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Response of vegetable pea (*Pisum sativum*) to sowing date and phosphorus under on-farm conditions

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ABSTRACT

A field experiment was conducted during the winter season of 1999–2000 and 2000-2001 at Kokriguda model watershed, block Semiliguda, district Koraput (Orissa), to find out optimum sowing time and phosphorus dose for vegetable pea (*Pisum sativum* L.). The earliest sowing date (18 October) resulted in significantly better growth, yield attributes, green pod yield and net returns than 2 November and 17 November. Between the later 2 sowing dates, 2 November was significantly superior. Increasing phosphorus levels from 0 to 75 kg P_2O_5/ha significantly improved growth, yield and net returns. Moreover, combination of 18 October sowing and 75 kg P_2O_5/ha resulted in highest green pod yield of 43.33 q/ha being significantly higher than all other combinations. Phorphorus-use efficiency was highest with 18 October sowing and with 25 kg P_2O_5/ha. Maximum water-use-efficiency was recorded with 2 November-sown and 75 kg P_2O_5/ha applied crop.

Key words: Vegetable pea, Sowing dates, Phosphorus, Eastern Ghats of Orissa, Optimum dose, Economics

Vegetable pea is highly profitable winter crop cuiltivated in irrigated uplands in tribal dominant Eatern Ghats of Orissa. It is generally sown in October in sequence with rainy-season vegetables or groundnut. Pea being a leguminous crop fixes 46–49 kg atmospheric N/ha/crop and could improve the fertility of nutrient deficit red soils of this region. Hence it forms an important alternative to high water requiring, nutrient exhaustive and less profitable crops for cultivation in winter *(rabi)* seasons. But agronomic optimals, viz. appropriate sowing time (Singh *et al.,* 1996; Sharma *et al.,* 1997) and adequate phosphorus fertilization appears to be the most considerable parameters for realzing the yield potentials and hence the net profit. The present investigation was undertaken at the farmer's field in tribal watershed to determine optimum sowing time and phosphorus dose for vegetable pea.

MATERIALS AND METHODS

The field experiment was conducted during winter seasons of 1999–2000 and 2000–2001 at Kokriguda Watershed in Semiliguda block of Koraput district (Orissa), being develoed into a model by the Research Centre, CSWCRTI, Sunabeda, for Eastern Ghats region. The treatments comprised 3 sowing dates (18 October, 2 and 17 November) and 4 phosphorus levels (0, 25, 50 and 75 kg P_2O_5/ha). The experiment was laid out in split-plot design, keeping sowing dates in main plots and phosphorus levels in sub-plots, replicated thrice. The soil was red lateritic with sandy-loam texture, acidic in reaction (pH 6.2), low in organic carbon (0.32%), available nitrogen (234 kg/ha), available phosphorus (8.0 kg P/ha) and medium in available K (196.9 kg K/ha). Nitrogen through urea and K through muriate of potash were applied as per recommended dose as basal application. Phosphorus was applied through single superphosphate as per treatments.

RESULTS AND DISCUSSION

Effect of sowing dates

The crop sown on 18 October recorded significantly higher green pod yield, straw yield, net returns and benefit : cost ratio than that sown on 2 and 17 November (Table 1). Between the latter 2 sowing dates, sowing on 2 November was significantly superior. Significant increase in yield attributes, viz. pods/plant, seeds/pod, and shelling per cent, facilitated by significantly more plant height, and dry root weight/plant and availability of longer duration for completing growth phases and entering into physiological stages (pod setting) in the earliest sowing date (18 October) as observed in this study (Table 1), might have contributed to its superiority in terms of green pod, straw yields and net income over 2 and 17 November sowing dates. Such significant differences in growth, yield attributes and yield could be ascribed to variation in climatic characters, especially relative humidity and maximum and

Table 1. Effect of sowing dates and phosphorus on growth and yield attributes, yield phosphorus-use efficiency, water-use efficiency and economics of vegetable pea (mean data of 2 years)

