# Effect of phosphorus on different varieties on growth and yield of pea (*Pisum sativum* L.)


## ABSTRACT

A field experiment entitled “Effect of phosphorus on different varieties on growth and yield of field pea (*Pisum sativum* L.)” was carried out during the *rabi* season 2023-24 at Pandit Deen Dayal Upadhyay Institute of Agriculture Science, Utlou, Bishnupur District, Manipur, India. The treatment comprised of three different phosphorus levels (0,40 and 60 kg/ha) and three varieties $V_1$ – Prakash, $V_2$ – Rachna, $V_3$ – Aman with a total of 9 treatment combinations. The experiment was laid out in a factorial randomized block design (FRBD) with three replications. The results reveal that the maximum growth character viz. plant height(cm), number of branches per plant, fresh weight and dry weight per plant(g), number and dry weight of nodules were recorded maximum on Aman ($V_3$) and minimum values were recorded on Prakash ($V_1$).The maximum yield character such as number of pods per plant, number of seed per pod, pod length(cm), stover yield (q/ha), test weight (g), harvest index (%) were recorded under variety Aman ($V_3$) followed by Rachna($V_2$) and Prakash($V_1$).Among the phosphorus levels 60 kg $P_2O_5$/ha recorded higher growth attribute, yield attribute and yield of pea as compare to other phosphorus which was followed by 40 kg $P_2O_5$/ha and 0 kg $P_2O_5$/ha. The treatment combination 60 kg $P_2O_5$/ha + Aman ($P_3V_3$) was found best for pea cultivation. From the present record it can be concluded that using 60 kg $P_2O_5$/ha + Aman ($P_3V_3$) proved to be more productive and profitable for the cultivation of pea during rabi season in Manipur climate condition.


*Keywords:* Keywords: Field pea, phosphorus, varieties, growth, yield

## 1. INTRODUCTION

Field pea (*Pisum sativum* L.) is one of the important pulse crops in the world. It is cultivated in a 6.2 million hectares area with a total production of 20.5 million tonnes annually. The important field pea-growing countries are Canada, Russia, the USA, China & India. Canada ranks first in the world in respect of production followed by Russia. In India, field pea occupies an area of 0.64 million ha with an annual production of 0.88 million tonnes (2020 - 21). Uttar Pradesh is the major field pea-growing state. Besides, Uttar Pradesh, Madhya

Pradesh and Bihar are the major field pea-producing states. It is highly nutritious and contains a high proportion of digestible protein (22.5%), carbohydrates (62.1%), fats (1.8%), minerals (Ca - 64 mg/100 g, Fe—4.8 mg/100 g), and vitamins (riboflavin - 0.15 mg/100 g, thiamine - 0.72 mg/100 g, and niacin - 2.4 mg/100 g). Peas contribute about 3% of the total pulse area and about 5% of total pulse production in India.

The response of phosphorus depends upon many factors like climate, variety of soil type and availability of nutrients during the period of growth. The application of phosphorus increased the production of pulse crops. Phosphorus is the vital component of DNA, RNA, ATP and photosynthetic system and catalysis a number of biochemical reactions from the beginning of seedling growth through to the formation of grain at maturity. Sharma *et al.* (2004) reported that one of the advantages of feeding plants with phosphorus is to create deeper and more abundant roots. It also raises the efficiency of plants for photosynthesis, enhances the activity of rhizobia and increases the number of branches and pod per plants, consequently producing a higher total yield of pea. Phosphorus is crucial for root development, energy transfer, and overall plant metabolism Nadeem *et al*. (2003). The genetic diversity within pea varieties is significant, with each variety displaying distinct characteristics and adaptations. This diversity is essential for breeding programs focused on enhancing yield, disease resistance, and adaptability to different environmental conditions. Keeping these points in views, the present investigation entitled “Effect of phosphorus on different varieties on growth and yield of field pea (*Pisum sativum* L.)” was conducted during rabi 2023-24 at the farm of Pandit Deen Dayal Upadhyay Institute of Agriculture Science, Utlou, Bishnupur, Manipur.

