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# INFLUENCE OF ZINC AND BORON ON GROWTH AND YIELD OF PEA (*PISUM SATIVUM SUBSP. HORTENSE*)

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**ABSTRACT**

A field experiment was conducted to investigate the response of influence of zinc and boron on growth and yield of pea (*Pisum sativum subsp. hortense*) at the Vegetable Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, during the winter season, 2019-2020. The experiment was laid out in Randomized Block Design comprising of nine treatments including different concentrations of boron and zinc applied to pea crop *viz*., control, Boron-20 (0.06%), Boron-20 (0.09%), $ZnSO_4$ (0.03%), $ZnSO_4$ (0.05%), Boron-20 (0.06%)+$ZnSO_4$ (0.03%), Boron-20 (0.06%)+$ZnSO_4$ (0.05%), Boron-20 (0.09%)+$ZnSO_4$ (0.03%) and Boron-20 (0.09%)+$ZnSO_4$ (0.05%) control with replicated thrice. Garden pea variety Azad Pea-3 was sown at spacing of 30 x 10 cm and crop was uniformly fertilized by 20 kg N, 40 kg/ha each of $P_2O_5$ and $K_2O$ through urea and di-ammonium phosphate and muriate of potash. However, zinc and boron was applied through zinc sulphate and borax as foliar spay. The results indicated that the application of B-20 (0.09%) + $ZnSO_4$ (0.05%) showed the maximum plant height (58.80 cm), length and width of pod (4.03 and 1.7 cm), pod yield (135.37q/ha) and TSS (14.650 Brix) and shelling percentage (36.52%) of seed followed by application of B-20 (0.09%) + $ZnSO_4$ (0.03%) i.e., 14.20 ºBrix. Thus, application of B-20 (0.09%) + $ZnSO_4$ (0.05%) was found to the best treatment among all the treatments and it gave the maximum growth attributes which in turn improved the yield of garden pea.
***Keywords*** **:** Garden pea, Growth, Zinc, Boron and yield.

## Introduction

India is the world's second largest producer of vegetables with an area and production estimated to be 11232.19 mha and 207207.84 tons, respectively (NHB, 2023-24). Vegetables are rich in vitamins, minerals and antioxidants and are considered to be indispensable for human health. Insufficient consumption of good quality vegetables, causes the variety of mineral deficiency symptoms in human body. Vegetable production is a key component of farm diversification plans as well as a viable source of income to farmers in developing nations (Adhikary *et al*., 2018) and (Akshata, 2013). According to ICMR, per day per person intake of the leafy vegetable, root, tuber vegetable and other vegetables should be in the ratio of 125 g, 100 g, 75 g, respectively.

*Pisum sativum* L. (2n=14) belongs to the family Leguminosae is a popular winter season vegetable of northern and western plains of India as well as a summer crop in the hill areas. Pea is the world's third most important legume crop (Timmerman-Vaughan *et al*., 2005) which grows in colder altitudes and during the winter season in the tropics and subtropics (Praveena *et al*., 2018). The area and production of pea in India during 2023 were estimated to be 611.39 thousand hectares and 6667.59 million tonnes respectively (NHB, 2023-24). Pea is high in protein, carbohydrate and fiber, sugar, salt, potassium, iron, zinc, vitamin along with fair amount of vitamins A and C (Bele and Thakur, 2019; Das *et al*., 2012). It has a

variety of health benefits such as prevention stomach cancer, arthritis, diabetes and boost immunity. Apart from these it has the unique capacity to repair biological nitrogen, mobilise insoluble soil nutrients and change the quality of soil properties. So, for the proper growth of pea there is need of essential nutrients like zinc and boron. Zinc is an important micronutrient in crop nutrition since it is involved in a variety of physiological functions and enzyme activities, including protein and auxin production, glucose metabolism, cellular membrane maintenance and pollen generation. Unfortunately, zinc deficiency affects roughly half of Indian soils (Singh and Bhat, 2013) which causes the stunted growth, chlorosis, reduced leaves, 3 spikelet sterility and increased susceptibility to high light temperature and fungal infections which are observable problems in plants. To overcome these nutritional losses, foliar application of micronutrients is important. Zinc treatment is required for healthy crop growth and increased yield.

