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Impact of different doses of phosphorus application on various attributes and Seed yield of Pea (*Pisum sativum* L.)

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Abstract

This investigation was undertaken with prime objective to find out the effect of various doses of phosphorus application on seed yield of three varieties i.e. Rachna, Aparna and Pant Pea-5 of Pea during rabi season 2015-16. Phosphorus fertilizer doses 0, 30, 60, and 90 kg/ha was used. The field experiments were carried out, wherein the influence of the different fertilizer doses was also determined on the plant morphological and growth characters and their ultimate impact on the seed yield. It was found that seed yield is dependent significantly and positively on number of seeds per pod and harvest index in all the three varieties i.e. Rachna, Aparna and Pant Pea-5. Seed yield was also dependent positively and weakly on biological yield (4100 kg/ha). As phosphorus doses have been found to be effective in increasing seed yield (2250 kg/ha) and hence, these fertilizer doses which are cheaper and easily available could be used to achieve better seed yield in Pea.

Keywords: Pea, phosphorus (P_2O_5), seed yield, quality

1. Introduction

India is the largest pulses producing nation in the world. Pulses are mainly grown in rainfed area. Pea is one of the most important pulse crops of India grown in 23.0 million hectare area annually and produces 15.2 million tonnes grain. It is generally cultivated on marginal and light texture soils having limited moisture and poor fertility. Amongst the various agronomic factors known to augment crop production, the application of optimum quantity of phosphorous has an important role in getting high seed yield of field pea [1] and [8]. In Jhansi conditions almost no research work has been done to find out the proper doses of phosphorus application for getting high yield in pea. Keeping in view the above facts the present study was under taken to find out the effect of application of phosphorus on seed yield, biological yield and other characters in different varieties of field pea viz., 'Rachna, Aparna and plant pea-5' in the agro-climatic conditions of Jhansi region of (U.P.)

2. Materials and Methods

The field experiment was conducted at the Agricultural research farm of Bundelkhand University, Jhansi (U.P.) during Rabi season, 2015-16. The fertilizer treatments were comprised of four levels of phosphorus viz-0, 30, 60 and 90 kg/ha and three varieties of pea, viz., Rachna, Aparna and Pant pea-5 and the experimental design used was randomized block with three replications.

Urea was the source of nitrogen and the source of sulphur was gypsum while triple super-phosphate was used as source of phosphorus. Observations were recorded on seed yield and biological yield (kg/ha), number of pods per plant, Number of seeds per pod, 100 seed weight, harvest index, plant height, branching, dry weight and plant population. The data was subjected to statistical analysis as per method proposed by [2].

3. Result and Discussion

The results obtained in the present study are discussed character- wise.

3.1 Seed yield

It was observed that there was significant increase in seed yield with increase in the dose of phosphorus. All the three i.e. Rachna, Aparna and Pant Pea-5 varieties different significantly from each other. The highest seed yield (table-1) was recorded in Pant Pea-5 (2205 kg/ha) followed by Aparna (1940 kg/ha) and the lowest seed yield (2012 kg/ha) was recorded by

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Rachna. These findings are in consonance with the reports of [9]. In case of phosphorus, maximum seed yield (2250 kg/ha.) was recorded with the application of 90 kg P₂O₅ /ha, which was significantly higher than all other three levels of phosphorus. Similar findings were reported by [10], who reported that the treatment dose of 60 kg P₂O₅/ha gave highest seed yield as compare to other treatments.

3.2 Biological Yield

The result presented in table-1 showed that all the three levels of phosphorus viz. 30, 60, and 90 kg/ha gave significantly higher biological yield over 0 kg P₂O₅ /ha. It was further clear from the data that pea variety Pant pea-5 yielded significantly higher biological yield (4100 kg/ha) in comparison to Aparna and Rachna. Similarly Pea variety, Rachna also gave significantly higher biological yield (4020 kg/ha) as compared to Aparna. These results are in full agreement with those obtained by [9]. However, in case of phosphorus, the biological yield increased successively with increase in doses of phosphorus up to 90 kg P₂O₅ /ha (4175 kg/ha) and the differences in the biological yield under all the four doses of phosphorus were significant from each other. The biological yield kg/ha was significantly influenced by varieties and phosphorus doses, variety, Rachna produced significantly high biological yield (4020 kg/ha) at 60 kg phosphorus. The results are in conformity with the findings of [8].

