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Short Communication

Effect of row spacing, row direction and fertility levels on Frenchbean (*Phaseolus vulgaris* L.) seed production in dry temperate zone of Himachal Pradesh

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Abstract

The experiment was conducted during summer seasons of 2015 & 2016 at the Research Farm of Highland Agriculture Research and Extension Centre, Kukumseri, Lahaul-Spiti district of dry temperate zone of Himachal Pradesh. The study revealed that the tribal farmers of Lahaul & Spiti district of Himachal Pradesh can take Frenchbean seed production of 'PalamMriduala' cultivar by sowing the crop in north-south row direction (more seed yield by 15.7% & Rs 1,31,467 as net returns/ha) at row spacing of 30 cm (more seed yield 22.7% &Rs 1,41,404 as net returns/ha) and by applying 62.5 N, 125 kg P_2O_5 and 62.5 kg K_2O/ha (7.25 % more seed yield & Rs.1,31,467 as net returns/ha) as basal application to realize more productivity and profitability compared to sowing in east-west at 45 cm row spacing and 100 % of recommended dose of fertilizer.

Key words: *Phaseolus vulgaris*, spacing, row direction, fertility levels.

Seed potato became a commercial crop of Lahaul valley (Himachal Pradesh) in 1960s followed by green peas in mid eighties. Thereafter apple came up as an commercial crop due the shift in snow line as a result of which apple cultivation in Kullu valley is being affected. Recently the cole vegetable crops, French bean, tomato etc. are coming up as commercial crops. The farmers are facing serious problem of shortage of seed. Therefore, present investigation was undertaken to find out the package of practice for seed production of Frenchbean cultivar 'Palam Mridula' which has been released recently and is of great demand by the farmers. It is a bush type bean and is being preferred by farmers who had the only option of growing contender cultivar in the zone.

Plant stand design is a key parameter for grain yield of French bean and other row crops. Plant stand design affects many factors such as light, water, nutrients, and weeds which are crucial for crop production. Row spacing requirements of French bean depend on architecture and growth pattern of the varieties. For higher yield, higher proportion of incident radiation at the soil surface must be intercepted by crop canopy. If a row distance is too wide, solar radiation that falls between crop rows remains unutilized. On the other hand, plants become crowded and they suffer from mutual shading if the row distance is too narrow. Moreover, yield may be reduced in narrow spacing due to increased competition of plants for nutrient and moisture. Similarly, orientation of the rows also affects photosynthetic efficiency and canopy temperature as it affects interception of solar radiation by the crop canopy. A uniform distribution and proper orientation of plants over a cropped area are needed for greater light interception throughout the crop profile and maximum photosynthetic efficiency by all the leaves of a crop plants. Crop nutrition is key factor in harnessing the food yields of crops. There is still a lack of knowledge on proper row-spacing and row direction required for realizing economically profitable yield of new French bean variety.Therefore, the present investigation was carried out to examine the effect of row spacing, row-direction and fertility levels on productivity and profitability of French bean seed production in cold desert zone of Himachal Pradesh.

The experiment was conducted during summer seasons of 2015 & 2016 at the Research Farm of Highland Agricultural Research and Extension Centre, Kukumseri, Lahaul-Spiti district of dry temperate zone of Himachal Pradesh. It is situated at 32° 44'55" N

latitude and 76° 41' 23" E longitude at an elevation of 2672 m above mean sea level. The area remains snow bound during winters and only one cropping season is available to the farmers for crop cultivation. Treatments comprised of all possible combinations of two row spacing (30, 45 cm), two row- directions (North-South & East West) and two fertility levels (100 & 125% recommended fertilizers) tested in factorial randomized block design replicated thrice. The recommended fertilizer level for French bean in dry temperate zone is 50 kg N, 100 kg phosphorus and 50 kg potash per hectare andthe fertilizers were applied as basal application at the time of sowing. The crop was sown in the mid of June and soil moisture was supplemented with sprinklers as per the requirement of the crop.Soil fertility analyses of the fieldcarried out revealed that the soil was medium in available N (361 kg /ha), available P (21 kg/ha) and available potash (202 kg/ha). The Ca and Mg content ranged were 2.66& 1.58-1.78meq/100g, respectively. Micronutrients Zn, Fe, Mn& Cu were 2.48, 9.32, 5.82, 0.8 ppm, respectively. Organic carbon was 12 g/kg, EC 68-84 µs/cm and soil pH was below neutral point. The soil was medium deep sandy skeletal.

The minimum mean monthly minimum temperature during cropping period ranged between 6.9 to 13.5˚C in 2015 and 9.4 to 14.2 ˚C during 2016 (Table 1). The maximum temperature range was 19.6 to 24.7 ˚C and 22.5 to 25.5˚C during the respective years. The optimum temperature for *Phaseolus vulgaris* has been documented to be 20-25˚C. The rainfall received during these cropping seasons was 205.9 and 144.1 mm in 2015 and 2016. As the soil has gravels and poor water retention capacity, the need based sprinkler irrigations were given by using snow melt water in order to avoid water stress to the crop.