Boron is one of the critical micronutrients and is necessary for tissue development and differentiation as well as preventing infertility and deformity in reproductive organs. In legume crops, boron improves grain and straw yield, nutrient content, nutrient uptake and quality. The thick growth, brittle and outward curled juvenile leaves are among the indications of boron deficiency. The toxicity symptoms in plant have been observed as significant reduction in growth. Keeping in the view indispensable use of pea in human nutrition and paucity of knowledge on usefulness of zinc and boron on pea, the present investigation on "Influence of zinc and boron on growth and yield of pea (*Pisum sativum subsp. hortense*)" was conducted.

## Materials and Methods

An experiment was conducted at Vegetable Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, during the winter season, 2019- 2020.

The experiment was laid out in the Randomized Block Design comprising of 9 treatments including different concentrations of boron and zinc applied to pea crop *viz*., control, Boron-20 (0.06%), Boron-20 (0.09%), $ZnSO_4$ (0.03%), $ZnSO_4$ (0.05%), Boron-20 (0.06%) + $ZnSO_4$ (0.03%), Boron-20 (0.06%) + $ZnSO_4$ (0.05%), Boron-20 (0.09%) + $ZnSO_4$ (0.03%) and Boron-20 (0.09%) + $ZnSO_4$ (0.05%). The crop was managed as per regional recommendations of the crop. The data pertaining to plant height, number of days taken for 50 % flowering, length of pod (cm), width of pod (cm), pod yield (q/ha), shelling (%) and TSS (°Brix) were recorded. The data were analysed as the method described by Gomez and Gomez (1984).

## Result and Discussion

### Growth parameters

The results with respect to growth parameters (Table-1) revealed that the different concentrations of zinc, boron and their combinations extended considerably significant effect on plant height of pea. At 45 DAS, the highest (58.80cm) plant was recorded with the application of Boron-20 (0.09%) + $ZnSO_4$ (0.05%) and it was statistically better over the other treatments whereas minimum (42.34 cm) in plant height was recorded in control. At this stage the application of B-20 at 0.09% + $ZnSO_4$ at 0.05% recorded 38.88% more plant height as compared to untreated plot. This is due to fact that foliar application of zinc has a significant impact on the height of plant as zinc is an essential component of a number of enzymes that are responsible for many metabolic events in the plant and also boron has a crucial part in the growth of vegetable plants. The administration of zinc and boron to tomato plants resulted in an increase in plant height (Quddus *et al*., 2018). Shukla and Behra (2019) investigated tomato plant height responses to foliar treatments of several micronutrients. The application of B-20@ 0.09% + $ZnSO_4$ at 0.05% also exhibited the longest (4.03cm) pod length and pod width (1.7cm). The spraying of boron and zinc affected the number of days taken to 50% flowering when compared to control. Application of boron-20 at 0.09% + $ZnSO_4$ at 0.05% show 50% earlier blooming (33.43 days), followed by B-20 at 0.09% + $ZnSO_4$ at 0.03% (36.20 days), boron-20 at 0.06% + $ZnSO_4$ at 0.05% (37.83 days). The untreated plant exhibited delayed so the flowering (44.80 days) as compared to other treatments. Application of B-20 at 0.09% + $ZnSO_4$ at 0.05% took 34% less time to flowering as compared to control. This may be due to fact that when Zn and B were applied jointly, yield attributes of garden pea was found to be higher than their individual application. Micronutrients (boron and zinc) may have boosted soil fertility and enhanced the yield. Similar results were reported by Umesh and Shankar (2013).

