

## Original Paper

# Effect of Nitrogenous Fertilizer on the Vegetative Growth and Yield Attribute of Pea (*Pisum sativum* L.)

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Received: June 6, 2019

Accepted: June 17, 2019

Online Published: July 16, 2019

doi:10.22158/ra.v4n1p1

URL: <http://dx.doi.org/10.22158/ra.v4n1p1>

### Abstract

*An experiment was conducted to study the effect of chemical fertilizer on the pea growth and yield attributes. Therefore, the main objective of this study was to investigate the effect of chemical fertilizer alone and in combination. This study consists of three different nitrogen levels (90, 100 and 110 kg ha<sup>-1</sup> as urea), three different levels of phosphorus (60, 70 and 80 P<sub>2</sub>O<sub>5</sub> kg ha<sup>-1</sup> as DAP) and their combination. Treatments were arranged in a complete randomized block design with three replications. The results showed that both the single and combined application of nitrogen and phosphorus fertilizer increased the growth and yield attribute of the pea plant. Maximum number of primary (6.91) and secondary branches per plant (7.97), number of leaves per plant (12.50) and plant height (51.24 cm) was attained by the combine application of P80+N110. Similarly, the maximum increase in yield parameters such as pod length (7.5 cm), number of pods per plant (7.23), pod weight (12.50 g) and number of grains per pod was obtained in P80+N110. In general, combined application of fertilizers significantly increased all the growth and yield attribute of the pea plant when compared to fertilizers applied alone with respect to control.*

### Keywords

*pea, nitrogen, phosphorus*

## 1. Introduction

Pea (*Pisum sativum* L.) is an important edible fresh vegetable growing throughout the world in the winter season, but it can also be grown in the summer season in the hilly areas of the world. Pea is also a cheap and valuable vegetable that grown in Pakistan as compared to the other developed countries (Akhtar, 2003). It is considered an important legumes crop after soybean, groundnut and beans, legumes crop also play a vital role in organic farming by fixing the atmospheric Nitrogen (N) that help in the production of grain protein while also improving the soil N for the coming crop (Alam et al., 2010; Corre-Hellou & Crozat, 2005). In the world trade pea contributed about 40% of the total pulses and can occupy the third position among the legumes in Pakistan (Oram & Agcaoili, 1994; Aslam et al., 2000). The deficiency of the major nutrients like NPK may inhibit the normal growth of the plant (Badr et al., 2014).

In Pakistan, pea grown on about 2.0% area of the total cultivated area, as compared to other countries of the world the cultivation of pea in Pakistan is very low (Aslam et al., 2000). There are many factors that affecting the growth and production of the pea in country like Pakistan, the main reason for the low production is the unavailability of improved variety seed climatic condition and unequal distribution of fertilizers (Hussain et al., 2002). The soil of the study area is of low fertility, to fulfil the requirement of the pea plant needs the application of additional fertilizer like Nitrogen (N) and Phosphorus (P) (Anon., 1995). Previous studies investigated that the amendment of N fertilizer significantly improves the vegetative growth of many legumes plant (Togay et al., 2005; Achakzai et al., 2002). Most of the scientist used pot experiments, while little is known about the application of chemical fertilizer under field conditions. Amin, E. M. H. (2011) reported that nitrogen fertilizer increases the growth of the plant. With the application of chemical fertilizer, the plant height and number of branches per plant, of pea were increased (Vorob, 2000). With the application of high levels of P fertilizer could also increase the growth attribute of pea plant (Kumar, 2011). Therefore, the main objectives of the present study were to evaluate the effect of nitrogen and phosphorus fertilizer on the growth and yield of pea plant.

