Indian Journal of Agronomy **44** (1) : 137–140 (March 1999)

Influence of irrigation and phosphorus on growth, green pod yield and nutrient uptake of pea (*Pisum sativum*) in Lahaul Valley of Himachal Pradesh

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Received: October 1997

ABSTRACT

A field experiment was conducted to study the effect of irrigation and phosphorus levels on pea (*Pisum sativum* L. s.l.) at Kukumseri in Lahaul Valley of Himachal Pradesh, during summer of 1993 and 1994. The individual as well as cumulative response of irrigation and P was found significant. Phosphorus @ 80, 40 and 0 kg P_2O_5/ha in different irrigation and P level combinations gave maximum green-pod yields at 4, 8 and 12 days interval of irrigation respectively.

Key words : Pea, Irrigation, Phosphorus, Yield

Although a lot of work has been done to find out the effect of moisture and P on pea under varied agroclimatic conditions of Himachal Pradesh. But such information is very scanty for Lahaul Valley and no work has been reported on the response of pea to irrigation and phosphorus together. Keeping above objective in view an attempt was made to find out the individual and cumulative effect of irrigation and phosphorus on green pod yield and nutrient uptake of pea.

MATERIALS AND METHODS

The field experiment was laid out during summer of 1993 and 1994 on a sandy-loam soil, in factorial randomized block design with 3 replications at Kukumseri 30°41'77" and 32°59'57" N and 76°46'34" and 78°41'34" E at 2,462 m above mean sea-level. The soil was neutral, with the organic carbon 0.85%. The available nitrogen, phosphorus and potassium was 265, 35 and 315 kg/ha respectively. The field capacity and permanent wilting point were 28.8 and 7.0% (w/w) respectively. The bulk density at 0–15 cm, 15–30 cm and 30–45 cm was 1.39, 1.42 and 1.45 g/cm^3 respectively. The treatment combination consisted of 3 regimes of irrigation, viz. 4-day interval (M_1), 8-day interval (M_2), and 12-day interval (M_3); and 4 levels of P, viz. 0, 40, 80 and 120 kg P_2O_5/ha, along with recommended dose of N (25 kg/ha). 'Arkel' pea was planted in 3 m x 2 m plot with 40 cm x 10 cm spacing on 27 May 1993 and 6 June

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1994. The depth of irrigation water was 5 cm. The water was applied through PVC pipes having diameter of 2.5 cm. The crop was harvested on 26 August 1993 and 8 September 1994. Yield attributes, i.e. plant height, pods/plant, pod length, seeds/pod, green pod and vine yield were recorded. The N, P and K concentrations were determined and nutrient uptake by vine was calculated by multiplying total dry weight with concentration of the nutrient. The total amount of water applied in M_1, M_2 and M_3 treatments was 350, 200 and 150 mm respectively in both the years.

RESULTS AND DISCUSSION

Yield attributes

All the yield attributes except pod length and seeds/pod differed significantly amongst irrigation and P levels. But the trend was not consistent (Table 1). However, yield attributes increased with the increase in irrigation and P levels. In general, yield attributes were more in 1993 than in 1994 owing to early sowing and decorous germination.

Green pod yield

Green pod yield differed significantly among irrigation and P levels. Amongst irrigation levels, M_1 irrigation gave the maximum and significantly higher green pod yield than M_3, whereas green pod yield in M_1, M_2 and M_3 did not differ among themselves. Under different P levels, green pod yield increased with an increase in P levels up to 80 kg/ha. Phosphorus @ 120 kg/ha gave numerically at par green pod yield with 40 and 0 kg P_2O_5/ha (Table 1).

Interaction effect of irrigation and P was found significant on green pod yield (Table 2). Table 2 showed that the response to P increased with an increase in irrigation level. At frequent irrigation (M_1) response to P was up to 80 kg/ha, whereas at M_3 0 kg P_2O_5/ha, gave the better yield than 40, 80 and 120 kg

Table 1. Effect of irrigation and nitrogen on growth, green pod and vine yield of pea

Treatment	Plant height (cm)		Pods/plant		Pod length (cm)		Seeds/pod		Green pod/plant		Vine yield (unit)	
	A	B	A	B	A	B	A	B	A	B	A	B
Irrigation												
M_1	50.1	47.3	12.1	11.5	6.9	6.8	6.0	6.0	65.3	48.0	26.0	19.6
M_2	51.2	50.8	11.4	10.4	7.2	6.8	6.4	5.7	64.5	45.6	25.3	18.0
M_3	47.8	46.8	10.1	9.8	6.7	6.5	5.6	5.8	62.9	42.8	24.0	19.9
CD (P = 0.05)	2.94	1.92	0.84	0.76	0.24	NS	0.28	NS	2.16	2.90	1.16	NS
Phosphorus												
P_0	47.2	44.2	11.2	10.2	6.6	6.5	5.4	5.9	62.7	42.8	24.2	19.9
P_{40}	48.9	48.2	11.6	10.9	7.1	6.8	6.0	5.9	64.4	47.0	26.6	17.7
P_{80}	50.1	50.1	11.1	10.4	7.3	6.9	6.3	6.2	66.7	48.0	27.6	19.0
P_{120}	51.8	50.3	11.8	10.9	7.0	7.1	6.3	6.1	63.2	49.4	23.5	20.0
CD (P= 0.05)	2.82	3.28	0.64	NS	0.36	0.24	0.24	0.28	2.86	3.12	2.46	2.18

Details of treatments are given under Materials and Methods
A, 1993, B, 1994

P_2O_5/ha, though the P status in the field was high (35 kg P_2O_5/ha). Phosphorus @ 40 kg/ha was found the best at M_2 (8-day interval). In first year, green pod yield was more in all the treatments than that of second year owing to undecorus germination in 1994 by repeated rainfall just after sowing.

