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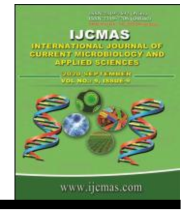

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# Effect of Different Levels of NPK and Zinc on Physico-chemical Properties of Soil, Growth and Yield of Pea [*Pisum sativum* L.] Var. Bliss-101

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A field experiment was conducted at department of soil science and agricultural chemistry, SHUATS, Prayagraj, during rabi 2019 on loamy sand soil. The experiment consisted of 9 treatments combinations which were replicated thrice and laid out in a RBD of three levels of NPK (0 % NPK, 50 % NPK and 100 % NPK), three levels of Zn (0 % $ZnSO_4$, 50 % $ZnSO_4$ and 100 % $ZnSO_4$). The results showed that progressive increase in the growth of (Plant height (cm), number of leaves per plant, number of branches) and in yield, number of pods per plant, number of seed per pod, and Pod yield (q $ha^{-1}$) in application of $T_8$ (NPK 100 %, Zn 100 % 40: 80:40 Kg NPK+20 Kg Zn $ha^{-1}$) of Pea [*Pisum sativum* L.] were found to be the best treatment combinations.

## Introduction

Pea is one of the six major pulse crop cultivated globally and it is the second highest yielding legume in the world after common bean (*Phaseolus vulgaris* L.) (FAO, 2010). Pea (*Pisum sativum* L.) is one of the world's oldest domesticated crops. In addition, it is also important vegetable crop due to its high nutritive value, particularly proteins 7.2g/100g (Singh *et al.*, 2007). In major part of the world and also consumed as green vegetables (whole pods or immature seed) in Asian countries as well as dry seed in Europe, Australia, America and Mediterranean regions (Ghafoor *et al.*, 2008). Green peas are eaten cooked as a vegetable, and marketed fresh, canned or frozen while ripe dried peas are used whole, split or made into flour. Field pea is an important pulse crop in India, covering an area of 0.498 million ha with production of 4.81million tonnes (Anonymous, 2017).

In 2017, a total of 8,141,031 hectares of field pea were harvested globally, with the top producers consisting of Canada, Russia, China, India, and the United States (FAOSTAT, 2019) however, this is only a minimal fraction compared to cereal production. Cultivated land acreage for field pea and other pulses has been in steady decline over the past 30 years (Stagnari *et al.*, 2017). Average yields have increased about 70–84% since 1974 for staple legumes, such as soybean, lentil, chickpea, and groundnut; in contrast, yields for field pea have increased but resulted in no net production gains due to decreasing land acreage (Foyer *et al.,* 2016). The minimal expansion of pulses in agriculture is due to smaller and unpredictable yields, caused by susceptibility to environmental factors, and has resulted in a less-developed global market with decreased profits, disincentivizing farmers from using pulses for income while policymakers focus more attention and resources on cereals in developing countries (Foyer *et al.,* 2016; Stagnari *et al.,* 2017).

Therefore, increase in quality seed production of pea is the need of the time to boost up the production of crop Improper farming practices such as monocropping, imbalanced fertilization, poor soil organic matter management, soil contamination, soil compaction, mining of soil nutrients, water logging, depletion of ground water, decline in soil biodiversity and changing pest and disease complex and application of imbalanced NPK fertilizers ratio of 7.9:3:1 as against normal values of 4:2:1 are the major factors for soil degradation (Purohit and Gehlot, 2006). Looking the adverse effects of fertilizers and chemicals stress is being given to promote organic farming. It is estimated that plant nutrients (NPK) addition during 2020 will be removal of 37.46 million tonnes nutrients by crops for which nutrient additions generally fall short of requirement *i.e.,* 7.86 million tonnes.

In this context, the projected (2025) availability of plant nutrients trapable from organic sources is 7.75 million tonnes (Purohit and Gehlot, 2006). Besides, there is growing demand for organic produce which gets higher remunerative price even if yields are lower. Most of people believe that organic farming is the right choice for the long term future of the earth.

Zinc plays an outstanding role in synthesis of chlorophyll, protein and also regulates water absorption. Moreover, it also play role in carbohydrates metabolism and activation of various enzymes which help in inducing alkalinity tolerance in crops by enhancing Na/K and Na/Ca ratio.

