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Research Article

Growth, Yield and Quality Response of Field Pea (*Pisum sativam* L.) in Relation to Use of Phosphorous and Varieties

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ABSTRACT

To study the effect of phosphorus and varieties on growth and yield of field pea, an experiment was conducted at Instructional Farm of Department of Agronomy, Faculty of Agriculture, AKS University, Sherganj, Satna (M.P.) during rabi season of 2020-21. The experiment consisted of randomize block design having factorial arrangement with three replications. In this experiment, 12 treatment combinations including four field pea varieties and treatments were V1- Arkel, V2- PSM-3, V3- Kashi Nandiniand V4- Aman, while three phosphorus levels were tested are P1- 0 kg/ ha, P2- 25 kg/ ha and P3- 50 kg/ ha. During the course of the study, it was found that field pea varieties and phosphorus application significantly affected plant height, number of branches per plant, number of pods per plant, number of grains per pod, length of pod, seed index, grain &stover yield of field pea. Higher plant height (54.19 cm), number of branches per plant (9.93) at maximum crop growth stage of 90 DAS were recorded in the field pea variety of Arkel in combination with application of phosphorus @ 50 kg P2O5 /ha. Similarly, resulted in highest number of pods per plant (23.60), number of grains per pod (7.00), length of pod (13.14 cm), seed index (20.93 g), grain yield/ha (17.39 q/ha) andstover yield/ha (17.97 q/ha)recorded under same treatment of field pea variety of Arkel in combination with application of phosphorus @ 50 kg P2O5 /ha.It was concluded from the results that application of phosphorus @ 50 kg/ha with field pea variety of Arkel improved yield and yield components of field pea.

Keywords: *Phosphorus, Variety, Branches, Pod, Seed index, Stover yield.*

INTRODUCTION

Pea (*Pisum sativum* L.) is an important crop grown throughout the world. It is cultivated on a large scale for green pods and seeds. At global level, it ranks fifth in terms of area and production under legumes.

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India is the second largest producer of pea in the world after Russia (Negi et al., 2004). Green pea occupies an area of 7,42,000 ha with a production of 4,346,000 tons in the world (Fageria et al., 2003). Pea occupies an area of 540 thousand hectares with the production of 5427 thousand tones grain in India (Anonymous, 2017).

The productivity of pea is low because of its cultivation generally in poor soils. Several factors are responsible for low productivity, among them imbalance fertilization and terminal stress are important ones. To enhance the productivity of this crop, use of balanced fertilization are of great importance. Application of phosphorus increased the production of pulse crops (Sharma & Sharma, 2014). The response of phosphorus depends upon many factors like climate, variety and soil type and availability of nutrients during the period of growth. The requirement of phosphorus in legumes like pea is higher than other crops for their root development and metabolic activities. Phosphorus is the important component of photosynthetic system and catalyses' a number of bio chemical reactions from the beginning of seedling growth through to the formation of grain at maturity. It plays an important role in cell division, carbohydrate break down for energy release, transfer of inherited characteristics and hastening the maturity of plants. In areas where legumes are traditionally grown without phosphorus, poor nodulation was observed with low- yield.

The modern varieties of field pea usually produce higher grain yield and yield component of field pea are markedly influenced by fertilizer levels. The farmers usually grow field pea without optimum dose of fertilizers; they hesitate to grow with higher doses. New varieties with optimum dose of fertilizers may increase the yield. The wide variations in yield attributing parameters persisted among the varieties obtained from the different parental origin. Attainments of particularly higher or lower yield attributing character among varieties are the genetically controlled phenomenon. Such variations in yield attributes among the field pea genotypes have also been observed by several research workers, (Bhowaland & Bhowmik, 2014). Although a number of varieties of pea are available for cultivation but there is a lack of information for their suitability for cultivation in different altitudinal ranges. Hence, present investigation was carried out to study the growth, yield and qualitative behavior of field pea to define optimum dose of phosphorus and field pea varieties.