## 2. Method

A research was conducted at the Horticulture research farm, Agriculture University Peshawar during 2015-2016 to investigate the response of two different chemical fertilizer on the growth and yield attributes of garden pea. The experiment was design in a randomized complete block design having three replications. Two different types of fertilizers were used in this study, 1) Urea as a source of nitrogen having three different levels, i.e., 90, 100 and 110 kg ha<sup>-1</sup>, 2) diammonium phosphate (DAP) for phosphorus having three levels, i.e., 60, 70 and 80 P<sub>2</sub>O<sub>5</sub> kg ha<sup>-1</sup> were applied alone and also in combination with each other in order to test its combine effect on the growth and yield attribute of the garden pea. The field was irrigated as per the requirements of pea plants and the weeds were removed manually throughout the experimental duration. After reaching the plant to physiological maturity, then select five random plant for the number of primary and secondary branches. Plant height were

measured with the help of meter rod and number of leaves were count manually per plant. For pod length we select 50 pods per treatment and then the length was measured in centimetres and average was calculated. The number of pods were measured in each treatment on the middle row and average pods/plant were calculated. Pod weight were measured by selecting fifty pods in each treatment, measured and average were calculated. Number grains were calculating by taking fifty pods form each treatment and the number total seeds was recorded and average was calculated.

### *2.1 Statistical Analysis*

For each parameter the data were individually analysed by using SPSS 20.0 package, through randomized complete block design. The means were compared by using Least Significant Difference (LSD) test at 5% level of probability (Steel & Torrie, 1980).

## **3. Results and Discussion**

Data taken on different vegetative growth parameters indicated that pea crop treated with phosphorus and nitrogen significantly ( $P=0.05$ ) affected in terms of its growth (Table 1). Treatments gave significant effect when compared to control. In case of primary branches, the maximum number (6.91) was achieved when combine treatment of P 80+N 110 was applied which was followed by statistically same but numerically lower value (6.43) in case of P70+N110 treatment. Generally, it was noticed that both nitrogen and phosphorus fertilizers gave non-significant effect when compared with their combine effect. The lowest number of branches (4.81) was found in control treatment having similar effect with phosphorus and nitrogen applied alone. The same results were reported by Achakzai (2012) that with the application of chemical fertilizer the primary branches of garden pea increased. Similarly, our results were also in accordance with Kakar et al. (2002), who investigated the role of fertilizers on vegetative growth of pea. Studies have shown that nitrogen improves vegetative growth, while, phosphorus has a role in providing energy in transferring photosynthates from source to sink. High energy phosphates are the constituents of ATP and adoneine diphosphate (ADP) that drives many chemical reactions in plants. Therefore, the improved growth and higher number of branches was noted in adequate level of nitrogen and phosphorus fertilization (Ahmad et al., 2017).

**Table 1. Effect of Phosphorus and Nitrogen on Vegetative Growth Attributes of Garden Pea Crop**

Treatments	Primary branches per plant	Secondary branches per plant	Plant height per plant	No of leaves per plant
control	4.81 d	5.61 e	36.68 f	9.85 h
Phosphorus 60 kg ha <sup>-1</sup>	4.95 d	6.10 de	40.54 e	10.47 g
Phosphorus 70 kg ha <sup>-1</sup>	4.99 d	6.25 de	43.89 cd	11.12 f
Phosphorus 80 kg ha <sup>-1</sup>	5.50 c	6.32 de	44.64 cd	11.72 cd
Nitrogen 90 kg ha <sup>-1</sup>	5.01 cd	6.13 de	40.67 e	11.13 f
Nitrogen 100 kg ha <sup>-1</sup>	5.23 cd	6.11 de	44.77 cd	11.63 d
Nitrogen 110 kg ha <sup>-1</sup>	5.73 c	6.39 d	45.55 c	11.68 d
P 60+N90	4.97 d	6.18 de	40.12 e	10.45 g
P 60+N 100	5.21 cd	6.90cb	42.98 ed	11.98 c
P 60+N 110	5.56 c	7.25 b	47.01 b	12.26 b
P 70+N 90	5.10 cd	6.20 d	44.56 dc	11.01 d
P70+N 100	5.34 cd	6.98cb	46.69 bc	11.54 de
P70+N 110	6.43 ab	7.30 a	48.26 b	12.35 a
P80+N 90	6.12 b	7.25 b	45.25 cd	11.61 d
P 80+N100	6.25 b	7.62 a	48.27 b	12.41 a
P 80+N 110	6.91 a	7.97 a	51.24 a	12.50 a
LSD	0.50	0.60	0.8	0.26

Each value is a mean of three replicates. Values in a column sharing the same latter have no significant difference after applying LSD test at P=0.5.