**Table 1:** Effect of zinc and boron at plant height, days taken to 50% flowering, length and width of pod in pea.

| Treatments | Plant height (cm) 45 DAS | Day taken to 50% flowering | Length of pod (cm) | Width of pod (cm) |
|---|---|---|---|---|
| $T_1$- Control | 42.34 | 44.80 | 2.33 | 1.16 |
| $T_2$- B-20 (0.06%) | 43.51 | 43.20 | 2.53 | 1.20 |
| $T_3$- B-20 (0.09%) | 45.07 | 42.97 | 2.67 | 1.27 |
| $T_4$- $ZnSO_4$ (0.03%) | 45.63 | 40.90 | 2.83 | 1.33 |
| $T_5$- $ZnSO_4$ (0.05%) | 46.73 | 39.27 | 2.97 | 1.37 |
| $T_6$- B-20 (0.06%) + $ZnSO_4$ (0.03%) | 48.15 | 38.73 | 3.13 | 1.40 |
| $T_7$- B-20 (0.06%) + $ZnSO_4$ (0.05%) | 49.83 | 37.83 | 3.30 | 1.50 |
| $T_8$- B-20 (0.09%) + $ZnSO_4$ (0.03%) | 53.90 | 36.20 | 3.60 | 1.57 |
| $T_9$- B-20 (0.09% )+ $ZnSO_4$ (0.05%) | 58.80 | 33.43 | 4.03 | 1.70 |
| **S.Em (±)** | 0.75 | 0.59 | 0.081 | 0.065 |
| C.D. at 5% | 2.27 | 1.79 | 0.244 | 0.195 |

Data presented in Table. 2 revealed that the application of levels various treatments of boron and their combination have been significant effect on pod yield (q/ha). Maximum (135.37 q/ha) fresh pod yield was recorded with the application of B-20 (0.09%) + $ZnSO_4$ (0.05%) which was found to be statistically at par with the application of B-20 (0.09%) + $ZnSO_4$ (0.03%). Combined application of boron-20 @ 0.09% and+ $ZnSO_4$ at 0.05% gave 35.87% more pod yield over control. This may be due to fact that when Zn and B were applied jointly, yield of garden pea seed was found to be higher than their individual application. Micronutrients (boron and zinc) may have boosted soil fertility and microbial multiplication as a result which there is higher nitrogen fixation, improved sugar transport and improved plant uptake and assimilation of available nutrients. Data revealed that application of that zinc and boron had an iconic influence on total soluble solids. Application of B-20 (0.09%) + $ZnSO_4$ (0.05%) showed the maximum (14.65 °Brix) TSS and shelling percentage (36.52%) of seed followed by application of B-20 (0.09%) + $ZnSO_4$ (0.03%) i.e., 14.20 °Brix. Similar findings have been reported by Salih *et al*. (2013) in tomato and Aslam *et al*. (2002) and Zahoor *et al*. (2013).

**Table 2:** Effect of zinc and boron on pod yield (q/ha), shelling (%) and TSS (°Brix) in pea.

| Treatments | Yield (q/ha) | Shelling (%) | TSS ($^0$Brix) |
|---|---|---|---|
| $T_1$- Control | 99.63 | 34.80 | 13.18 |
| $T_2$- B-20 (0.06%) | 103.70 | 35.14 | 13.24 |
| $T_3$- B-20 (0.09%) | 106.53 | 35.39 | 13.15 |
| $T_4$- $ZnSO_4$ (0.03%) | 111.54 | 35.44 | 13.20 |
| $T_5$- $ZnSO_4$ (0.05%) | 116.23 | 35.70 | 14.00 |
| $T_6$- B-20 (0.06%) + $ZnSO_4$ (0.03%) | 119.03 | 35.99 | 14.12 |
| $T_7$- B-20 (0.06%) + $ZnSO_4$ (0.05%) | 128.70 | 36.12 | 14.16 |
| $T_8$- B-20 (0.09%) + $ZnSO_4$ (0.03%) | 133.43 | 36.26 | 14.20 |
| $T_9$- B-20 (0.09%) + $ZnSO_4$ (0.05%) | 135.37 | 36.52 | 14.65 |
| S.Em (±) | 0.80 | 0.15 | 0.061 |
| C.D. at 5% | 2.40 | 0.46 | 0.1841 |

## Conclusion

It can be concluded that application of B-20 (0.09%) + $ZnSO_4$ (0.05%) showed the maximum plant height (58.80 cm), length and width of pod (4.03 and 1.7 cm), pod yield (135.37 q/ha) and TSS (14.65 °Brix) and shelling percentage (36.52%) of seed followed by application of B-20 (0.09%) + $ZnSO_4$ (0.03%) i.e., 14.20$^0$ Brix. Thus, application of B-20 (0.09%) + $ZnSO_4$ (0.05%) was found to the best among all the treatments and it gave the maximum growth attributes which will in turn improve the yield of garden pea.

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