MATERIALS AND METHODS

The experiment was carried out at Instructional Farm, Faculty of Agriculture, AKS University, Satna (M.P.) during rabi season 2020-21. The experiment was conducted in randomize complete block design having factorial concept with three replications. Different rates of phosphorus and varieties allocated to the plots as per treatments. Seed rate used as 80 kg/ha for sowing with 30.0 cm row to row distance and 10.0 cm within plant. The treatments were four field pea varieties i.e. V_1- Arkel, V_2- PSM-3, V_3- Kashi Nandini and V_4- Aman, while three phosphorus levels were tested are P^1- 0 kg/ ha, P_2- 25 kg/ ha and P_3- 50 kg/ ha. The gross and net plot size was 5 m x 3.5 m and 4 m x 3 m, respectively. The fertilizers grades were applied as per treatments. Whole dose of N, P and K was applied as basal dose at the time of sowing. Full recommended dose of nitrogen and potassium at the rate of 30 kg N /ha and 50 Kg K_2O /ha, respectively was uniformly applied to each plot (except control plots) as basal dose before sowing.Phosphorus was applied as per treatment. All the other agronomic practices were applied uniformly to all the treatments. The experiment will be consisting of the following factors along with their respective levels.

RESULTS AND DISCUSSION

Data regarding plant height and number of branches per plant are reported in (Table 1). Statistical analysis of the data revealed that maximum plant height (54.19 cm) and number of branches per plant (9.93) at maximum crop growth stage of 90 DAS were recorded under the field pea variety Arkel sown with application of phosphorus @ 50 kg P_2O_5 /ha while, lowest values were observed with under the field pea variety of PSM-3 sown with without application of phosphorus @ 0 kg P_2O_5 /ha.

Field pea varieties differed significantly with respect to growth parameters of plant. Variety Arkel recorded significantly higher dry matter accumulation, plant height and branches per plant as compared to variety PSM-3, Kashi Nandini and Aman. This might be due to fast growth habit of variety Arkel which increased plant height, dry matter accumulation branching and nodules. The differences among the varieties with respect to growth habit may be owing to inheritance of genetic divergence of the varieties. The present findings have been supported by many workers like Govardhan et al. (2017) and Datta and Das (2018).

Application of higher rate of phosphorus improved the nutrient availability status, resulting into grater removal which might have increased the photosynthesis and then translocated the synthase to different parts for promoting meristematic development in potential apical buds and intercalary meristems and hence increased the number of leaves. These results corroborated the findings of Bhuiyan et al. (2008) and Hussena et al. (2015). This result is similar with the findings of Jaiveer et al. (2017).

Data regarding number of pods per plant, number of grains per pod, length of pod, seed index, grain & stover yield of field pea are reported in Table 1 and maximum values were observed when crop fertilized with increasing rate of phosphorus @ 50 kg/ha and field pea variety Arkel. Statistical analysis of the data revealed that highest number of pods per plant (23.60), number of grains per pod (7.00), length of pod (13.14 cm), seed index (20.93 g), grain yield/ha (17.39 q/ha) and stover yield/ha (17.97 q/ha) recorded under the treatment combination of field pea variety of Arkel in combination with application of phosphorus @ 50 kg P_2O_5 /ha. While, lowest values were observed in plot that received no phosphorus with field pea variety of PSM-3.

The results regarding yield contributing characters showed that variety Arkel was superior which might be because of synthesis of more photosynthates due to increased source capacity and efficient translocation of photosynthates to the sink (seed). Deepa et al. (2020) also observed improvement in yield attributes due to field pea varieties having different genetic makeup. Increase in grain yield and its parameters may be due to increase in the number of leaves which worked as an efficient photosynthesis structure and produced high amount of carbohydrates in the plant system. More number of branches which borne more number of flowers, which resulted higher fruits/plant and fruit yield and their attributes. Similar findings also reported by Datta and Das (2018). The data on mean grain yield and straw yield per hectare showed that the variety Arkel recorded significantly higher. Which might be due to accumulation of more dry matter and higher biomass potential.

The plant nutrients are most important for growth and development of crops. When soil content less available nutrients, plant cannot absorb sufficient amount of nutrients from soil ultimately it results in to reduction in yield of crop. Availability of essential plant nutrients resulted in a production of superior yield attributes. The yield of crop largely depends upon the source-sink relationship i.e., mobilization of photosynthates from the synthesis sites and temporary storage organs towards the developing seeds. The different components of sources are leaf area, number of branches and number of root nodules before anthesis and that of sink are number of pods per plant, seeds per pod and 1000- seed weight.

