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Response of Planting Time and Phosphorus Dosage on Yield and Nutrient uptake in Dolichos Bean (*Lablab Purpureus* L.)

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ABSTRACT

Dolichos bean is an important hardy legume vegetable crop, grown widely in the region during August to March. The photo-insensitive line gave an advantage for year round production of the crop however the productivity is very low. Keeping in view an experiment was conducted to study the response of semi-dwarf photo-insensitive line (RCDL- 10) of dolichos bean on time of planting (May, June, July, August, September and October) and graded doses of phosphorus (30, 40, 50 and 60 kg/ha P_2O_5). May sowing took the least number of days to complete the physiological and developmental stages. Longest vine length, pod length and highest number of primary branches were recorded in the July sowing whereas; shortest vine length and lowest number of branches per plant was recorded in October sowing. The highest yield and yield attributes; highest total NPK uptake by the plant was observed in early planting. For higher nutrient uptake, early sowing is preferred. However, in late sown crop, there is need to apply the higher levels of phosphorus to compensate the loss of nutrient uptake. Phosphorus dose of 60 kg/ha recorded the highest yield (123.04 g/plant), total NPK uptake by the plant.

1. Introduction

Dolichos bean (*Lablab purpureus* L.) is one of the most important indigenous, leguminous vegetable crops of India. It is widely grown as a winter season vegetable crop. The crop is also known for its richness in protein (3.6%) and fibre (1.8%). However, dry seed contain 23.0 - 28.0% protein. The pods are also rich in phenol (1.7- 9.67 mg/100 g) which is a potential antioxidant (Rai *et al*., 2014). Photo-insensitive genotype, which does not require any specific short day conditions for flowering and pod set, can be grown as a highly remunerative off season crop during summer and rainy season (Pan *et al*., 2004). ICAR Research Complex for North Eastern Hill Region, Umiam, Meghalaya has identified one such semi-dwarf photo-insensitive genotype (RCDL-10) in dolichos bean which can be sown from April to November. The potential productivity of this cultivar in the North Eastern Region of India has been found to be 70-95q/ha.

The legumes require phosphorous for adequate growth and nitrogen fixation and their effectiveness in soil improvement can be hindered by phosphorous deficiency (Giller and Cadisch, 1995). Phosphorus is one of the most limiting nutrients in acid soils of the region by fixation. Phosphorus deficiency can limit nodulation by legumes and phosphorous fertilizer application can overcome the deficiency on soils that do not strongly adsorb phosphorous (Giller and Wilson, 1991). The significant effects of phosphorus have been observed in legume crops by the several researchers (Saxena *et al*., 1996; Som and Hazara, 1999; Singh *et al*., 2005). Since dolichos bean is a very remunerative crop having multiple uses and well suited to agro-climate of the region, therefore, further investigation is needed to increase the existing levels of productivity by exploring its photo-insensitivity traits and the beneficial role of phosphorus fertilization in conjunction. Keeping this in view, the present investigation has been carried out to assess the impact of planting time and dosage of phosphorus on yield and nutrient uptake pattern of photo-insensitive line, RCDL-10 of dolichos bean.

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2. Materials and Methods

The present work was carried out at the Horticulture Farm of ICAR Research Complex for NEH Region, Umiam, Meghalaya during 2009-2010. The experiment was laid out in split plot design with six treatments as month of sowing allocated in main plots and four different phosphorus levels allocated in sub-plots with three replications. The sowing was done in the first week each of May (D_1), June (D_2), July (D_3), August (D_4), September (D_5) and October (D6) and the different phosphorus (P_2O_5) levels were 30 kg/ha (P_1), 40 kg/ha (P_2), 50 kg/ha (P_3) and 60 kg/ha (P_4). Seeds were sown at a spacing of 60×30 cm apart. The observations on growth and yield parameters *viz.* vine length (cm), numbers of primary branches/plant, fresh and dry weight of pods(g), pod length (cm), numbers of pods/plant, numbers of seeds/pod, pod yield per plant(g) and per hectare (q). The total nitrogen uptake was determined by Kjeldahl method, total phosphorus uptake determined by Vanadomolybdophosphoric acid method in di-acid digested sample and total potassium uptake was determined by Flame photometric method in di-acid digested sample as suggested by Jackson (1973). Data recorded during the study were statistically analyzed using SPAR-I.