In the present study both the chemical fertilizers have significantly increased the secondary branches of pea plant alone and in combination as compared to their respective control. Within the treatment the single fertilizers application showed non-significant results, whereas the combined application revealed significantly increased in the number of secondary branches of pea plant as compared to control. The lowest number (5.61) of secondary branches was recorded at control while the highest number of secondary branches were recorded at the P 80+N 110 (7.97). From the results, it is clear that the combined application of chemical fertilizer increased the vegetative growth of the plant. Our results are in line with Kakar et al. (2002) who applied different levels of NPK to the field of pea plant and reported, that with the application of varying NPK levels the growth the secondary branches of pea increased.

Plant height were slightly increased by the single application of both fertilizers, while the plant height significantly increased under its combined application as compared to control. The single application of chemical fertilizer also showed nonsignificant results within in the treatment except the 60 kg P ha<sup>-1</sup> and 90 kg N ha<sup>-1</sup>. Whereas at the highest combined application the plant height significantly increased as compared to other treatments and control. The maximum plant height (51.24 cm) was recorded at P 80+N 110 followed by P 80+N100 and the minimum plant height (36.68 cm) was that of control. Our results are in agreement with Achakzai (2102) who reported that with application of chemical fertilizer the plant height increased. The application of different levels of nitrogen fertilizer increase the quality and growth of the maize (Amin, 2011).

In the current study number of leaves were significantly increased by the application of N and P fertilizers. Within in the treatments of single and combined application of fertilizers number of leaves showed significant results. As the rate of the fertilization increased the numbers of the leaves increased. From the Table 1 it is cleared that the combined application will be more suitable for the growth of the plant. In our present study the highest number leaves was recorded at combined application (P 80+N100 and P 80+N100) 12.50 and 12.41 respectively, while the lowest was recorded at the control (9.85). Similar results were investigated by Alam et al. (2010) who demonstrated that with application of organic and inorganic source of fertilizer increased the number of leaves per plant. Nitrogen has a role in increasing vegetative growth of plants. If not in adequate levels, it might also increase the vegetative stage of plants. Similarly, Achakzai (2012) studied the effect of different phosphorus levels on the pea growth attributes, reported that with application of chemical fertilizer the number of leaves per plant increased as compared to the control.

It is clear from the Table 2 that the single application of phosphorus and nitrogen slightly increase the length of the pods. When the phosphorus and nitrogen were in combination the pod length was significantly increased as compared to their single application and control. Within the treatments both the combined and single application of fertilizer significantly increased the pod length. The maximum pod length was recorded at the higher level (combine) of fertilizers P 80+N 110 (7.5 cm) followed by the P 80+N100 (7.3 cm), P80+N 90 (6.8) and the lowest values was recorded at control. The data revealed that the combine application of chemical fertilizers have significant effect as compared to their single application. The increase pod length might be due to the reason that nitrogen increases vegetative growth, which in turn results in increase in photosynthesis. On the other hand, phosphorus improves energy transfer in plants. Akhtar et al. (2003) also found the same results and reported that, with the application chemical fertilizer the pod length of the garden pea increased as compared the control. Kumar (2011) also investigate that as the application of phosphorus increased the length of the pods become increased, our results also showed the same trend and the pod length increased as the of the fertilizers increased.

Number of pods per plant increased with the amendment of chemical fertilizers, either at single application or combine application of fertilizer. All the treatments increased the number of pods per plant as the rate of the fertilizer increased. Within the treatment the no of pods per plant showed significant results. The maximum pod number was recorded at the combine application of fertilizer as compared to their single application. The highest pods number was observed at P 80+N 110 (7.23) whereas the lowest number of pods was observed at the control. Our results are in agreement with Kumar (2011) revealed that as the rate of the fertilizer increased the number of pods per plant increased. Similarly, Akhtar et al. (2003) also found the same results and stated that the number of pods per plant increased with the application of chemical fertilizers.