3.3 Straw Yield (kg/ha.)

Straw yield recorded in three varieties of Pea viz- Rachna, Aparna and Pant pea-5 and four doses of phosphorus application are given in table-1. Which revealed that varieties i.e. Rachna gave significantly higher straw yield as compared to varieties Aparna and Pant pea-5. The highest straw yield (2008) was recorded in Pea variety Rachna in comparison to Aparna and Pant pea-5 but the lowest straw yield (1860) was recorded in case of variety, Pant pea-5. In case of application of phosphorus, the dose of 90 kg P₂O₅/ha, was observed to be significantly better over control as well as other two doses (30 and 60 kg/ha) of phosphorus in straw yield in field Pea. But the application of phosphorus at the rate of 30 and 60 kg/ha was also significantly different with each other in producing the straw yield. Similar results were reported by [8], who found that application of phosphorus in Pea crop was beneficial at it increased the straw yield according to doses.

3.4 Number of pods per plant

The results presented in table-1, indicated that all the three varieties of pea differed significantly from each other in number of pods per plant. The two varieties of pea i.e. Aparna and Pant pea-5 gave significantly high number of pods per plant in comparison to variety, Rachna. The highest number of pods per plant was recorded in variety Pant pea-5 [20] followed by Aparna. These findings are in consonance to

results reported earlier by [11], In case of phosphorus application of 90 kg P₂O₅ kg/ha dose of phosphorus produced highest number of pods per plant followed by 30 kg and 60 kg of phosphorus per hectare. The differences in the number of pods per plant among all the doses of phosphorus including control (0 kg P₂O₅ /ha) were significant. The successive increase in the number of pods per plant under varied doses of phosphorus may be due to variation in availability of more nutrients for proper growth of plants at different stages of the crop. These findings are in full agreement to results reported earlier by [3].

3.5 Pod wt./plant

The pod weight per plant is most important traits in field pea for obtaining good grain yield. The data is given in table-1, indicated that pod weight per plant of different varieties was significantly different from each other. The highest pod weight was recorded in variety Pant pea-5 followed by Aparna and Rachna. However significantly lower pod weight per plant was recorded in (48) in variety Rachna in comparison to Aparna and Pant pea-5 both the stages. However varieties Aparna and Pant pea-5 had almost at per pod weight per plant study as (48 & 54) respectively, the differences in the mean value of pod weight per plant with the use of various levels of phosphorus application were significantly higher in comparison to zero kilogram of phosphorus. The highest pod weight per plant was recorded in 90 kg P₂O₅/ha followed by 60 and 30 kg P₂O₅ per hectare. These results confirm the finding of [5] and [11], while growing through results obtained in this study of it was observed that pod weight per plant and proper application of phosphorus his important attributes for getting high seed yield in Pea.

3.6 Number of seeds per pod

Number of seeds per pod recorded in three varieties of pea viz., Rachna, Aparna and Pant pea-5 and four doses of phosphorus application are given in table-1 which revealed that two varieties i.e. Aparna and Pant pea-5 gave significantly higher number of seeds per pod as compared to variety Rachna. The highest number of seed per pod (06) was recorded in pea variety Pant pea-5 in comparison to Aparna and Rachna but the lowest number of seeds (05/pod) was recorded in case of variety, Rachna. In case of application of phosphorus, at dose of 90 kg P₂O₅ /ha, was observed to be significantly better over control as well as other two doses (30 and 60 kg/ha) of phosphorus in number of seed per pod in field pea. But the application of phosphorus at the rate of 30 and 60 kg/ha was also significantly different with each other in producing the number of seed per pod. Similar results were reported by [3] and [6], who found that application of phosphorus in pea crop was beneficial as it increased the number of seed per pod according to doses.

Table 1: Effect of phosphorus on seed yield, biological yield, Straw yield and some quality traits in field Pea.