3. Results and Discussion

The results under present investigation revealed significant difference for all the traits (Table1). Month of sowing and phosphorus significantly affected pod yield. All the yield attributing factors were found to be positively correlated with early sowing up to August and after that every delay in sowing affected all these factors adversely. The highest rainfall was recorded during August followed by July. However, the lowest sunshine hours was recorded in month of August and shown gradual increasing trend with the proceedings of the months (Figure 1).

3.1 Effect of planting time and phosphorous doses on growth and yield

Among the growth related traits, longest vine length (331.16 cm) and highest number of branches (15.31) were recorded in the July sowing whereas; shortest vine length (158.66 cm) and lowest number of branches per plant (10.08) was recorded in October sowing. Similar findings were recorded by Dhital *et al*. (1997) in cowpea. In broad bean, Joshi *et al*. (1984) reported that less growth and yield in late sowing might be because the plants did not pass the juvenile phase fully or the thermal requirement was not met. In the present study, it was observed that the temperature and rainfall decreased from October onwards which might have affected the plant growth (Figure 1). An increasing trend was observed in the plant growth with increase in the phosphorus levels, where, phosphorus dose of 60kg/ha gave the longest vine length (292.07cm) and highest number of branches per plant (13.49) while, 30kg/ha P_2O_5 gave the shortest vine length (256.02 cm) and lowest number of branches per plant (11.68). Similar observations were made by Tewari and Singh (2000) as well as Singh and Verma (2002) in French bean. Singh *et al.* (2005) reported that the increase in plant growth might be attributed to the role of phosphorus in various metabolic processes such as cell division, cell development and cell enlargement. The longest pod length was recorded in June and July sowing (8.26cm each) while; the shortest pod length (8.06cm) was recorded in the September and October sowing. The high temperature and abundant rainfall might have favoured good pod development in early sown crop. This is corroborated by the findings of Singh *et al*. (2004) and Pan *et al.* (2004) in dolichos bean. Similarly, the pod length increased with higher levels of phosphorus dose. The longest pod length (8.27cm) was recorded at phosphorus dose 60kg/ha while, the shortest pod length (8.05) was recorded with 30kg/ha P_2O_5. The increase in the level of phosphorus helped better and efficient nodulation, which resulted in increased assimilation of nitrogen, well filled pods and higher yield as reported by Saxena *et al*. (1996). Similar observations were also recorded by Tewari and Singh (2000) in French bean. The yield and yield attributes also had a similar trend, where, highest dry weight of pods (0.94g) was recorded in the May and June sowing. May sowing recorded highest fresh weight of pods (4.17 g), highest number of seeds per pod (4.40), highest number of pods per plant (42.18), highest pod yield per plant (168.70 g) and pod yield per hectare (93.72 q) while, the lowest fresh weight of pods (3.99g) was recorded in the September sowing, the lowest dry weight (0.73g) of pods, the lowest number of pods per plant (14.99), the lowest number of seeds per pod (3.99) , the lowest pod yield per plant (59.97 g) and per hectare (33.33 q) was recorded in the October sowing. Similar observations were also recorded by several researchers (Singh *et al.,* 2004; Pan *et al*. 2004; Kathiravan *et al*., 2008) in dolichos bean. The favourable temperature and abundant rainfall during May to September might have resulted in longer pods which were well filled with seeds and the decrease in temperature from October onwards might have affected the plant growth and pod development and this had finally resulted in less number of pods in late sown crops. The yield attributing characters might have been favourably influenced in early sowing and therefore, the yield increased. Late sown crops did not attain required vegetative growth and consequently resulted in poor yield.