The deficiency of Zinc is most widely spread as reported. (Thakkar *et al.,* 2005) Zinc deficiency is particularly reported from Punjab, tarai area of U.P., some parts of Haryana, Western U.P. and Delhi. If Zinc deficiency is acute, a dose of 50 kg $ZnSO_4$ $ha^{-1}$ recommended. The Zinc is an essential component required in the biosynthesis of plant hormone viz. Indole acetic acid (IAA) and is a component of a variety of enzymes such as carbonic anhydrates, alcohol dehydrogenises etc. Zinc plays a role in the synthesis of nucleic acid and protein. It also helps in the utilization of phosphorus and nitrogen along with physiology of seed formation. The Zinc also maintains the semi-permeability of the cell membrane.

## Materials and Methods

### Soil sampling

The soil of experimental area falls in order of Inceptisol and in experimental plots is alluvial soil in nature. The soil samples randomly collect from five different sites in the experiment plot prior to tillage operation from a depth of 0-15 cm. The size of the soil sample reduce by conning and quartering the composites soil sample is air dry and pass through a 2 mm sieve by way of preparing the sample for physical and chemical analysis. The experimental details are given below under different heading:

### Design and treatment

The experiment consisted of 9 treatments combinations which were replicated thrice and laid out in a factorial RBD (R.A. Fisher) of three Levels of NPK (0 % NPK, 50 % NPK and 100 % NPK), three level of Zn (0 % $ZnSO_4$, 50 % $ZnSO_4$ and 100 % $ZnSO_4$).

## Experimental sites

The experiment was conducted on the research farm of department of Soil Science and agricultural chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj which situated six km away from Prayagraj city on the right bank of yamuna river, the experimental site is located in the sub – tropical region with $25^0$ N *latitude* $81.50^0$ E longitude and *95 MS Laltitude.*

## Fertilizer application

The fertilizers were applied in each plot according to treatment combinations. $T_0$- Control (Absolute control) , $T_1$- NPK 0 %, Zn 50 % 10 Kg Zn $ha^{-1}$, $T_2$- NPK 0 %, Zn 100 % 20 Kg Zn $ha^{-1}$, $T_3$- NPK 50 %, Zn 0 % 20:40:20 Kg NPK $ha^{-1}$, $T_4$- NPK 50 %, Zn 50 % 20:40:20 Kg NPK+10Kg Zn $ha^{-1}$, $T_5$- NPK 50 %, Zn 100 % 20:40:20 Kg NPK + 20 Kg Zn $ha^{-1}$, $T_6$-NPK 100 %, Zn 0 % 40:80:40 Kg NPK $ha^{-1}$, $T_7$- NPK 100 %, Zn 50 % 40:80:40 Kg NPK + 10 Kg Zn $ha^{-1}$, $T_8$- NPK 100 %, Zn 100 % 40:80:40 Kg NPK + 20 Kg Zn $ha^{-1}$ was given in equal quantity to each plot which was calculated on the basis of general recommendation for pea as 40 Kg, 80 Kg, 40 Kg $ha^{-1}$ was supplied.

**Table.1** Interaction effect of different treatment combination of NPK and Zinc fertilizers on pre and post harvest observations

| Treatments | Plant height (cm) | Number of leaves plant$^{-1}$ | Number of Branches plant$^{-1}$ | Number of Pods plant$^{-1}$ | Number of Seed per pod (g) | Pod Yield (q $ha^{-1}$) |
|---|---|---|---|---|---|---|
| $T_0$ | 71.41 | 134.50 | 23.93 | 17.40 | 7.40 | 84.40 |
| $T_1$ | 66.94 | 172.20 | 40.53 | 22.53 | 8.47 | 84.43 |
| $T_2$ | 64.47 | 231.67 | 38.13 | 23.20 | 8.67 | 90.76 |
| $T_3$ | 65.39 | 140.67 | 40.40 | 24.13 | 9.03 | 89.83 |
| $T_4$ | 65.42 | 135.00 | 41.20 | 22.33 | 9.13 | 94.46 |
| $T_5$ | 72.29 | 211.93 | 44.53 | 24.53 | 9.33 | 101.73 |
| $T_6$ | 69.57 | 147.60 | 36.60 | 19.07 | 8.00 | 97.46 |
| $T_7$ | 60.56 | 203.27 | 43.93 | 23.33 | 9.13 | 99.56 |
| $T_8$ | 68.62 | 259.53 | 67.40 | 28.00 | 9.47 | 103.6 |
| F- test | S | S | S | S | S | S |
| S. Ed. (±) | 1.998 | 7.017 | 2.648 | 1.461 | 0.52 | 2.16 |
| C. D. (P = 0.05) | 4.123 | 14.483 | 5.466 | 3.016 | 1.074 | 4.459 |