**Table 2. Effect of Phosphorus and Nitrogen on Yield Attributes of Garden Pea Crop**

Treatments	Pod length (cm)	No of pods per plant	Pod weight (g)	No of grains per pod
control	5.0 l	3.19 i	9.90 e	4.01 e
Phosphorus 60 kg ha <sup>-1</sup>	5.5 jk	4.01 h	10.00 cd	4.9 bc
Phosphorus 70 kg ha <sup>-1</sup>	5.8 hi	4.26 g	10.50 bc	4.95 bc
Phosphorus 80 kg ha <sup>-1</sup>	6.5 e	4.50 f	10.59 bc	5.00 bc
Nitrogen 90 kg ha <sup>-1</sup>	5.4 ik	3.90 h	10.23 cd	4.85 bc
Nitrogen 100 kg ha <sup>-1</sup>	5.9 gh	4.30 g	10.45 cd	4.97 bc
Nitrogen 110 kg ha <sup>-1</sup>	6.6 de	5.00 e	11.03 b	5.23 b
P 60+N90	5.6 j	4.23 g	9.80 e	4.89 cd
P 60+N 100	6.0 g	4.35 g	10.24	5.01 b
P 60+N 110	6.3 f	4.60 f	11.03 b	5.12 b
P 70+N 90	5.8 hi	5.02 e	11.24 b	4.99 c
P70+N 100	6.1 g	5.92 d	11.40 b	5.15 bc
P70+N 110	6.7 cd	6.02 d	12.00 ab	5.20 bc
P80+N 90	6.8 c	6.25 c	11.50 b	4.98 c
P 80+N100	7.3 b	7.02 b	12.02 a	5.50 ab
P 80+N 110	7.5 a	7.23 a	12.50 a	5.95 a
LSD	0.19	0.21	0.97	0.60

Each value is a mean of three replicates. Values in a column sharing the same latter have no significant difference after applying LSD test at P=0.5.

In our present study pod weight were significantly influenced with the application of chemical fertilizers. The single and combined application showed significant results but within the treatments the single application of fertilizer showed nonsignificant results and the same trend was observed when we

applied these two fertilizers in combination. The highest pod weight was measured at the high combined level of both fertilizer P 80+N 110 (12.50 g) and lowest grain weight was recorded at control (9.90 g). The increase in pod weight might be due to the fact that addition of nitrogen improves vegetative growth, which in turn can efficiently utilize sunlight for higher photosynthesis. Our results are in line with Kanaujia et al. (1997) reported that with application of chemical fertilizers the growth and yield attribute of pea plant increased like number of seeds per pod<sup>-1</sup> and pod weight.

Number of grains per pod were recorded with the amendment of both nitrogen and phosphorus fertilizers. Both the amendment significantly increased the no of seed per pod. Within in the treatments single application of chemical fertilizer showed non-significant results except N110 kg ha<sup>-1</sup> and control, and the same trend was followed in the combined application. However, throughout the treatments the combined application of fertilizer increased the number grains per pod as compared to the single application and control. In our present study the highest number of grains per pod was recorded at P 80+N 110 (5.95 grains per pod) followed by P 80+N100 (5.50 grains per pod) while the lowest number of grains was measured at control (4.01 grains per pod) and at low level of nitrogen and phosphorus alone 4.9 and 4.85 grains per pod respectively. Similar results were documented by Kumar (2011) who demonstrated that the number of grains per pod become increased as the rate of the fertilizer increased. In addition, our results were also in line with Bahadur et al. (1990) who applied nitrogen and phosphorus to the field and investigated that the yield and growth response of garden pea plant significantly improved.

#### 4. Conclusion

From the above study we conclude that the single application of chemical fertilizer slightly improved the growth and yield attributes of pea plant, but when we applied the phosphorus and nitrogen fertilizer in combination, it showed highly significant results as compared to their single application and control.

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