## 2. MATERIAL AND METHODS

The field experiment was conducted during Rabi seasons 2023-24 at Pandit Deen Dayal Upadhyay Institute of Agriculture Science, Utlou, Bishnupur District, Manipur, India. The experimental site is located at 24°43’22.4” N latitude, 93°51’35.2” E longitude and at an altitude of 790 m above mean sea level. The soil of the experimental field was clay in texture with acidic reaction (pH 5.2), high organic carbon (1.9%), low in available nitrogen (188 kg/ha), medium available phosphorus (20 kg P/ha) and medium in available potash (216.18 kg K/ha). The experiment was laid out in a factorial randomized block design (FRBD) with three replications. The treatments are $T_1$ $P_1V_1$ 0 kg $P_2O_5$/ha + Prakash,$T_2$ $P_1V_2$ 0 kg $P_2O_5$/ha + Rachna, $T_3$ $P_1V_3$ 0 kg $P_2O_5$/ha + Aman, $T_4$ $P_2V_1$ 40 kg $P_2O_5$/ha + Prakash, $T_5$ $P_2V_2$ 40 kg $P_2O_5$/ha + Rachna, $T_6$ $P_2V_3$ 40 kg $P_2O_5$/ha + Aman, $T_7$ $P_3V_1$ 60 kg $P_2O_5$/ha + Prakash, $T_8$ $P_3V_2$ 60 kg $P_2O_5$/ha + Rachna, $T_9$ $P_3V_3$ 60 kg $P_2O_5$/ha + Aman.A uniform dose of 20 kg nitrogen (as urea), 60 kg phosphorus (SSP) and 40 kg potash (MOP) was applied to all the treatments. The biometric observations on different characteristics *viz*., plant height, number of branches were recorded at various stages of crop growth. The grain yield (kg/ha) was also recorded from each net plot at the time of harvest. Mean values of data obtained from the experiment are computed for statistical analysis to test significance and interpretation of results.

## 3. RESULTS AND DISCUSSION

### 3.1 Effect of phosphorus and varieties of plant height (cm)

The data on plant height was found to be significantly influenced by phosphorus and varieties in field pea as shown in Table 1. The effect of phosphorus and varieties on the plant height of pea was found to be not significant in plant height. Application of treatment (0,40,60 $P_2O_5$/ha) shows an increase in height as compared to control phosphorus. In all the four stages of recording 30 DAS remain par and it increases significantly up to 60 kg $P_2O_5$/ha at 60 DAS. Again, variation of plant height with application of 40 and 60 kg $P_2O_5$/ha

was found to be significant in three stages of recording at 60 DAS,90 Das and at harvest. Application of phosphorus 60 kg $P_2O_5$/ha recorded higher plant height due to higher phosphorus level to grow taller which causes a positive effect of phosphorus on root multiplication, nodulation and speeding up the height of the plant. Phosphorus and variety interaction was found to be non-significant for the plant height of pea. These findings were supported by Tripathi *et al.* (2020) and Singh *et al.* (2008). Among the varieties, the maximum height was observed in the variety Aman($V_3$). followed by Rachna ($V_2$) and the lowest plant height variety is recorded at Prakash ($V_1$). The differences in plant height among the varieties may be attributed to variations in genetic composition and the rate of cell division at various growth stages. Similar result in variation of plant height with different varieties was also reported by Sen *et al.* (2016) in pulse crops.

**Table 1. Effect of phosphorus and varieties on plant height (cm) of field pea.**

| Treatment | Plant height (cm) | | | |
|---|---|---|---|---|
| | 30 DAS | 60 DAS | 90 DAS | At Harvest |
| **Phosphorus levels** | | | | |
| **$P_1$ (0 kg $P_2O_5$/ha)** | 8.72 | 27.79 | 37.76 | 38.42 |
| **$P_2$ (40 kg $P_2O_5$/ha)** | 9.04 | 29.32 | 40.12 | 41.24 |
| **$P_3$ (60 kg $P_2O_5$/ha)** | 9.60 | 31.23 | 42.39 | 43.60 |
| **S.Ed (±)** | 0.15 | 0.18 | 0.63 | 0.67 |
| **C.D. (P = 0.05)** | 0.32 | 0.38 | 1.34 | 1.41 |
| **Varieties levels** | | | | |
| **$V_1$ (Prakash)** | 8.91 | 28.74 | 39.27 | 40.45 |
| **$V_2$ (Rachna)** | 9.12 | 29.59 | 39.72 | 40.69 |
| **$V_3$ (Amana)** | 9.33 | 30.00 | 41.29 | 42.12 |
| **S.Ed (±)** | 0.15 | 0.18 | 0.63 | 0.67 |
| **C.D. (P = 0.05)** | 0.32 | 0.38 | 1.34 | 1.41 |