Phosphorus Level (kg/ha)	Seed yield (kg/ha.)	Biological yield (kg/ha.)	Straw Yield (kg/ha.)	No. of pods/plant	Pod wt./plant	No. of seed/pod
0	1705	3605	1345	12	37	03
30	2050	3970	1920	18	53	04
60	2140	4063	1923	20	59	05
90	2250	4175	1925	22	66	06
SEm±	11.0	12.0	10.5	0.2	0.3	0.1
CD at 5%	33.0	36.1	31.7	0.6	0.9	0.3
Varieties						
Rachna	2012	4020	2008	16	48	05
Aparna	1940	3800	1860	18	54	06
Pant pea -5	2205	4100	1895	20	60	06
SEm±	11.0	12.0	10.5	0.2	0.3	0.1
CD at 5%	33.0	36.1	31.7	0.6	0.9	0.3

3.7 Plant height

It is clear from table-2 that all the three varieties of pea differed significantly in their height at both the stages i.e. at 60 days of sowing and at maturity in all the three doses of phosphorus as compared to control. However, the difference height under 60 kg and 90 kg P₂O₅ was non-significant at both the stages of crop growth. Height of plants was highest at both the stages of crop under phosphorus level of 90 kg/ha. The varietal differences in plant height of varieties were significant at both 60 days and at harvesting stages. The height plants of Rachna variety were highest and significant at both the stages of crop growth. This is due to the fact that Rachna variety of pea is fast and tall growing at us both the stages of crop as compared to Aparna and Pant pea-5. These findings are in consonance with the results report by [8]. The combined effect of varieties and phosphorus levels was significant on plant height. The pea variety Rachna had significantly more plant height at both the stages under 90 kg P₂O₅/ha. While the plant height of Aparna and Pant pea-5 was at par both the stages. These findings are in full agreement with the report published by [6], who observed that plant height and number of branches increased significantly with the increasing levels of phosphorus fertilizer.

3.8 Branching

It is revealed from table-2 that all the three varieties of pea had significant effect on the number of branches per plant. The highest number of branches was recorded (3.21) in Rachna variety which was significantly high in comparison to the branches number in Aparna and Pant pea-5. However, non-significant difference was observed between the heights of plants of Aparna and Pant pea-5. The effect of different doses of phosphorus on number of branches per plant was evident from the fact that the number of branches per plant in different doses varied considerably. All the three doses of phosphorus (30, 60 and 90 kg/ha) had significantly high effect on branches number in comparison to control (0 kg P₂O₅) this could be due faster cell division and menstematic activity due to availability phosphorus which is the constitute of amino acid, protein, chlorophyll, and protoplast which enhance the photosynthetic activity in the plants. These results are in agreement with the findings of [6] and [9], who reported that increasing levels of phosphorus increased the relative growth rate and net asseveration rate at all the stages of crop growth.

3.9 Fresh weight per plant

It is revealed from table-2 that all the three varieties of Pea had significant effect on the fresh weight per plant at both the stages i.e. at 90 days and at maturity stages. The highest fresh weight was recorded (64.2 & 130) in both the stages (60 days and 120 days) in Rachna variety. This was significantly high in comparison to the fresh weight per plant in Aparna and Pant pea-5. However, non-significant difference was observed between the higher of plants of Aparna and Pant pea-5. The effect of different doses of phosphorus on fresh weight per plant was evident from the fact that the fresh weight per plant in different doses varied considerably. All the three doses of phosphorus (30, 60 and 90 kg/ha) had significantly high effect on fresh weight in comparison with the findings of [6] and [11]. Who reported that increasing levels of phosphorus increased the relative growth rate and net asseveration rate at all the stages of crop growth.

3.10 Dry weight per plant

The result concerning dry weight of plant in three varieties of

pea and phosphorus fertilizers levels, presented in table-2 revealed that maximum dry weight (60 days and 120 days) (35.2 gm & 70.2 gm) per plant was recorded in variety Rachna, which was significantly superior in comparison to other two varieties, Aparna and Pant pea-5. The differences in dry plant weight between Aparna and Pant pea-5 was significant due to application of different doses of phosphorus viz., 30, 60 and 90 kg of P₂O₅ which produced higher dry plant weight per plant than 0 kg P₂O₅/ha. The dry plant weight recorded in (60 days and 120 days) three doses of phosphorus (30, 60 and 90 kg P₂O₅) was significantly different from each other and 90 kg P₂O₅ gave highest dry plant weight which was followed by 60 kg and 30 kg P₂O₅ kg/ha. These results are in conformity with the findings of [7], who also reported increase in dry weight of plants with increase in doses of phosphorus.

