 1.92 (90.66 percent over farmers), spray of systemic insecticide imidacloprid 17.8 SL reduced the aphid population from 3.47 per plant (68.04 percent over farmers) in average various years. The seed yields of lentil under improved technology with average yield of 19.67 q/ha which was 102.05 percent higher over the farmer's practice (9.73 q/ha). However, maximum average gross returns (Rs.88,823 /ha) as well as benefit cost ratio (8.68) were recorded under improved technologies as compared to farmer's practice (Rs.44,077/ha). Adoption of 100 percent of the respondent adopted the good land preparation and timely sowing, which was followed by 67.21 percent of the high yielded variety, majority of the respondent constraints faced by not existing of the market (100 %), it was also fallowed by lack of technical guidance (91.80%), not existing of the potential market (85.25%). The significant increase in yield is attributed due to introduction of new varieties, use of sulpher and weedicide in cluster mode. This mode facilitated better crop management resulting in better quality production.

Keywords

Lentil, Pulses, Technology gap, BC ratio, Extension gap

Introduction

The Indian agriculture has considered as backbone of Indian economy. India is the largest producer, consumer and importer of pulses in world. It account of 33% of world area and 22% of the world production of pulses (Sandhu and Dhaliwal, 2016). Pulses has ability to fix the atmospheric nitrogen and addition of organic matter to soil, which are important factors to maintaining soil fertility (Kumar *et al.,* 2017). In order to address this short coming the Government of India has devised a programme to promote the pulse

cultivation in cluster mode under National Food Security Mission through KVKs. Lentil is primarily a rabi season pulse crop of Samastipur, Bihar. It is also called "Poor man's" meat because lentil seed contains 22-34.6% protein (Adsule *et al.,* 1989). Pulses play an important role in rainfed as well as partially irrigated agriculture by improving physical, chemical, and biological properties of soil and are considered excellent crops for natural resource management, environmental security, crop diversification and consequently for viable agriculture (Kannaiyan, 1999; Ali and Kumar, 2006). The energy content of most pulses has been found to be between 315 and 432 Kcal/100g with high protein content which is about twice as compared to cereal and several times than root tuber (FAO, 1986; Kushwah *et al.,* 2002). Lentil predominantly is the rainfed crop grown in constrained environment. Several causes are responsible for low yield of lentil of which the use of traditional local cultivars, low plant density per unit area, weed infestation and poor crop management practices constitute the major ones. The major constraints under rainfed lentil cultivation of eastern Uttar Pradesh are non-availability of superior genotypes, reduced plant population due to reduced soil moisture and delayed sowing.

The use of improved varieties alone accounts for 20-25% increase in productivity of lentil crop. India ranked first in lentil area and second in the production with 39.79% and 22.79% of world area and production respectively. The National yield average was (753 kg/ha). The lowest yield was observed in the state of Maharashtra (379 kg/ha), C.G. (410 kg/ha) followed by and M.P. (634 kg/ha) (DES, 2015-16). It is a valuable human food, mostly consumed as dry seeds (whole decorticated, seed decorticated and split). In Indian sub-continent mostly consumed as 'Dal' by removal of outer skin and separation of cotyledons, snacks and soup preparation etc. It is easy to cook and easily digestible with high biological value, hence also referred to patient. Dry leaves, stems, empty and broken pods are used as valuable cattle feed. Nutritive value of lentil given below-

Protein - 24-26%, Carbohydrate- 57– 60%, Fat-1.3%, Fiber-3.2%, Phosphorus - 300 mg/100 g, Iron-7 mg /100 g, Vitamin C-10-15 mg/100g, Calcium- 69mg/100g, Calorific value-343 Kcal/100g and Vitamin A- (450 IU).

Measuring the different yield gaps in pulses has been the major methodological exercise till date. In this regard, the standard terminologies have been identified and defined. For example, yield potential (Yp), also called potential yield, is the yield of a crop cultivar when grown with water and nutrients non-limiting and biotic stress are effectively controlled (Evans, 1993; Van Ittersum and Rabbinge, 1997; Evans and Fischer, 1999). At farm-level, most important problem in lentil production is its poor land preparation, input cost, dieses and weed infestation. Providing effective extension service is inevitable to break the existing resistance by awareness creation through demonstration at farmers training centre. Complementary lentil technologies including tillage frequency, seed treatment, planting techniques, genetically improve seed, disease, insect and weed management practice have to be provided to boost lentil production and to be change the livelihood of Indian farmers.

However, most of the cluster frontline demonstrations results have been presented in the form of yield and economic advantages and hence, quantification of yield gap minimized because of such demonstrations becomes an important area of investigation.

