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Influence of fertility levels and rhizobium on the productivity of pea under Lahaul valley conditions of Himachal Pradesh

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Abstract

A field experiment was conducted for the two consecutive summer seasons of 2003 and 2004 to evaluate N application techniques in relation to rhizobium inoculation in pea. Five N treatments, *viz.*, 0, 100% basal, 50% basal + 50% topdressing at flowering, 100% basal + 25% at flowering and 75% basal; alone and in combination with seed inoculation with rhizobium plus one absolute control were evaluated for seed yield and related traits. Results of the study revealed that100% N basal increased plant height, pods/plant, seeds/pod, 1000-seed weight, seed yield, net return, and B:C ratio significantly. Neither split application nor additional 25% N recorded any significant benefit in terms of yield and returns but increased available soil N content after the termination of the experiment. Seed inoculation brought about significant increase in plant height, yield contributing traits and returns. Pea seed yield was positively associated with plant height, pods/plant, seeds/pod and 1000-seed weight.

Keywords: Fertility levels, rhizobium, pea, productivity, Lahaul valley

Introduction

Garden pea is an important cash crop grown in almost all ago-climatic zones in winter (*rabi*) season. However, in dry temperate region, it is cultivated during summers. Farmers get premium prices of green produce owing to its great demand and scarcity in the market during this period. The dry temperate region of Himachal Pradesh is characterized by high wind velocity, scarcity of rainfall, uneven variation in temperature, low relative humidity and high evapo-transpiration. Soils are coarser and low in water holding capacity. For successful cultivation, the soils in dry temperate region need to be attended by supplying judicious use of fertilizers. The pea crop responds well to applied plant nutrients (Singh, 1999; Chadha *et al.*, 2004). Because of high rate of evapo-transpiration, crop is grown using frequent irrigations. As a sequel to the fact, nutrients application methods need special attention. The garden pea is known to respond to application of nitrogen effectively (Brkic *et al.*, 2004; Vimala and Natarajan, 1999; Vimala and Natarajan, 2000). The crop also responds to seed inoculation with rhizobium (Kanaujia *et al.*, 1997; Vimala and Natarajan, 1999; Vimala and Natarajan, 2000; Pandey 2003). Seed production is almost negligible in the dry temperate region and farmers depend entirely on outside seed supply. The seed from outside sources many a times carry disease inoculums and adversely affect the productivity. Keeping above facts in mind, the present investigation was undertaken to study the response of nutrients application in relation to seed inoculation with rhizobium on seed crop of pea.

Material and Methods

A field experiment was conducted during the summer seasons of 2003 and 2004 at the experimental farm of Regional Research Station of CSK HPKV, Kukumseri, Lahaul and Spiti (32°46'15" N latitude, 76°41'23" E longitude and 2734 m altitude). The soil of the experimental field was sandy loam (62, 26 and 12 per cent sand, silt and clay, respectively), almost neutral in reaction (pH 6.4), had 0.98% organic carbon, 141, 48 and 130 kg ha^{-1} of available N, P and K, respectively.

Five N treatments *viz.* 0, 100% (at sowing), 100% (in two equal splits *i.e.* at sowing and flowering), 125% (100% at sowing and 25% at flowering) and 75% (at sowing) of recommended dose alone and in combination with seed inoculation with rhizobium apart from one absolute control were tested in randomized block design with three replications. The

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recommended dose of N @ 20 kg/ha, P_2O_5 (60kg/ha) and K_2O (30kg/ha) were applied in all the treatments except the absolute control. N, P and K were applied through urea, single super phosphate and muriate of potash, respectively. Azad P-1 cv. of pea at 130 kg/ha was sown at a row spacing of 30 cm on 16 May 2003 and 18 May 2004. Rest of the management practices were followed in accordance with the recommended package of practices. Economics of the treatments was computed based upon the prevalent market prices. Soil samples collected at the termination of the experiment, were analyzed for organic carbon content and available NPK status.

Results and Discussion

Effect of Nitrogen

It was observed that the trends were similar during both the years of study. Application of 100% N significantly increased pods/plant, seeds/pod and 1000-seed weight over control (0 kg N/ha). Split application of nitrogen as well as additional application of 25% N did not record any significant increase in influencing pods/plant, seeds/pod and 1000- seed weight over 100% recommended N. However, 100% N resulted in significantly higher plant height over the split application of N (50% N at sowing and 50% at flower initiation). Application of N at 75% of the recommended dose improved the growth and yield attributes in comparison to no N application but it was found to be significantly inferior to other N levels (Table 1).

Owing to improvement in growth and yield contributing traits, seed yield was increased significantly due to 100% recommended N by 37.9% over the control. Neither split application nor the additional 25% N affected the yield significantly over the recommended level of N as basal. This clearly suggested that N application should only be made as basal to fulfill the initial need until the biological N fixation activity begins. Application of 25% less N than the recommended could also bring about significant increase in seed yield by about 25% than the control treatment.

Increase in seed yield owing to 100%basal, 50% basal + 50% N at flowering and 100% basal + 25% N at flowering fetched significantly higher net monetary returns and B: C ratio. Application of 75% N as basal was inferior to other N rates but significantly increased net return and B: C ratio by 30.5 and 26.7%, respectively over the control (Table 2).