Table 1. Effect of phosphorus levels and planting time on yield and related traits in dolichos bean

	Vine length (cm)	No. of branches	Fresh wt. of pods (g)	Dry wt. of pods (g)	Pod length at maturity (cm)	No. of seeds / pod	No. of pods / plant	Pod yield /plant (g)	Pod yield (q / ha)
A. Phosphorus doses									
30 (kg/ha)	256.02	11.68	4.00	0.79	8.05	4.07	24.08	96.30	53.5
40 (kg/ha)	266.34	12.49	4.07	0.85	8.16	4.15	25.10	100.38	55.76
50 (kg/ha)	280.42	12.94	4.15	0.89	8.21	4.24	26.63	106.51	59.17
60 (kg/ha)	292.07	13.49	4.22	0.91	8.27	4.34	30.76	123.04	68.35
S Em±	9.28	0.48	0.04	0.02	0.04	0.07	2.13	8.54	2.67
CD5%	29.23	1.50	0.12	0.07	0.12	0.21	6.73	26.9	8.41
B. Planting time									
May	318.49	13.82	4.17	0.94	8.18	4.40	42.18	168.70	93.72
June	314.57	12.63	4.13	0.94	8.26	4.27	32.36	129.45	71.91
July	331.16	15.31	4.15	0.89	8.26	4.18	23.51	94.05	52.25
August	320.66	13.47	4.15	0.91	8.22	4.19	27.63	110.52	61.4
September	198.73	10.59	3.99	0.76	8.06	4.17	19.17	76.67	42.49
October	158.66	10.08	4.05	0.73	8.06	3.99	14.99	59.97	33.3
S Em±	6.44	0.30	0.03	0.01	0.03	0.07	1.48	5.93	1.85
CD5%	18.47	0.86	0.07	0.03	0.09	0.19	4.25	17.01	5.31

The highest fresh weight (4.22g), dry weight (0.91g) of pods, highest number of pods per plant (30.76), seeds per pod (4.34), pod yield per plant (123.04g) and per hectare (68.35q) was recorded with the application of 60kg P_2O_5 per hectare while, the lowest value for all the above characters were noted with 30kg P_2O_5 per hectare. The increased level of phosphorus might have helped in better and efficient nodulation, which resulted in increased assimilation of nitrogen, well filled pods and higher yield (Saxena *et al*., 1996). Low content of phosphorus affected the yield and dry matter production of pulse crops due to indirect effect on nitrogen fixation through the supply of photosynthates to nodules (Cassman *et al.*, 1980). Similar findings were also recorded by Tewari and Singh (2000) as well as Singh and Verma (2002) in French bean.

3.2 Effect of planting time and doses of phosphorous on nutrient uptake pattern

It is evident from Table 2 that there were significant differences in total NPK uptake by the plant in different sowing months. The uptake of nutrients decreased significantly with the delay in sowing from May to October (Figure 2). However, the uptake of NPK increased with increases in doses of phosphorus level (Figure 3). The uptake of nitrogen decreases significantly with the delay in the month of sowing from May (57.7kg/ha) to October (32.9kg/ha). When sown from June onwards, the total nitrogen uptake was lower as compared to May sowing. In early sowing, the total nitrogen uptake was higher even at lower levels of phosphorous dose as compared to late sown crop with higher dose. With the increase in phosphorous levels the total nitrogen uptake increased. The total nitrogen uptake ranged from 42.43kg/ha (P_1) to 48.46kg/ha (P_4). The interaction effect of month of sowing and phosphorous dose was found to be significant in respect of total nitrogen uptake by the plant. The highest total nitrogen uptake (60.7kg/ha) was recorded at May sowing with P_4 while, the lowest uptake (31.08kg/ha) was recorded in October sowing with P_1. Similarly, the total phosphorous uptake by the plant decreased significantly with the delay in sowing from May (7.2kg/ha) to October (3.68kg/ha). When sown from June onward total P uptake by the plant was lower as compared to May sowing. In early sowing, the total phosphorous uptake