Materials and Methods

The present study was carried out Farmers' operational area of Krishi Vigyan Kendra, Basuli, Maharajganj Achrya Narendra Deva University of Agriculture & Technology, Ayodhya (U.P.) during rabi season of 2017-18, 2018-19 and 2019-20 three consecutive years in the farmer's field in selected as per guide line of Cluster Front Line Demonstration to KVK by ICAR-ATARI, Kanpur Zone –III. Accordingly CFLDs under Lentil (Masoor) crop laid out in block and villages; namely Mithora (Devruaa, Parsa Raja), Sadar (Gonriya Babu) and Siswa (barwa Kala). The knowledge level of the farmers in these villages was also evaluated by random sample of 20 farmers each village. Thereby sample included 300 numbers of farmers in the study. The farmers were asked to reply questions about the improved agro techniques including the high yielding varieties of lentil (Masoor).The score so obtained under various questions were summed up. On the basis of the total score obtained, respondents were categorized on to three classes' i.e. low, medium and high level of knowledge.

The soils of CFLDs field were found sandy loam to clay loams. Each demonstration was conducted in an area of 0.4 ha and 0.4 ha area adjacent to the demonstration plot as farmer's practices i.e. prevailing cultivation practices served as local check. All 61 front line demonstrations in 9.60 ha area were conducted in different villages. The improved technologies package included chickpea wilt resistant varieties, line sowing, integrated nutrient management and timely weed removal. The variety of lentil Pant Lentil 8, in fertilizer 20:40:20:30 NPK and sulpher as basal application. Seeds were treated with Trichoderma viride 5gm/ Kg seed and inoculated with Rhizobium and PSB culture with @20 gm/Kg seed. Seed sowing was done between October 28 to 05 November in every year with a seed rate of 25 kg /ha in line sowing with row to row spacing of 30 cm and 10 cm between plants in the row. Recommended dose of fertilizer (20:40:20:30 NPK Sulpher, kg/ha.) was applied through urea, single super phosphate and murate of potash as basal application. One hand weeding was done at 25 DAS for control of weeds. Foliar spray of Imidacloprid 17.6 SL was done at flower initiation stage for management of aphid. The crop was harvested during March 15 to 25 March after the leaves turn yellow and start dropping. Foliar spray of Spray of NAA 40 mg/lt and Salicylic acid 100 mg/lt once at pre-flowering and another at 15 days. Pre emergence application of Pendimethalin 3.3 litres/ha on 3 days after sowing using sprayer fitted with flat fan nozzle using 500 litres of water for spraying one ha followed by one hand weeding at 20 DAS (or) application of quizalofop ethyl @ 50 g ai/ha and imazethapyr @ 50 g ai/ ha on 15 – 20 DAS. If herbicides are not applied give two hand weedings on 15 and 30 days after sowing. The data on incidence of wilt disease was recorded from flowering to crop maturity stages, whereas, aphid population was recorded from flowering to podding stages. The data on seed yield, cost of cultivation and gross and net monetary return were collected from technological demonstration plot. In addition to this, data on farmer practices were also collected from the equal area. The benefit cost (B:C) ratio was calculated based on gross return. The following formulae were used to calculate the parameters as suggested by (Das *et al.*, 1998):

1. Increase in grain Yield= Grain yield from Demo plot– Grain yield from FP plot /Grain yield from Demo plot X 100

2. Net Return= Gross Return – Cost of cultivation

3. Benefit/ Cost Ratio= Gross Return / Cost of Cultivation X 100

The data were collected through personnel interview, tabulated and analyzed to find out the results and draw the conclusion. The statistical tool like percentage was employed to analyze the data. The constraints as perceived by respondents were scored on the basis of magnitude of the problem as per (Meena and Sisodiya, 2004). The responses were recorded and converted in to mean percent score and ranked accordingly as per (Warde *et al.,* 1991). From front line demonstration plots and farmers practice plot (control plot) and finally extension gap, technology gap, and technology index were calculated as given as formula suggested by Samui *et al.,* (2000) and Dayanand *et al.,* (2012) as given below.

1. Technology gap = Potential yield – Demonstration yield
2. Extension gap = Demonstration yield – farmers yield
3. Technology index = [(Potential yield – Demonstration yield) /Potential yield] x 100

The data of adoption and horizontal spread of technologies were collected from the farmers with the interaction them. Data were subjected to suitable statistical methods. The following formulae were used to assess the impact on different parameters of lentil crop.

1. Impact of yield = Yield of demonstration plot- yield of control plot/Yield of control plot X 100
2. Impact on adoption (% change) = No. of adopters after demonstration- No. of adopters before demonstration /No. of adopters before demonstration X 100
3. Impact on horizontal Spread (% change) = After area (ha) - Before area (ha)

The distribution of beneficiaries according to their change of area after conducting the FLD on their field. Unfortunately use of local varieties and poor nutrient management results in very low yield.

