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EFFECT OF SOWING DATES AND NITROGEN LEVELS ON YIELD AND ECONOMICS OF VEGETABLE PEA-WHEAT-MAIZE CROPPING SYSTEM IN CENTRAL PART OF UTTAR PRADESH

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ABSTRACT

A field experiment was conducted during 2006-08 at Kanpur to study the effect of dates of sowing and nitrogen levels on the vegetable pea. The doses of nitrogen were applied in vegetable pea whose residual effect was studied on second (wheat) and third (maize) crop applying uniform level of fertilizer dose in wheat and maize. The yield attributing characters of vegetable pea i.e. pod/plant; pod length (cm), seed weight (g/pod), seed/pod and shelling (%) were significantly higher when vegetable pea was sown on 20 October compared with 30 September and 10 October sown crop. The yield attributing characters of vegetable pea and wheat crop were significantly higher with 80 kg N ha^{-1} compared to 60, 40, 20 and control treatment. The B: C ratio showed opposite trend, the highest ratio of 1:1.72 was recorded in 30 September sown crop than observed on later dates of sowing. The higher pod yield (54.3 q ha^{-1}) of vegetable pea was recorded in 20 October sown crop which was 4.3 and 8% higher than the pod yield obtained in 10 October and 30 September sown crop, respectively. Significantly higher yield of 54.8 q ha^{-1} was recorded at 80 kg N ha^{-1} and lowest in control. The yield of wheat crop was maximum i.e. 36.6 q ha^{-1} at first date of sowing which was 3.0 and 6% higher than second and third date of sowing. The residual effect of N from 80 kg N ha^{-1} plot being at par with 60 kg N ha^{-1} produced significantly higher yield of wheat than control. Non-significant relationship was observed for all nitrogen treatments in maize crop.

Keywords: Vegetable pea, wheat, maize and crop rotation.

INTRODUCTION

Potato-wheat-maize cropping sequence is dominant in Uttar Pradesh. Recently farmers initiated to grow early vegetable pea (*Pisum sativum* L.) for green pods in place of potato (*Solanum tuberosum* L.) in the same sequence and this cropping sequence proved more remunerative and also sustains soil health by including the crop which has the capacity to build root nodules and fix nitrogen from the environment (Snapp and Silim, 2002). Fertilizer and water requirement of pea is lesser and its harvesting is also earlier than potato. After picking of green pods, plant parts of pea may be used as fodder for livestock or may be used as green manure. The information for time of sowing and suitable dose of nitrogen for vegetable pea crop and its effect on succeeding wheat crop is meager. Thus, the study was conducted to study the effect of date of sowing and levels of nitrogen on yield, yield attributes and economies of vegetable pea in vegetable pea-wheat-maize cropping system in central part of Uttar Pradesh.

MATERIALS AND METHODS

A field experiment was conducted during 2006-2008 at instructional farm of the Chandra Shekhar Azad University of Agriculture and Technology, Kanpur on sandy loam soils. The soil was slightly alkaline (pH7.8), low in organic carbon (4.5 kg^{-1}) and available N (225 kg ha^{-1}) and medium in available P_2O_5 (15.1 kg ha^{-1}) and K_2O (186 kg ha^{-1}). The experiment was laid out in split-plot design keeping date of sowing (10 Sept., 10 and 20 Oct.) as main plot with a net plot size of 14.4m^2 and nitrogen levels (0, 10, 20, 40, 60 and 80 kg ha^{-1}) as sub plot. "Arkel" vegetable pea was used as a test crop. The residual effect of nitrogen applied in pea was observed in succeeding 'K-7903, Halna' wheat, which was sown in the third week of December to first week of January and harvested in to last week of April. After harvest of wheat, 'Azad Uttam' maize was grown during kharif season. Wheat and maize were raised on residual fertility status of pea applying uniform recommended dose of 120 kg N, 60 kg P_2O_5 and 60 kg K_2O ha^{-1} in wheat and 100 kg N, 60 kg P_2O_5 and 40 kg K_2O ha^{-1} in maize. This crop rotation of vegetable pea-wheat-maize was grown continuously for two years on the same site with same recommended fertilizer levels. The phosphorus and potassium were applied through single superphosphate and muriate of potash, respectively. The nitrogen was applied through urea as per treatments. In pea, 2 irrigations at 30 and 50 days after sowing, in wheat 5 irrigations at an interval of 20-25 days while in maize 3 irrigations before sowing, 25 and 55 days after sowing were given in

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both the years. Hand weeding before first irrigation was done in pea while Isoproturon and 2, 4-D was sprayed in wheat crop for weed control and in maize crop one manual weeding and hoeing during July was done in both the years of experimentation. Other management practices were adopted as per recommendations and need of the crop. Yield attributes were based on the net randomly selected 4 plants. Net returns and benefit: cost of cultivation was worked out on the basis of prevailing market rates.