Vine yield

The study was conducted under dry cold temperate conditions of Lahaul Valley, where the fodder is extremely scare for animals during winter months when there is snow everywhere. The farmers try to preserve even single piece of vegetative vis-a-vis reproductive parts of any crops for feeding animals. Vine yield differed significantly among different irrigtion treatments only in first year. Vine yield was highest in M_1, followed by M_2 and M_3 in first year, whereas it was maximum in M_3, followed by M_1 and M_2 respectively in second year. Amongst P levels, vine yield differed significantly among different phosphorus levels, but it did not follow any consistant trend. In first year it was maximum at 80 kg P_2O_5/ha, and in second year it was maximum at 120 kg P_2O_5/ha. Baswana and Legha (1995) reported that the highest pod yield vis-a-vis gross weight of green pod and vine were observed at maximum number of irrigation levels (4 in numbers) in the soil of Bawal in Haryana.

Nutrient uptake by vine

Nitrogen uptake: Nitrogen uptake by vine differed significantly among different irrigation and N levels (Table 3). M_1 treatment showed maximum and significantly more N uptake than M_3 which was numerically at par with M_2. Under different P, it was maximum at 80 kg/ha and minimum at 0 kg/ha; 40 and 80 kg/ha being found statistically at par with each other. However, in general, N uptake among different irrigation and P levels was more in 1993 than in 1994, owing to more vine yield in 1993.

Phosphorus uptake: Phosphorus uptake by vine differed significantly under different P levels. Under different irrigation treatments, it was maximum in M_2 and minimum in M_3. However, P uptake under different irrigation treatments was statistically at par. Amongst P levels, it was maximum at 80 kg/ha and minimum at 0 kg/ha. Phosphorus uptake amongst 40, 80 and 120 kg P_2O_5/ha was at par in both the years.

Table 2. Effect of irrigation and nitrogen on nutrient uptake by pea vine

Treatment	N uptake (kg/ha)		P uptake (kg/ha)		K uptake (kg/ha)	
	A	B	A	B	A	B
Irrigation						
M_1	53.1	40.5	11.8	9.6	41.5	32.4
M_2	52.1	39.2	12.1	10.0	41.4	31.7
M_3	49.4	38.4	11.7	9.3	40.3	31.0
CD (P = 0.05)	2.64	1.76	NS	NS	NS	1.12
Phosphorus						
P_0	48.1	32.0	9.5	7.6	37.0	28.8
P_{40}	54.4	40.7	12.0	9.9	43.5	32.7
P_{80}	55.0	41.6	13.3	10.8	43.5	33.1
P_{120}	49.2	38.7	12.0	9.4	40.2	31.2
CD (P= 0.05)	3.28	1.86	1.56	1.42	2.24	1.76

Details of treatments are given under Materials and Methods
A, 1993; B, 1994

Table 3. Interaction effect of irrigation and nitrogen on green pod yield of pea

Treatment	Phosphorus (kg/ha)			
	0	40	80	120
		1993		
M_1	61.0	63.8	72.4	64.0
M_2	62.8	66.6	64.3	63.7
M_3	64.8	62.8	62.8	61.8
CD (P = 0.05)				
Irrigation x phosphorus			3.96	
		1994		
M_1	40.6	48.1	56.1	47.2
M_2	41.3	50.1	46.8	45.1
M_3	46.5	52.8	41.2	40.8
CD (P = 0.05)				
Irrigation x phosphorus			4.45	

Details of treatments are given under Materials and Methods

Potassium uptake: The potassium uptake did not differ significantly among different irrigation levels in 1993, whereas it differed significantly in 1994. However, K uptake was maximum under M_1, followed by M_2 and M_3. Amongst different P levels, 0 kg/ha showed signifcantly lower K uptake than 40, 80 and 120 kg/ha. The K uptake obtained at 120 kg/ha was numerically less and statistically at par with 40 and 80 kg P_2O_5/ha. In general nutrient uptake was higher 1993 than that in 1994, owing to more vine yield in 1993 than in 1994. Kanwar and Grewal (1990) also reported that increase in moisture levels favours phosphorus transformation into different phosphorus fractions particularly that of Al-P and Fe-P and at sometime improves the available P status of soil. Since nodulation in the valley was almost negligible and 25 kg N/ha recommended (HPKV, 1993) was applied to the crop, might have proved as limiting factors for the supply of photosynthates. Owing to this, 120 kg P_2O_5/ha was found to be poor at all the irrigation levels than 80 kg P_2O_5/ha.

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