## 3.2 Effect of phosphorus and varieties of number of branches per plant

The data on number of branches was found to be significantly influenced by phosphorus and varieties in field pea as shown in Table 2. The effect of different doses of phosphorus on a number of branches per plant was evident from the fact that the number of branches per plant in different does not vary considerably. At 30 DAS the number of branches did not differ significantly over control as well as between 40 and 60 kg $P_2O_5$/ha. In the subsequent 3 stages (60, 90 DAS and at harvest) it increases significantly with increased level of phosphorus at 40 and 60 kg $P_2O_5$/ha. Phosphorus and variety interaction was found to be non-significant for the number of branches per plant of field pea. An increase in phosphorus level boosts rhizobium activity, which improves N fixation in the root nodules and promotes better growth and development which leads to enhanced cell division causing cells to produce more branches. A similar result was also reported by Bhat *et al.* (2013). However, in the last three stages of recording (60, 90 DAS and at harvest), the maximum number of branches was observed in the variety Aman ($V_3$) which remains par with Prakash ($V_1$). Again, Prakash ($V_1$) remains par with Rachna ($V_2$) in the last three stages of recording. This finding was supported by Yadahalli *et al*. (2006).

**Table 2. Effect of phosphorus and varieties on number of branches per plant of field pea.**

| Treatment | Number of branches per plant | | | |
|---|---|---|---|---|
| | 30 DAS | 60 DAS | 90 DAS | At harvest |
| **Phosphorus levels** | | | | |
| **$P_1$ (0 kg $P_2O_5$/ha)** | 0.99 | 1.44 | 2.60 | 2.70 |
| **$P_2$ (40 kg $P_2O_5$/ha)** | 1.21 | 1.92 | 2.71 | 3.06 |
| **$P_3$ (60 kg $P_2O_5$/ha)** | 1.33 | 2.24 | 3.10 | 3.31 |
| **S.Ed (±)** | 0.06 | 0.11 | 0.10 | 0.08 |
| **C.D. (P = 0.05)** | 0.13 | 0.24 | 0.21 | 0.18 |
| **Varieties levels** | | | | |
| **$V_1$ (Prakash)** | 1.11 | 1.70 | 2.66 | 2.89 |
| **$V_2$ (Rachna)** | 1.18 | 1.88 | 2.83 | 3.06 |
| **$V_3$ (Amana)** | 1.24 | 2.03 | 2.92 | 3.12 |
| **S.Ed (±)** | 0.06 | 0.11 | 0.10 | 0.08 |
| **C.D. (P = 0.05)** | 0.12 | 0.24 | 0.21 | 0.18 |

## 3.3 Effect of phosphorus and varieties of number of pods per plant

Number of pods per plant data revealed a significant impact of both phosphorus levels and pea varieties in the field experiment as shown in Table 3. The individual effect of phosphorus and varieties on the number of pods per plant of pea could not bring a significant difference in the number of pods per plant. The maximum number of pods per plant is recorded with the application of 60 kg $P_2O_5$/ha. The lowest number of pods per plant was recorded at control phosphorus. Phosphorus and variety interaction was found to be non-significant for the number of pods per plant of field pea. An increase in the number of pods per plant might be because of the essential role of phosphorus in photosynthesis, fast energy transfer may have enhanced photosynthetic efficiency and consequently photosynthesis availability which further results in an increase in overall biomass production and plant part translocation. A similar result was also reported by Hangsing *et al*. (2020). Among the variety ($V_3$) Aman recorded a maximum number of pods per plant as compared to variety ($V_1$) Prakash and ($V_2$) Rachna. However, ($V_1$) Prakash and ($V_2$) Rachna did not differ significantly in terms of number of pods per plant. The variation in number of pods per plant might be due to differences in genetic differences. These findings were supported by the findings of Tripathi *et al.* (2020).