3.11 Plant population

The proper plant population is most important traits in field Pea for obtaining good grain yield. The data is given in table-2 indicated that plant population of different varieties was significantly different from each other. The highest plant population was recorded in variety Pant pea-5 followed by Aparna and Rachna, however significantly lower plant population was recorded (35.2 & 30.1 M²) in variety Rachna in comparison to Aparna and Pant pea-5 at both the stages. However, varieties Aparna and Pant pea-5 had almost at par plant population study as (35.4 and 38.5 M²) respectively. The differences in the mean value of plant population with the use of various levels of phosphorus application were significantly higher in comparison to zero kilogram of phosphorus. The highest plant population was recorded in 90 kg P₂O₅/ha followed by 60 and 30 kg P₂O₅ per hectare. These results confirm the finding of [1]. While going through the results obtained in this study of it was observed that proper plant population and proper application of phosphorus his important attributes for getting high grain yield in field Pea.

3.12 100 Seed weight (gm.)

Hundred seed weight of pea in three pea varieties i.e. Rachna, Aparna and Pant pea-5 was significantly different among all the varieties (table-2). Variety pant pea-5 had highest seed weight following by Aparna and Rachna. Application of 90 kg P₂O₅/ha was significantly better over control and produced highest 100 seed weight of 37 gram. However, 100 seed weight recorded with the application of 30 and 60 kg P₂O₅/ha remained at par. This significant influence of different levels of phosphorus fertilization over the lower levels may be because of prolonged formation of primary and secondary branches and seeds in the pods under higher rates of phosphorus. These results are in full agreement with those observed by [4] and [5], who observed that the increasing levels of phosphorus not only increased the 100 seed weight but also gave higher yield of straw, more leaf area index, high growth rate and higher net assimilation rate at all the stages of crop growth.

3.13 Harvest index

The data given in table-2 revealed that among that all the three varieties of pea, the variety Pant pea-5 gave significantly higher harvest index (53.7 %) as compared to Aparna and Rachana, however, lowest harvest index was recorded in variety of Rachana. The data also revealed that all the three levels of phosphorus gave significantly higher harvest index as compared to zero levels of phosphorus. The use of 90 kg P₂O₅/ha gave significantly higher harvest index (53.8 %) over

other two doses i.e. 30 and 60 kg P₂O₅ /ha. The difference in the harvest index between 30, 60 and 90 kg P₂O₅ /ha was non-significant. The value of harvest index in zero kilogram of phosphorus was significantly low as compared to the harvest

index value of all the other three levels of phosphorus. Similar result were reported by [5], who observed that harvest index, dry weight and plant population increased significantly with increase in levels of phosphorus fertilizer.

Table 2: Effect of phosphorus on Plant height, Branches per plant, fresh weight per plant and some other traits in field Pea.

Phosphorus level (kg/ha)	Plant height		Branches / plant (90 days stage)	Fresh weight/plant (gm.)		Dry weight/plant (gm.)		Plant population (M ²)		100 seed weight	Harvest index
	60 days	At harvest		90 days	120 days	90 days	120 days	Initial	Final		
	0	8.0		24.0	2.11	35.0	101	15.0	30.0		
30	10.2	27.5	2.62	46.8	119	26.8	54.3	36.8	34.6	34	51.6
60	11.4	30.4	3.03	58.5	124	38.5	77.4	2.5	36.6	36	52.6
90	11.8	30.8	3.09	64.2	130	44.2	88.3	44.2	38.4	37	53.8
SEM±	0.2	0.11	0.07	0.27	0.23	0.20	0.23	0.27	0.23	0.4	1.1
CD at 5%	0.6	0.34	0.15	0.82	0.69	0.6	0.69	0.82	0.69	1.2	3.4
Varieties											
Rachna	11.4	28.4	3.21	55.2	120	35.2	70.2	35.2	30.1	32	50.0
Aparna	10.2	27.4	2.38	49.4	114	29.4	60.0	49.4	35.4	35	51.0
Pant pea -5	10.3	27.5	2.55	52.5	118	32.5	65.1	49.5	38.5	36	53.7
SEM±	0.2	0.11	0.6	0.27	0.23	0.20	0.23	0.27	0.23	0.4	1.1
CD at 5%	0.6	0.34	0.13	0.82	0.69	0.6	0.69	0.82	0.69	1.2	3.4

4. Conclusion

The findings of present study clearly indicate role of proper varieties and fertilization levels for getting higher yield in field Pea. Varieties Pant pea-5 followed by Rachna and Aparna gave better yield in that order use of 90 kg P₂O₅/ha give higher seed yield was the best than all other two levels of phosphorus for achieving better growth, high seed productivity and better quality in agro- ecological conditions of Jhansi reason of U.P.

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