RESULTS AND DISCUSSION

Effect of date of sowing on vegetable pea

The yield attributing characters of vegetable pea i.e. pods/plant, pod length (cm.), pod weight(g), seed weight (g/pod), seed/pod and shelling (%) were significantly affected with sowing dates. The pods/plant increased significantly with each delay in sowing and maximum pods (15.7) was observed when pea was sown on 20 October which was 6.2 and 23.5% higher than 10 October and 30 September sowing dates. On pooled basis, 20 October sown pea gave 9.3 cm pod length while 10 October and 30 September sowing dates gave 8.8 and 8.1 cm pod length, respectively which were 5.8 and 15.2% more than 10th October and 30 September. The seed weight (g/pod) of vegetable pea was significantly higher in 20 October sown crop (7.6 g) which was 19.4 and 39.7% more than 10 October and 30 September sown crop. On pooled basis (Table 1), 20 October took significantly maximum shelling (44.6%) and 30 September took minimum (42.5%). In pooled results, 20 October sowing gave highest pod yield of 54.3 q ha^{-1} which was 4.3 and 8.0% higher than the pod yields obtained in 10 October and 30 September sowings; respectively. These results of early sowing of vegetable pea were confirmed by the finding of Sharma (2002) and Dass et al. (2005). The net profit (Rs/ha) and benefit: cost ratio for vegetable pea was also worked out (Table 3) which shows that early sowing of vegetable pea on 30 September fetches higher price in the market with the Rs.29,634 (Net profit) and B:C ratio 1.72 as compared to Rs.18,807 (Net profit) 1.13 (B:C ratio) and Rs.18,906(Net profit) and 0.79 (B:C ratio) in case of 10 and 20 October sowing treatments.

Table 1: Yield attributing characters and green pod yield of vegetable pea as affected by different treatments (mean of two years)

Treatments	Pods/plant	Pod length (cm)	Pod Weight (g/pod)	Seed Weight (g/pod)	Seed/ pod	Green pod yield (q/ha)	Shelling (%)
Date of Sowing							
30th September	12.7	8.1	12.1	5.5	4.3	50.3	42.5
10th October	14.8	8.8	13.1	6.4	4.7	52.1	43.4
20th October	15.7	9.3	14.1	7.6	5.0	54.3	44.6
CD (P=0.05)	0.4	0.3	0.4	0.4	0.2	0.7	0.7
N levels (kg ha^{-1})							
0	11.4	7.5	8.8	3.8	3.5	47.6	39.1
20	13.6	8.4	11.9	6.1	4.3	51.3	42.8
40	14.6	9.0	13.9	6.9	4.8	53.2	43.9
60	15.8	9.3	15.2	7.1	5.2	54.3	45.6
80	16.6	9.5	15.8	8.5	5.6	54.8	46.2
CD (P=0.05)	0.7	0.5	0.9	0.8	0.4	1.4	1.5

Effect of nitrogen

The pooled data on pods/plant clearly indicated (Table1) that increasing N levels increased pod/plant and 80 kg N ha^{-1} gave maximum pods/plant (16.6) which was found to be 5.1, 13.6,21.5 and 45.4% more than 60, 40, 20 and 0 kg N ha^{-1},respectively. The pod length (cm) was maximum (9.5 cm) at 80 kg N ha^{-1} treatment and minimum under control. The significantly higher seed weight of 8.5 g was produced with 80 kg N ha^{-1} treatment which was 19.3, 22.0, 38.8 and 24.4% more than seed weight in 60, 40, 20 and control, respectively. The shelling percent was maximum (46.2%) at 80 Kg N ha^{-1} which was higher by 0.57, 2.25, 2.35 and 7.05% over shelling percent at 60,40,20 and 0 kg^{-1}, respectively. These results supported by the findings of Sharma and Choker (1989), Samra et al (1989). The increasing levels of N increased pod yield up to highest level of N (80 kg ha^{-1}). The yield at this level of N remained at par with 60 kg N ha^{-1} level but significantly higher than other lower levels of N. In case of pooled data, 80 kg N ha^{-1} gave highest pod yield of 54.8 q ha^{-1} which was 0.8,2.9,6.8 and 15% higher than the pod yields obtained in 60, 40, 20 and 0 levels of N, respectively. The results confirm the study of Honda et al. (1994) and Sharma (2002). The pod yield was not influenced significantly by interaction effect. The Net profit and B:C ratio in vegetable pea were highest Rs.24,726 (1.28) and Rs.24,640(1.29) for 80 and 60 kg N ha^{-1}, respectively.

Residual effect on succeeding crops

The spiklet was slightly more in earlier sowing than later sowing. The grain/spike was not affected significantly with date of sowing. The grain wt./spike on pooled basis was maximum (2.38 g) in 30 September sowing and minimum in crop sown on 10 October. However, the difference in grain weight / spike was statistically non-significant. On pooled basis, test weight was maximum (35.7 g) in 30 September sowing treatment and this test weight was found to be 1.9 and 4.6% more over 10 and 20 October treatments. These results were supported by the finding of Sharma and Choker (1989), Samre et al. (1989). In pooled results, 30 September sown pea gave maximum grain yield of 36.6 q ha $^{-1}$ of wheat which was 3.0 and 5.2% higher than the grain yield recorded after pea sowing of 10 and 20 October, respectively. The net profit and B:C ratio were not affected by date of sowing. However, maximum net profit was obtained in the crop sown after pea (September 30).