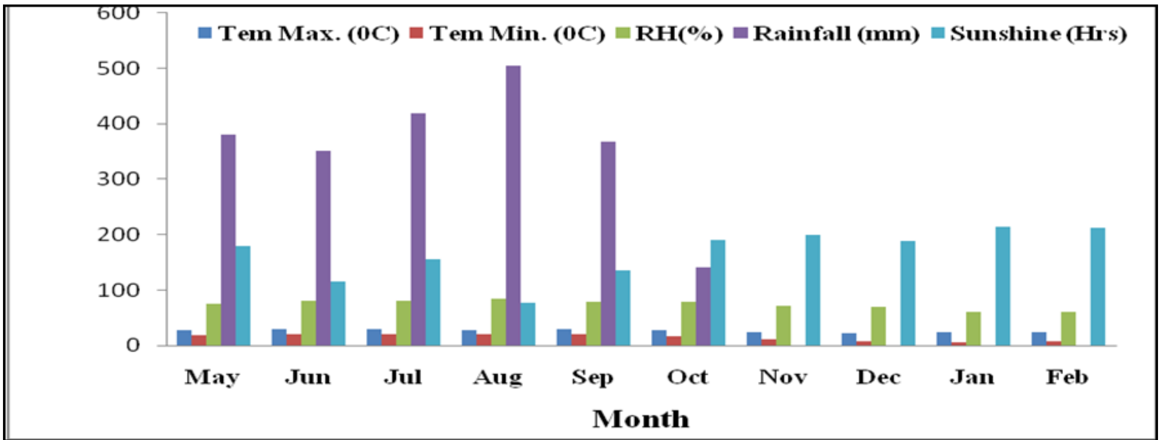

Figure 1. Monthly meteorological data during May, 2009 to Feb, 2010

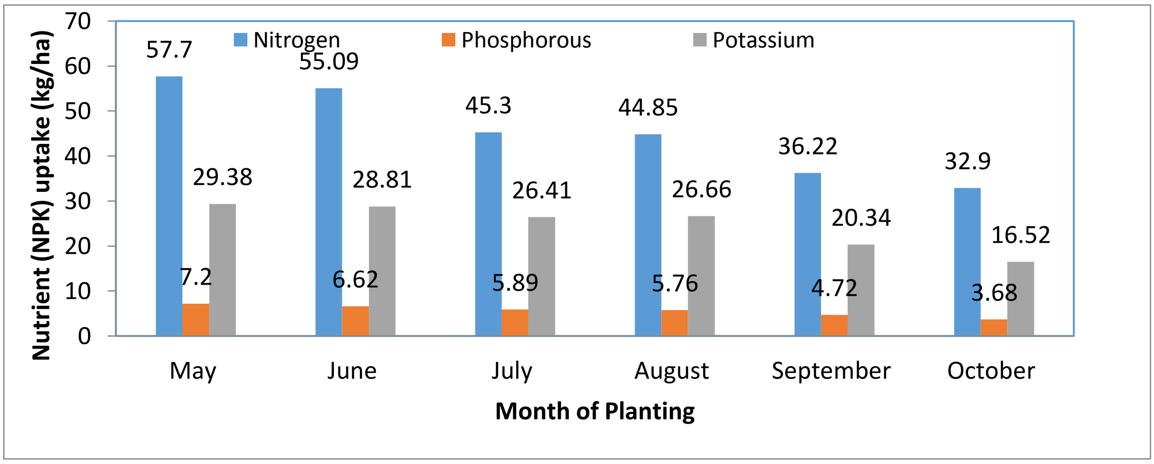

Figure 2. Nutrient uptake (NPK month wise) in dolichos bean

was high even at lower levels of phosphorous while the late sowing required higher phosphorous doses to compensate total phosphorous uptake partially. The total phosphorous uptake by the plant varied from 6.11kg/ha (P_4) to 5.13kg/ha (P_1). The interaction effect of month of sowing and phosphorous dose was found to be significant in respect of total phosphorous uptake by the plant. The highest total phosphorous uptake by the plant (7.39kg/ha) was recorded in May sowing when fertilized with 60kg/ha phosphorous while the lowest total phosphorous uptake by the plant (3.41kg/ha) was recorded in October sowing with 30 kg/ha of phosphorus fertilization (Table 2). Likewise, highest total potassium uptake was observed when the crop was sown early (May: 29.38kg/ha) as compared to late sown crop (October: 16.52kg/ha). Early sown crop at lower doses of phosphorous (P_1) outperformed the late sown crop even at higher doses of phosphorous (P_4). Increase in phosphorous level also persistently increased the average total potassium uptake in all the months of sowing. The highest total NPK uptake by the plant was recorded in May sowing while the lowest was registered by October sowing. The improvement in vegetative growth in early sown crop could be ascribed to more favourable climatic conditions in the form of air temperature and rainfall. Ulemale *et al*. (2003) also reported that the dry matter accumulation decreased with delayed sowing. Kumar *et al*. (2009) suggested that early sowing of dolichos bean resulted in higher uptake of nutrients, water and other essential elements, mostly due to higher translocation supported by profuse rooting behaviour.