## Results and Discussion

Data presented in table 1 showed that application of $T_8$ (NPK 100 %, Zn 100 % 40:80:40 Kg NPK+20 Kg Zn $ha^{-1}$) significantly enhanced the pre and post harvest of pea observations. The significantly highest plant height (68.62 cm), Number of leaves per plants (259.53), number of branches per plant (67.40), number of pods plant$^{-1}$ (28.00), number of Seed per pod (9.47), and Pod Yield (q $ha^{-1}$) (103.60) of pea were observed with application of (NPK 100 %, Zn 100% 40:80:40 Kg NPK + 20 Kg Zn $ha^{-1}$).

As the favourable effect of N, and indispensable elementary constituent of numerous organic compounds of general importance (amino acids, protein, and nucleic acid), which are needed in the formation of protoplasm and new cells, and thus increased fresh and dry weight of different parts of plant (Edmond *et al.,* 1981). In addition, Bidwell (1979) showed that phosphorous plays a vital role in the enzyme system for the energy transform in photosynthesis and respiration and then increased plant growth. Furthermore, El- Seifi *et al.,* (2013) found that potassium had a crucial role in the energy status of the plant, translocation and storage of assimilates and maintenance of tissue water relation, consequently, N, P and K, together promoted the plant growth characters.

Increase in plant height in response to higher N levels has been confirmed by Akbar *et al.*, (2002) and Rasheed *et al.*, (2004). Increase in plant height due to more N may be attributed to more vegetative development that resulted in increased mutual shading and internodal extension.

The favourable effect of applied zinc on these characters may be ascribed to its catalytic or stimulatory effect on most of the physiological and metabolic processes of plants. Zinc performs many catalytic functions in the plant besides transformation of carbohydrates, chlorophyll synthesis and protein synthesis Kelarestaghi *et al.*, (2007). Besides this, zinc also enhances the absorption of N, K and Zn (Ashoka *et al.*, 2008), and decreases the absorption of P (Khan *et al.*, 2007 and Alam *et al.*, (2000). Concerning the effects of treatments on the studied flowering traits, the results of the two growing seasons indicated that Farmyard manure + NPK Fertilizer significantly, delayed flowering and increased fruit set percentage. Such results might be attributed to the stimulation effects of N, P and K fertilizer on the vegetative growth characters that consequently, resulted in delaying the flowering and increasing fruit set percentage. Achakzai (2012) have also reported likewise. Number of branches per plant was significantly higher with (NPK 100 %, Zn 100 % 40:80:40 Kg NPK + 20 Kg Zn $ha^{-1}$). Also similar results with Andrzejewska, J. (2002) reported that the increase of seed yield affected by microelement fertilization resulted from the increase in the number of pods per plant and to a lower extent of the increase in the number of seeds per pod. Also Choudhary (2006) found that zinc fertilization in clusterbean up to 5 kg $ha^{-1}$ registered significant enhancement in pods per plant, seeds per pod, seed, straw and biological yields over preceding levels. However, similar results confirmed by Sharar *et al.*, (2003) have also stated positive influence of nitrogen and zinc on this trait. The positive yield forming effect of foliar application of zinc (Wronska *et al.*, 2007; Potrycki 2011). The maximum grain yield (37.78 q $ha^{-1}$) was observed by the application of $T_8$ = @ 100 % NPK + 100 % Zn and the lowest grain yield value (17.55 q $ha^{-1}$) was observed in treatment $T_0$ = @ 0 % NPK + 0 % Zn. Maize grain yield increased as a result of zinc application which has also been reported by Behera *et al.*, (2008).

In conclusion the present investigation, it was apparent that application of NPK and Zn fertilizers in treatment $T_8$ (NPK 100 %, Zn 100 % 40:80:40 Kg NPK + 20 Zn $ha^{-1}$) was found on maximum plant height, number of leaves per plant, number of branches, number of pods per plant, number of seed per pod and pod yield than other treatment combinations. All observations recorded are significant. Thus, it can be concluded that different levels of NPK and Zn fertilizers improved soil available nutrient, increased all mentioned observations. However, pod yield increased and also among the treatments $T_8$ recorded the best treatment which increased the availability of nutrient and influenced on plant parameters of pea as well.

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