## 3.4 Effect of phosphorus and varieties of seed yield (q/ha)

Seed yield data revealed a significant impact of both phosphorus levels and pea varieties in the field experiment as shown in Table 3. Phosphorus also increased the photosynthesis and translocation of assimilates to different plant parts for enhanced growth and yield attributing characters of the crop as observed in the number of pods per plant. The application of 60 kg $P_2O_5$/ha resulted in a significant and maximum seed yield. Phosphorus and variety interaction was found to be non-significant for the seed yield of field pea. This may be attributed to enhanced root proliferation, better root development, increased nutrient availability and uptake, improved energy conversion, and boosted plant metabolic activities. Such result was also reported by Khajuria *et al.* (2023) and Tanwar *et al.* (2003). Among the

varieties maximum seed yield was recorded in the variety ($V_3$) Aman and the lowest one was recorded in the variety ($V_1$) Prakash. The higher seed yield in ($V_3$) Aman might be due to higher test weight which was significantly superior to the other two varieties. These findings were supported by the findings of Pan *et al.* (2001).

### 3.5 Effect of phosphorus and varieties of stover yield (q/ha)

Stover yield data revealed a significant impact of both phosphorus levels and pea varieties in the field experiment as shown in Table 3. Application of phosphorus increases significantly with increased levels of phosphorus up to 60 kg $P_2O_5$/ha shows a significant difference in stover yield. The combined effect of phosphorus and varieties on the stover yield of pea was found to be significant. The higher stover yield with a suitable dose of phosphorus might be contributed by better growth of the plant as expressed in terms of plant height, number of branches per plant, and fresh and dry weight of the plant. Similar result was also reported by Siddiqui *et al.* (2022). Maximum stover yield was recorded in the variety ($V_3$) Aman and the lowest one was recorded in the variety ($V_1$) Prakash. The variation in stover yield may be due to differences in growth characteristics among the varieties, influenced by their genetic makeup. Such variation in stover yield in different varieties was also reported by Yadav *et al.* (2016). Phosphorus and variety interaction was found to be non-significant for the stover yield of field pea.

**Table 3. Effect of phosphorus and varieties on number of pods per plant, seed yield (q/ha) and stover yield (q/ha) of field pea.**

| Treatment | | | |
|---|---|---|---|
| | **No of pods per plant** | **Seed Yield (q/ha)** | **Stover Yield (q/ha)** |
| **Phosphorus levels** | | | |
| **$P_1$ (0 kg $P_2O_5$/ha)** | 8.50 | 10.00 | 26.34 |
| **$P_2$ (40 kg $P_2O_5$/ha)** | 10.27 | 14.79 | 28.92 |
| **$P_3$ (60 kg $P_2O_5$/ha)** | 11.17 | 19.80 | 29.71 |
| **S.Ed (±)** | 0.08 | 0.28 | 0.31 |
| **C.D. (P = 0.05)** | 0.18 | 0.59 | 0.65 |
| **Varieties levels** | | | |
| **$V_1$ (Prakash)** | 9.74 | 13.70 | 27.59 |
| **$V_2$ (Rachna)** | 9.97 | 14.71 | 28.48 |
| **$V_3$ (Amana)** | 10.24 | 16.17 | 28.91 |
| **S.Ed (±)** | 0.08 | 0.28 | 0.31 |
| **C.D. (P = 0.05)** | 0.18 | 0.59 | 0.65 |

### 4.CONCLUSION

Based on the result from the experiment it can be concluded that the effect of phosphorus on different varieties on growth and yield of field pea (*Pisum sativum* L.) significantly increases the growth parameters, yield attribute characters and yield under 60 Kg $P_2O_5$/ha + Aman in Utlou, Bishnupur District, Manipur, India.

## DISCLAIMER (ARTIFICIAL INTELLIGENCE)

I, Poireinganba Khumanthem hereby declare that NO generative AI technologies such as Large Language Models (Chat GPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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