The available N content after the termination of the experiment was significantly affected owing to N levels. In general, available N content was higher due to all N treatments than the control. Application of 25% more N than the recommended and split application of the 100% recommended N although did not make any significant contribution in increasing seed yield of pea but contributed significantly in increasing the available soil N content after the experiment was over. Organic carbon, P and K contents were not affected significantly but their values in general were higher due to all N application rates over control.

Effect of Rhizobium inoculation

Seed inoculation with rhizobium culture could bring about significant improvement in growth, yield contributing traits and seed yield of pea. On an average, seed inoculation increased seed yield of pea by 9.1% over no inoculation. Increase in yield owing to seed inoculation with rhizobium has been documented (Kanaujia *et al*, 1997; Vimala and Natarajan, 1999; Vimala and Natarajan, 2000; Pandey 2003). Because of significant increase in seed and haulm yields, net return and B: C ratio increased by 10.31 and 8.13%, respectively. Bhattarai *et al.* (2003) also obtained higher returns with the application rhizobium in pea. Seed inoculation could not bring about significant variation in soil properties, but in general the values of all the properties were higher than the control.

The interaction between N application and rhizobium was not significant. This showed that rhizobium brought about significant improvement in growth, yield attributes and yield irrespective of N application rates/techniques.

Control v/s others

The effect of the treatments was significant for growth, yield attributes and thereby on the seed yield of pea. The percent increase in seed yield, net return and B: C ratio was as high as 167.5, 245.5 and 196.4, respectively over the absolute control.

In the present investigation, pea seed yield was significantly and positively correlated with plant height (0.884** & 0.824**; $P<0.01$), pods/plant (0.883** & 0.826**), seeds/pod (0.935** & 0.878**) and 1000-seed weight (0.882** and 0.839**) in the year 2003 and 2004, respectively, showing high degree

Table 1. Effect of fertility levels and Rhizobium on yield contributing traits of pea

	Plant height (cm)			Pods/plant (No.)			Seeds/pod (No.)			1000 seed weight (g)		
	2003	2004	Pooled	2003	2004	Pooled	2003	2004	Pooled	2003	2004	Pooled
N levels												
N0	31.9	33.0	32.5	10.7	11.0	10.9	6.7	6.7	6.7	256.0	256.0	256.0
N100	43.0	44.0	43.5	13.1	13.1	13.1	8.4	8.3	8.4	285.3	287.8	286.6
N50+50	40.4	41.4	40.9	13.4	13.5	13.4	8.2	8.2	8.2	281.5	281.8	281.7
N100+25	41.9	43.8	42.8	13.7	13.9	13.8	8.4	8.4	8.4	282.8	284.0	283.4
N75	37.7	37.0	37.4	11.5	11.6	11.5	7.6	7.6	7.6	268.8	270.2	269.5
LSD (P=0.05)	2.2	2.1	1.7	1.2	1.2	0.8	0.5	0.6	0.4	6.4	6.2	4.1
Rhizobium												
N	36.5	37.1	36.8	12.0	12.0	12.0	7.5	7.5	7.5	267.8	269.6	268.7
N+R	41.5	42.6	42.1	13.0	13.2	13.1	8.2	8.2	8.2	282.0	282.3	282.2
LSD (P=0.05)	1.4	1.3	1.1	0.7	0.7	0.5	0.3	0.4	0.2	4.1	4.0	2.6
Control vs. others												
Control	24.5	25.5	25.0	7.3	7.2	7.3	4.1	4.6	4.4	235.3	238.3	236.8
Others	39.0	39.8	39.4	12.5	12.6	12.5	7.9	7.8	7.8	274.9	276.0	275.4
LSD (P=0.05)	2.3	2.2	1.8	1.2	1.2	0.9	0.5	0.6	0.4	6.7	6.6	4.3

of association with the parameters studied.

The findings of this investigation conclusively inferred that for higher pea productivity seed should be inoculated with rhizobium culture and the crop should be fertilized with 100% of the recommended dose of N.

Table 2. Effect of fertility levels and Rhizobium on pea seed yield (kg/ha), economics and soil properties

	Seed yield (kg/ha)			Net return	B:C ratio	OC (%)	Soil status		
	2003	2004	Pooled	(Rs/ha)			N	P	K
							(kg/ha)		
N levels									
N 0	2000	1949	1975	96757	4.45	1.02	144.0	45.3	138.0
N 100	2747	2700	2724	140849	6.25	1.07	158.5	47.1	142.2
N 50+50	2665	2718	2692	138836	6.13	1.03	165.0	46.7	143.8
N 100+25	2747	2799	2773	143619	6.31	1.13	188.6	47.8	118.0
N 75	2427	2527	2477	126224	5.64	1.08	154.5	46.4	143.5
LSD (P=0.05)	222	240	167	9865	0.40	NS	16.0	NS	NS
Rhizobium									
N	2385	2452	2418	122919	5.53	1.06	158.2	46.1	136.7
N+R	2649	2625	2637	135594	5.98	1.08	166.1	47.2	137.5
LSD (P=0.05)	140	152	106	6239	0.25	NS	NS	NS	NS
Control vs. others									
Control	727	1163	945	37403	1.94	0.82	136.2	40.7	138.0
Others	2517	2538	2528	129257	5.75	1.07	162.1	46.7	137.1
LSD (P=0.05)	233	252	176	10347	0.41	0.16	16.8	4.6	NS

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