Results and Discussion

Disease and pest incidence

Overall adoption level of lentil grower about recommended cultivation practices The analysis on overall adoption level of lentil grower about recommended cultivation practices revealed that majority of the respondent had medium level of adoption. The data on wilt disease incidence, aphid population, yield and yield attributing characters of lentil for 5 years presented in Table-1 revealed that occurrence of wilt disease in improved technology (use of wilt resistant variety and seed treatment by *Trichoderma viride* 5gm/ Kg seed was 1.92 percent as against farmers practice having 20.59 (90.66) percent during the years respectively. 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. Precautionary spray of systemic insecticide Imidacloprid 17.8 SL reduced the aphid population from 3.47 per plant (68.73 percent) in various years.

Yield and contributing characters

The yields contributing characters like no. of pods/plant obtained over the years under recommended practice as well as farmers practice. Observation revealed that, ear head numbers were high registered with FLD plots compare to farmer's practice. Numbers of pods per plant under improved production technology were 22.03 in farmer’s practice were 10.70 per plant during the years. The

productivity of lentil from mean grain yield of 19.67 q/ha under improved practice on farmer's field as compared to farmer's practices mean of grain yield 9.73 q/ha and grain yield increase 102.05% over farmer's practices presented in table -2.

Table.1 Differences between technological intervention and farmers practices under front line demonstration on Lentil

S. No.	Component	Technological intervention	Farmers practice	Gap
1.	Land preparation	Three ploughing	Three ploughing	Nil
2.	Variety	PL 08	Old mix variety	Full
3.	Seed rate	25/ha	40-45 kg/ha	Higher seed rate
4.	Seed treatment	Trichoderma viride 5gm/ Kg seed	No seed treatment	Full
5.	Seed inoculation	Rhizobium and PSB culture with @20 gm/Kg seed	No seed inoculation	Full
6.	Sowing method	Line Sowing	Broadcasting	Full
7.	Spacing	Row to row 30 cm and plant to plant 10 cm	Row to row 30 cm and plant to plant 15 cm	Partial
8.	Farm manure	5 t/ha.	No. farm manure	Full
9.	Fertilizer dose	FYM 5t/ha,20:40:25:30 Kg/ha (NPK Sulpher)	30 kg/ha. P	Partial
10.	Pre-emergent Herbicide application	Apply Pendimethalin @ 2.5 lit. per ha	No herbicide used	Full gap
11.	Post- emergent Herbicide application	quizalofop ethyl @ 50 g ai/ha and imazethapyr @ 50 g ai/ ha on 15 – 20 DAS	No herbicide used	Full gap
12.	Plant protection	Imidacloprid 17.6 SL	Use of correct dose and time	1- Application of insecticide without knowledge 2- Use of incorrect dose Partial

Table.2 Wilt disease incidence, insect population, seed yield of Lentil as affected by improved and local practices

Yields parameter	Year						Mean/total		Increase %
	2017-18	2017-18	2018-19	2018-19	2019-20	2019-20	IP	FP	
	IP	FP	IP	FP	IP	FP			
Wilt incidence	1.70	19.18	2.15	21.90	1.92	20.70	1.92	20.59	-90.66
Reduction percentage	–	91.14	–	90.18	–	90.72	–	90.68	–
Aphid population/Plant	5.10	11.90	3.18	11.10	2.14	9.60	3.47	10.87	-68.04
Reduction percentage	–	57.14	–	71.35	–	77.71	–	68.73	–
No. of pods per plant	21.00	10.20	22.60	11.30	22.50	10.60	22.03	10.70	105.92
Yield kg/ha.	18.90	9.10	19.50	9.00	20.60	11.10	19.67	9.73	102.05
Potential grain yield (q/ha)	23.50	23.50	23.50	23.50	23.50	23.50	23.50	23.50	0.00
Extension gap (q/ha)	–	9.80	–	10.50	–	9.50	–	9.93	–
Technology gap (q/ha	4.60	14.40	4.00	14.50	2.90	12.40	3.83	13.77	-72.15
Technology index	0.24	1.58	0.21	1.61	0.14	1.12	0.20	1.44	-86.33
No. of farmers	17	17	21	21	23	21	61	61	–
Area ha.	3.2	3.2	3.2	3.2	3.2	3.2	9.6	9.6	–

Table.3 Economics of CFLD of lentil as recommended practices as well as farmer's practices