The maximum test weight with optimum phosphorus rates was attributable to better nodulation and efficient functioning of nodule bacteria for fixation of nitrogen to be utilized by plants during seed development stage in the synthesis of protein which in turn led to increase in seed yield. Kumar et al. (2013) found that the increase in phosphorus levels was significantly increasing the weight of 1000-seed of field pea. The significant increase in test weight due to optimum dose of phosphorus application might be on account of better uptake and translocation of nutrients, especially phosphorus, resulting in bold seed formation by increasing the size and weight of grains. The results are in close accordance with findings of Rao et al. (2020).

The overall trends evidently indicate that the progressive increase in grain yield per plant, per plot as well as per hectare among the treatment was inconsistent. Secondly, there were significant variations in their yield. Significant variation was observed on the seed yield per plant as well as per hectare of field pea when the field was fertilized with different doses of phosphorus. Application of phosphorus (@ 50 kg P_2O_5 /ha) showed the maximum grain yield per hectare. On the other hand, the minimum grain yield per hectare was observed in the P0 treatment where without application of phosphorus was applied @ 0 kg/ha. This might be due to the fact that plant treated with optimum phosphorus doses, resulting increased the root nodulation through better root development and more nutrient availability, resulting in vigorous plant growth and dry matter accumulation leading to flowering, fruiting and grain yield per plant as well as per hectare. Ajay et al. (2014) was found that seed yield was significantly increased by phosphorus application.

Table 1: Response of different level of phosphorus and varieties on growth and yield of field pea

Treatment	Plant height (cm)	Number of branches/ plant	Number of pods per plant	Number of grains per pod	Length of pod (cm)	Seed index (g)	Grain yield (q/ha)	Stover yield (q/ha)
	Effect of varieties							
V_1	50.43	8.07	17.73	5.36	11.09	19.42	14.73	16.36
V_2	45.73	6.44	12.87	4.09	9.28	17.99	12.94	14.42
V_3	47.84	6.67	13.93	4.40	9.92	18.40	13.40	14.98
V_4	48.93	7.36	16.38	5.04	10.34	18.86	14.20	15.90
S. Em±	1.65	0.49	1.71	0.35	0.60	0.28	0.53	0.57
C.D. (P=0.05)	4.85	1.44	5.00	1.03	1.75	0.82	1.57	1.66
	Effect of phosphorus							
P_1	43.36	5.50	10.55	3.28	7.88	17.17	10.83	12.71
P_2	48.61	7.27	15.20	4.85	10.52	18.84	13.83	15.88
P_3	52.73	8.63	19.93	6.03	12.08	19.99	16.79	17.65
S. Em±	1.91	0.57	1.97	0.40	0.69	0.32	0.62	0.65
C.D. (P=0.05)	5.60	1.66	5.77	1.19	2.02	0.94	1.81	1.91
	Interaction effect between varieties and phosphorus							
V_1P_1	46.78	6.60	14.00	3.87	9.28	18.04	12.44	14.50
V_1P_2	38.30	4.53	7.53	2.40	6.08	16.20	9.39	11.27
V_1P_3	42.75	4.67	9.07	3.13	7.57	16.85	10.06	11.54
V_2P_1	45.61	6.20	11.60	3.73	8.59	17.60	11.44	13.54
V_2P_2	50.33	7.67	15.60	5.20	10.84	19.29	14.36	16.60
V_2P_3	47.73	6.87	14.73	4.40	10.17	18.44	13.25	15.18
V_3P_1	48.22	7.13	15.00	4.80	10.48	18.71	13.78	15.51
V_3P_2	48.15	7.40	15.47	5.00	10.58	18.92	13.92	16.23
V_3P_3	54.19	9.93	23.60	7.00	13.14	20.93	17.39	17.97
V_4P_1	51.16	7.93	16.33	5.47	11.60	19.33	16.17	16.83
V_4P_2	52.54	8.20	17.73	5.27	11.72	19.64	16.36	17.88
V_4P_3	53.03	8.47	22.07	6.40	11.85	20.06	17.25	17.92
S. Em±	0.96	0.28	0.98	0.20	0.34	0.16	0.31	0.33
C.D. (P=0.05)	1.98	0.59	2.04	0.42	0.71	0.33	0.64	0.68

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