Treatment	Plant height (cm)	Dry root weight (g/plant)	Initiation of pod formation (DAS)	Pods/ plant	Seeds pod	Shelling (%)	Green pod yield (q/ha)	Straw yield (q/ha)	PUE (kg green pods/ha/ kg P_2O_5)	WUE (green pods kg /ha/mm)	Cost of cultivation (Rs)	Net returns (Rs)	Benefit: cost ratio
Sowing date													
18 October	79.47	0.4	76.2	9.23	3.75	63.2	34.5	15.9	273	7.08	13,501	29,529	3.16
2 November	76.63	0.39	69.1	8.85	3.62	61.4	32.6	14.4	258	7.45	13,458	27,047	2.98
17 November	72.83	0.38	61.7	8.33	3.43	60.1	28	13.6	223	6.72	13,408	21,517	2.58
CD (P=0.05)	0.9	0.01	1.8	0.2	0.1	1.1.	0.9	0.5	2.7	0.2		1,005.4	0.1
Phosphorus (kg P_2O_5/ha)													
0	51.36	0.26	72.1	6.01	2.21	55.3	18.5	9.2	-	4.13	12,671	10,488	1.83
25	73.32	0.38	69.7	8.39	3.56	61.1	30.8	14.6	369	6.88	13,195	25,203	2.91
50	86.95	0.45	67.8	9.98	4.14	64	37.6	16.7	226	8.41	13,710	33,083	3.41
75	93.61	0.47	66.4	10.84	4.49	65.8	39.8	18.2	159	8.9	14,246	35,350	3.48
CD (P=0.05)	0.9	0.01	0.4	0.2	0.1	0.5	0.4	0.2	2.4	0.1		504.2	0.04

DAS, Days after sowing; PUE, Phosphorus-use efficiency, WUE, water-use efficiency

minimum ambient temperature, and longer crop duration in earlier sowing dates than the later. These results are in close conformity with those of Mehta *et al.* (1997) and Sinha *et al.* (2000).

Highest phosphorus-use efficiency of 273 kg green pods/ha/kg applied P_2O_5/ha was observed with 18 October, which declined significantly with each successive delay in sowing date. However, 2 November sowing recorded the maximum water-use efficiency (7.45 kg green pods/ha/mm), which was significantly higher than that of other 2 sowing dates (Table 1).

Effect of phosphorus

Each increase in dose of phosphorus from 0 to 75 kg P_2O_5/ha consistently and significantly increased growth characters like plant height and dry root weight and yield attributes, viz. pods/plant, seeds/pod and shelling per cent (Table 1).

The improvement in growth and yield attributes of pea owing to phosphorus application could be attributed to its important role in rapid cell-division and elongation in the meristematic regions, root development and proliferation, and enhancing flowering, pod setting and seed formation.

Initiation of pod setting was also significantly hastened by phosphorus application; the number of days to enter into this physiological stage was significantly reduced with increase in phosphorus application up to highest level. As a result of significantly favaourable impact of phosphorus application on growth, development and yield attributes, green pod and straw yields increased consistently and significantly with increasing levels of phosphorus from 0 to 75 kg P_2O_5/ha (Table 1). These results strongly corroborated the findings of Dubey *et al.* (1999) who reported significant improvement in green pod yield of pea up to 80 kg P_2O_5/ha. Significant increase in green pod yield and straw yield owing to phosphorus, in turn, led to significantly higher net returns and benefit : cost ratio. Water-use efficiency also increased significantly with increasing levels of phosphorus from 0 to 75 kg P_2O_5/ha, a significant reverse trend was, however, observed for phosphorus-use efficiency (Table 1).

Further, to estimate the optimum dose of phosphorus for each sowing date, the following regression equations were worked out.

18 October $Y = 1{,}718+62.1\ X - 0.423\ X^2$, $r = 0.955$

2 November $Y = 1{,}539.6 + 62.3\ X - 0.441X^2$, $r = 0.947$

17 November $Y = 1{,}304 + 54.1X - 0.382X^2$, $r = 0.948$

where Y, the yield of green pods (kg/ha); and X, the input dose of phosphorus (kg/ha)

Optimum dose of phosphorus for 18 October, 2 and

Table 2. Interaction effect of sowing dates and phosphorus on yield of vegetable pea (mean data of 2 years)

Sowing date or P level (kg/ha)	Green pod yield (q/ha)		
	18 October	2 November	17 November
P_0	20.45	19.2	15.95
P_{25}	33.47	31.52	27.37
P_{50}	40.88	38.6	33.33
P_{75}	43.33	40.9	35.22
CD (P=0.05)	0.74		

17 November sowing dates were worked out to be 71.4, 68.7 and 68.6 kg P_2O_5/ha, respectively, with corresponding green pod yield of 39.96, 37.38 and 32.18 q/ha respectively.

Interaction effect

Sowing dates and phosphorus interaction effect on green pod yield of pea was significant. Application of 75 kg P_2O_5/ha to 18 October sown crop gave highest green pod yield (43.33 q/ha), which was significantly higher than all other combinations (Table 2). In fact, 18 October sown crop responded to phosphorus application to a greater extent than delayed sowings (2 and 17 November). Green pod yield obtained from 18 October sown and 50 kg P_2O_5/ha applied crop was equal to November 2 sown and 75 kg P_2O_5/ha applied crop, and significantly higher than 17 November sown and 75 kg P_2O_5/ha applied crop. Similarly, application of 25 kg P_2O_5/ha to 18 October sown crop yielded as much green pods as 50 kg P_2O_5/ha to 17 November sown crop.

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