In addition, month of sowing as well as phosphorus levels remarkably influenced the tissue (leaves, stems and pods) nutrient content (NPK). Nutrient contents of all the tissue parts decreased linearly with the delay in sowing as well as fertilization with lower doses of phosphorus. Increase in phosphorus levels persistently increased the total nutrient uptake by the plant in all the months of sowing. The highest total NPK uptake by the plant was recorded with 60 kg/ha phosphorus dose. The findings are in close agreement with the findings of Meena *et al.* (2006) in chickpea and Parmar *et al*. (1999) in French bean. This might be due to higher dry matter accumulation with increase in phosphorus dose. Phosphorus application at different levels reflected significant influence in plant height as well as dry matter accumulation, which mostly increased with the increase in phosphorus levels. The other reason might be due to role of phosphorus in root development, the more the root growth the more will be the nutrient uptake. Hazra and Som (1999) also reported that the phosphorus stimulated early root growth and development. Application of phosphorus increased nodulation owing to better root growth, by which nitrogen uptake in plant was increased. The results of present experiment, revealed that early sowing of dolichos bean cv. RCDL-10 in the months of May and June resulted in better yield and related attributes, even at lower levels of phosphorus fertilization. Phosphorus dose of 60kg/ha, gave better results as compared to the lower doses in all aspect. For higher nutrient uptake early sowing is preferred. However, in late sown crop, there is need to apply the higher levels of phosphorus to compensate the loss of nutrient uptake.

Figure 3. Nutrient (NPK) uptake in dolichos bean at different doses of phosphorus