The productivity of the crop was significantly influenced by row spacing during both the years (Table 2). A closer spacing of 30 cm (row to row) recorded significantly higher grain yield by 178.37 kg and 157.9 kg per hectare during 2015 and 2016, respectively. Mean productivity of two years was increased by 168.1 kg per hectare (22.7 %) at closer row spacing compared to 45 cm. As 'Palampur Mridula' cultivar is of bush type and the height of the crop plants remain dwarf, the closer row to row spacing provided more land surface cover which might have used natural resources more efficiently resulting in significantly more yield under dry temperate zone. Results are in conformity with the findings of Goulden (1976) who have reported higher yield with decrease in row spacing of *Phaseolus vulgaris* L.

The productivity of the crop varied by direction of row sowing. Sowing crops in north-south direction resulted in an increase of 91.6 kg/ha compared to east to west direction of rows during 2015. The corresponding increase during summer 2016 was significantly more by 148.75 kg/ha. Mean of the two years revealed that productivity was more by 15.7 per cent (120.17 kg/ha) in north-south direction of rows compared to east –west direction of rows. Similar results (11% increase in yield) have been reported earlier by Bisheshwor *et al*. (2013).

In the present study, grain yield was not influenced significantly by fertility levels, however, the higher fertility level (62.5 N, 125 kg P_2O_5 and 62.5 kg K_2O/ha) recorded more seed yield during both the years, compared to recommended level of fertility (50 N, 100P_2O_5 and 50 K_2O kg/ha). Mean seed yield of two years revealed that productivity was increased by 7.25 per cent over recommended fertility level. Ram *et al*. (2015) have reported that fertilizer application of 150 kg N + FYM @ 5tons/ha resulted in higher grain yield of irrigated Frenchbean.

Analysis of the economic returns was carried out to find the extent of profitability to the farmers which can be accrued by the tribal farmers. Close row spacing of 30 cm recorded gross returns of Rs. 18,1417/ha and net returns of 1,41,404 with benefit cost ratio of 3.53 which were respectively more by Rs39,627, Rs29,627 & 0.42

Table1. Monthly weather data during the cropping period

Month	Mini. Temp.(°C)		Max. Temp. (°C)		Rainfall (mm)	
	2015	2016	2015	2016	2015	2016
June	8.0	10.4	19.6	22.5	39.2	18.1
July	13.5	14.2	24.7	26.4	33.0	27.4
August	12.6	13.5	22.6	23.6	45.7	97.3
September	6.9	9.4	20.9	25.5	88.0	1.3

Table 2. Productivity (kg/ha) and profitability of French bean seed production as affected by row spacing, direction of rows and fertility levels

Treatment		Grain yield (kg/ha)			Gross Returns (Rs/ha)	Net Returns (Rs/ha)	Benefit: cost
		2015	2016	Mean			
Row Spacing							
	30 cm	911.67	902.5	907.08	181417	141404	3.53
	45 cm	733.3	744.6	739.00	147790	111777	3.11
	CD (P=0.05)	123.9	88.1				
Row direction							
	North-South	868.3	897.92	883.11	176622	138609	3.64
	East-West	776.7	749.17	762.94	152587	114574	3.01
	CD (P=0.05)	NS	88.1				
Fertility level							
	100%	796.7	791.7	794.20	158840	121717	3.27
	125%	848.3	855.4	851.85	170370	131467	3.38
	CD (P=0.05)	NS	NS				

Price of seed Rs 200/kg

over the wider spacing of 45 cm. Thus, the tribal farmers could realize profitability margin of 1,41,404 by sowing the crop at closer spacing. Direction of rows affected the economic returns to a considerable extent. North-south sowing recorded Rs.1,76,622, Rs.1,38,609 & 3.64 as gross, net and benefit: cost values which were more compared to that of east –west direction of sowing. Thus, net profitability margin was more by Rs. 24,035/ha in north-south direction of sowing. Higher values of returns and benefit cost ratio were observed when fertility level was raised by 25 percent. The cost incurred on additional quantity of fertilizers was compensated and net profitability margin was increased by Rs 9,750/ha.

Thus, the tribal farmers of Lahaul & Spiti district of Himachal Pradesh can take Frenchbean seed production of 'PalamMriduala' cultivar by sowing the crop in north-south row direction(more seed yield by 15.7% & Rs 1,31,467 as net returns/ha) at row spacing of 30 cm (more seed yield 22.7% & Rs 1,41,404 as net returns/ha) and by applying 62.5 N, 125 kg P_2O_5 and 62.5 kg K_2O/ha (7.25 % more seed yield & Rs.1,31,467 as net returns/ha) as basal application to realize more productivity and profitability compared to sowing in east-westat 45 cm row spacing and 100 % of recommended dose of fertilizer.

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