Year	Potential grain yield (q/ha)	Cost of cash input		Additional cost in demonstrations (Rs./ha)	Sale price of grain (MSP) (Rs./qt)	Grain Yield (q/ha)		Total returns Rs. (ha		Extra returns	Incremental Benefit : Cost ratio
		FLD	FP			FLD	FP	FLD	FP		
2017-18	23.50	9250	8150	1100	4250	18.90	9.10	80325	38675	41650	8.68
2018-19	23.50	10205	9110	1095	4475	19.50	9.00	87263	40275	46988	8.55
2019-20	23.50	11230	10150	1080	4800	20.60	11.10	98880	53280	45600	8.80
Mean	**23.50**	**10228**	**9137**	**1092**	**4508**	**19.67**	**9.73**	**88823**	**44077**	**44746**	**8.68**

Table.4 Overall adoption of lentil farmers about improved cultivation practices (F =61)

Categories	Frequency	Percentage
Low	45	73.77
Medium	13	21.31
High	3	4.92

Table.5 Adoption of individual recommended cultivation practices of lentil farmers (F =61)

Sl. No.	Particular	Frequency	Percentage
1	High yield varieties	41	67.21
2	Land preparation	61	100.00
3	Seed treatment practices	20	32.79
4	Spacing	13	21.31
5	Sowing Mathed	10	16.39
6	Sowing time	61	100.00
7	Manuring	27	44.26
8	Recommended NPK and Sulpher	19	31.15
9	Disease management	17	27.87
10	Pest management	21	34.43
11	Foliar application of nutrients	9	14.75
12	Weedicide dose	11	18.03

Table.6 Constraints faced by farmer

Sl. No.	Constraints	Frequency	Percentage
1	Lack of technical guidance	56	91.80
2	Complexity	40	65.57
3	Lack of financial support	36	59.02
4	Not existing of the potential market	52	85.25
5	Monopoly of Merchant in the market	49	80.33
6	Non-availability of skilled labour	32	52.46
7	Lack of marketing facilities	61	100.00

Table.7 Impact CFLDs on horizontal spread of lentil

Variety	Area (ha.)		Change in area (ha)	Impact (% Change)
	Before demonstration	After demonstration		
Pre-emergent Herbicide application	11	263	252	772.73

Extension gap

The extension gap 9.93 q/ha during the period of study emphasized the need to educate the farmers through various means for the adoption of improved agricultural production to reverse the trend of wide extension gap (Table 2).

Technology gap

The technology gap is the difference or gap between the demonstration yield and potential yield and it was varies during the year of observation. The trend of technology gap 3.83 q/ha reflected the farmer's practice (13.77 q/ha).

Technology index

In carrying out such demonstration with encouraging results during the period of study. As such, the reduction in technology index 0.20%, exhibited the feasibility of the demonstrated technology in this region.

Economics

The inputs and outputs price of commodities prevailed during the CFLD period, were taken for calculating cost of cultivation, net returns and B:C ratio (Table 3). The investment on production by adopting improved technology with a mean value of Rs. 10,228/ha against farmers practice where the variation in cost of production with mean value of Rs. 9,137/ha.

Cultivation of wheat under improved practices fetch higher net return of mean value Rs. 88,823 compared to farmer practice to mean amount of Rs. 44,777/ ha. The additional net return with mean value of Rs. 44,746/ ha over farmer practice. The B:C ratio of improved technology was 8.68.

Adoption of recommended cultivation practices

The individual adoption level was assessed with the packages of practices for enhancing the higher seed production in lentil under Maharajganj of Uttar Pradesh such as high yield varieties, land preparation, seed treatment practices, spacing, sowing time, manuring, recommended NPK and sulpher, cultural practices, disease management, pest management and foliar application of nutrients. It is evident from table 4 and 5 that 100 percent of the respondent adopted the good land preparation and timely sowing which was followed by 67.21 percent of the respondent adopted the water management practices. The same level of respondent recorded in cultural practices and pest management by 34.43 percent. The level of respondent adopted other recommended practices such as manuring (44.26 percent), seed treatment practices (32.79 percent), spacing (21.31 percent), disease management (27.87 percent), recommended NPK and Sulpher (31.15 percent) and foliar application of nutrients (14.75 percent).

Constraints faced by farmers

Table 6 revealed that majority of the respondent constraints faced by not existing of the market (100 %), it was also fallowed by lack of technical guidance (91.80%), not existing of the potential market (85.25%), lack of marketing facilities (100%), lack of financial support (59.02%).non-availability of skilled labour (52.46%), and monopoly of merchant in the market (80.33%)

CFLD on horizontal spread

The FLD produced a significant positive result and provided an opportunity to demonstrate the productivity potential and profitability of the latest technology

(intervention) under real farming situation. Therefore the study concludes that CFLDs conducted by KVK, Maharajganj made significant impact on pre-emergent herbicide application horizontal spread Impact (% Change of 777.73) of this technology (Table 7).

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