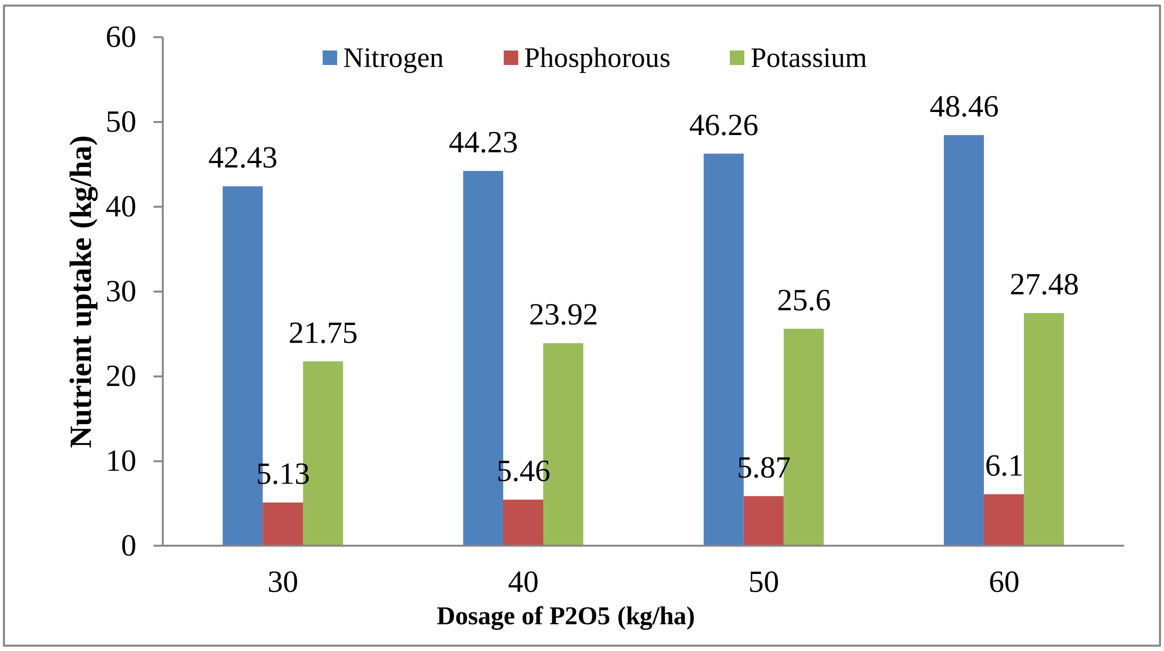

Table 2. Nutrients uptake at different doses of phosphorous and planting time

A. Total Nitrogen uptake					
	P_1 (30kg/ha)	**P_2 (40kg/ha)**	**P_3 (50kg/ha)**	**P_4 (60kg/ha)**	**Mean**
May (D_1)	54.16	56.24	59.71	60.7	57.7
June (D_2)	52.21	52.76	56.21	59.19	55.09
July (D_3)	42.51	44.56	46.14	47.98	45.3
August (D_4)	41.96	43.75	45.72	47.96	44.85
September (D_5)	32.64	35.45	37.06	39.73	36.22
October (D_6)	31.08	32.6	32.71	35.18	32.9
Mean	42.43	44.23	46.26	48.46	
	SEm±	CD 5%			
D (Month)	2.4	7.58			
P (Dosage)	0.5	1.44			
D x P	2.4	7.58			
B. Total Phosphorous uptake					
May (D_1)	6.98	7.05	7.38	7.39	7.2
June (D_2)	6.37	6.36	6.82	6.92	6.62
July (D_3)	4.61	5.62	6.03	7.32	5.89
August (D_4)	5.19	5.55	6.18	6.1	5.76
September (D_5)	4.25	4.72	4.96	4.94	4.72
October (D_6)	3.41	3.46	3.68	3.98	3.68
Mean	5.13	5.46	5.87	6.1	
	SEm±	CD 5%			
D (Month)	0.55	1.74			
P (Dosage)	0.1	0.3			
D x P	0.18	0.55			
C. Total Potassium uptake					
May (D_1)	26.02	29.86	29.01	32.65	29.38
June (D_2)	24.81	26.63	30.7	33.1	28.81
July (D_3)	21.54	25.05	27.19	31.86	26.41
August (D_4)	24.64	25.78	28.36	27.87	26.66
September (D_5)	17.75	20.27	21.45	21.87	20.34
October (D_6)	15.73	15.93	16.86	17.55	16.52
Mean	21.75	23.92	25.6	27.48	
	SEm±	CD 5%			
D (Month)	2.09	6.57			
P (Dosage)	0.65	1.87			
D x P	NS	NS			

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References

Cassman K.G., Whitney AS, Stockinger K.P (1980). Root growth and dry matter distribution of soybean as affected by phosphorus stress, nodulation and nitrogen source. *Crop Science* 20: 239-243.