Table 2: Yield attributing characters and grain yield of wheat as affected by different treatments (mean of two years)

Treatments	Spiklet	Grain/ spike	Grain wt./ Spike (g)	1000 Grain wt.(g)	Grain Yield of wheat (q/ha)	Maize Yield (q/ha)
Date of Sowing						
30th September	15.9	37.4	2.38	35.7	36.6	32.3
10th October	15.9	37.1	2.37	35.1	35.6	32.3
20th October	15.3	37.6	2.38	34.2	34.8	32.0
CD at 5%	NS	NS	NS	NS	NS	NS
N levels (kg/ha)						
0	11.9	33.4	1.79	33.4	34.1	32.1
20	12.2	35.7	2.02	34.5	35.2	32.2
40	14.3	36.7	2.23	35.1	35.8	23.3
60	15.4	39.4	2.38	35.8	36.5	32.1
80	16.3	41.6	2.43	36.1	36.8	32.3
CD at 5%	1.6	2.8	0.22	1.4	1.5	NS

The yield attributing characters i.e. spiklet, grain / spike, grain weight / spike and 1000 grain wt. (Table 2) of wheat crop increased with increasing levels of residual nitrogen. All attributes were significantly higher at 80 kg N ha^{-1} and lowest in control treatment. These results were supported by Sharma and Choker (1989). The Net profit and B:C ratio of wheat crop with residual effect of 80 kg N ha^{-1} was Rs.11,305 (0.54). The grain yield of succeeding wheat crop increased numerically due to increase in residual N but margins of increase could not touch the level of significance in individual year while in pooled analysis differences became significant. The residual effect of 80 kg N ha^{-1} being at par with 60 kg N ha^{-1}, gave significantly higher grain yield of wheat than control treatment. This much high yield of wheat after pea crop may be due to biological N fixation carried out by the microbes in vegetable pea which results in higher residual N of the soil.

Table 3: Effect of treatments on cost of cultivation, net profit and B: C ratio in vegetable pea-wheat-maize crop rotation (mean of two years)

Treatments	Vegetable pea			Wheat			Maize			Vegetable pea-wheat-maize cropping system		
	Cost of Cultivation (Rs.)	Net Profit (Rs.)	B : C ratio	Cost of Cultivation (Rs.)	Net Profit (Rs.)	B : C ratio	Cost of Cultivation (Rs.)	Net Profit (Rs.)	B : C ratio	Cost of Cultivation (Rs.)	Net Profit (Rs.)	B : C ratio
Date of Sowing												
30 September	21911	29634	1.72	21000	11181	0.53	13300	6394	0.48	56211	47209	0.84
10th October	18807	21461	1.13	21000	10230	0.49	13300	9388	0.48	53107	38079	0.72
20th October	18906	14942	0.79	21000	9512	0.45	13300	6235	0.47	53206	30689	0.58
N levels (kg ha^{-1})												
0	18400	19449	1.06	21000	8676	0.41	13300	6303	0.47	52700	34428	0.65
20	18692	22362	1.20	21000	9965	0.47	13300	6471	0.49	52992	38798	0.73
40	18918	23739	1.26	21000	10475	0.50	13300	6379	0.48	53218	40593	0.76
60	18982	24640	1.29	21000	11120	0.53	13300	6254	0.47	53282	42014	0.78
80	19375	24726	1.28	21000	11305	0.54	13300	6418	0.48	53676	42449	0.79

Cost of green pods-30 Sept-Rs 1000, 10 Oct.-750 and 20Oct. 600/q.
Wheat-Rs. 650/q, Straw Rs.150/q
Maize Rs. 550/q and stover Rs.40/q

These results supported the findings of Samra et al. (1989) and Nayak et al. (1983). The residual effect of treatments on grain yield of maize crop grown after wheat was non-significant. Results remained similar during both the years of experimentation and also in pooled analysis. The residue of vegetable pea after pea harvest was used as a green manure in the same plots, respectively.

Economics

Net profit was maximum under 30 September pea sown, while it was minimum in 20 October sown crop. In pooled data, early pea sowing earned maximum net profit of Rs.47,209 which was 31.6 and 63.3% more than the net profit with second and last pea sowing, respectively. Net profit increased with increasing N levels significantly up to 60 kg N levels where Rs.42,014 could be earned and this value was found 3.5, 8.6 and 22.0% more than the net profit at 40, 20 and 0 kg N ha^{-1}, respectively. The B:C ratio was higher in earlier sowing(0.84) crop it was 0.22 and 0.60 more than under 10 and 20 October date of sowing. Increasing N levels improved significantly B:C ratio up to 80 kg N ha^{-1} but increase beyond 20 kg N ha^{-1} was not significant.

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