Dhital B.K., Subedi M, Harding A.H (1997). Effect of planting date on grain yield, yield components and phenology of determinate cowpea varieties in the low hills of Nepal. Technical Paper Lumle Agricultural Centre. No. 97-1.

Giller K.E., Cadisch G (1995). Future benefits from biological nitrogen fixation: An ecological approach to agriculture. *Plant Soil* 174: 255–277

Hazra P., Som M G (1999). Environmental influences on growth, development and yield of vegetable crops. Technology for vegetable production and improvement. Pp106-127

Joshi R.P., Shah A, Singh R.D, Misra A.P (1984). Effect of time of sowing and spacing on growth and yield of broad bean. *Progressive Horticulture* 16 (3-4): 251-256.

Kathiravan M., Vijayakumar A, Vanitha C (2008). Influence of mother crop nutrition on seed yield and quality characteristics in lablab (*Lablab purpureus* L.). *Legume Research* 31(1): 72-74.

Kumar R., Nandan N, Kumar V, Prasad S, Singh D (2009). Response of summer mugbean (*Vigna radiata*) cultivars to sowing time and seed rate. *Indian Journal of Agricultural Sciences* 79(4): 309-312.

Meena L.R., Singh R.K, Gautam R.C (2006). Effect of moisture conservation practices, phosphorus levels and bacterial inoculation on growth, yield and economics of chickpea (*Cicer arietinum* L.). *Legume Research* 29 (1): 68-72.

Giller K.E., Wilson K.J (1991) Nitrogen fixation in tropical cropping systems. Wallingford: CAB International.

Jackson M.L (1973). Soil Chemical analysis. Printice Hall of India, Limited, New Delhi.

Pan R.S., Singh A.K, Rai M, Krishnaprasad VSR, Kumar S (2004). Genetic variation and character association in photo-insensitive Dolichos bean (*Lablab purpureus* L. Sweet). *Vegetable Science* 31(1): 22-25.

Parmar D.K., Sharma T.R, Saini J.P, Sharma V (1999). Response of French bean (*Phaseolus vulgaris*) to nitrogen and phosphorus in cold desert area of Himachal Pradesh. *Indian Journal of Agronomy* 44(4): 787-790.

Rai N., Rai K.K, Tiwari G, Kumar S (2014) Nutritional and antioxidant properties and their inter-relationship with pod characters in an under-exploited vegetable, Indian bean (*Lablab purpureus*). *Indian Journal of Agricultural Sciences* 84 (9): 1051–1055.

Saxena KK., Verma NR, Saxena HK (1996). Effect of phosphorus and potassium on green gram *(Phaseolus radiatus). Indian Journal of Agronomy* 41: 84-87.

Singh D., Dhillon NPS, Singh G.J, Dhaliwal H.S (2004). Evaluation of semphali (*Dolichos lablab* L.) germplasm under rainfed conditions. *Haryana Journal of Horticultural Sciences* 33(3/4): 267-268.

Singh M., Sekhon H.S, Singh J (2005). Growth and nodulation characteristics of mungbean (*Vigna radiata* (L.) Wilczek) genotypes in response to phosphorus application. *Crop Research* 29 (1): 101-105.

Singh N.B., Verma KK (2002). Nitrogen and phosphorus nutrition of French bean (*Phaseolus vulgaris* L.) grown in eastern Uttar Pradesh under late-sown condition. *Indian Journal of Agronomy* 47(1): 89-93.

Tewari J.K., Singh S.S (2000). Effect of nitrogen and phosphorus on growth and seed yield of French bean (*Phaseolus vulgaris* L.). *Vegetable Science* 27(2): 172-175.

Ulemale R.B, Giri R.S, Shivankar, Patil V.N (2003). Effect of sowing dates spacing and phosphate levels on growth and productivity of sunhemp. *Legume Research* 26 (2): 121-124.