Effect of FYM and Zinc Nutrition on Growth and Productivity of Pea (Pysum sativum L.) in Kashmir Conditions

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Authors’ contributions

This work was carried out in collaboration among all authors. ‘All authors read and approved the final manuscript.

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ABSTRACT

Present experiment carried out at Vegetable Farm, FOA (SKUAS-K) Wadura, Kashmir (India) to determine the influence of Farmyard manure (FYM) and Zinc nutrition on pea productivity. The experiment was set up in Factorial RBD with sixteen treatments and three replications. Pea variety PS-1100 was taken as experimental material. Growth height, yield attributing characteristics, and

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pod yield were recorded and statistically analysed. Both Zinc and FYM nutrition treatments showed a substantial impact on plant growth, yield and yield attributing characters in pea. Results revealed that treatment combination of Zinc at 5 kg ha⁻¹ + FYM at 350 q ha⁻¹ outperformed than other treatment combinations in terms of maximum pods plant⁻¹ (20.8), length of pods (9.4 cm), grain pod⁻¹ (9.8), pod weight (12.7g) and pod yield (71.2 q ha⁻¹). In conclusion, Zinc at 5 kg ha⁻¹ + FYM at 350 q ha⁻¹ is an effective dosage for maximizing pea pod production about 11.0 per cent greater than the control in Kashmir conditions.

Keywords: FYM; pea; Pisum sativum L.; plant growth zinc; yield.

1. INTRODUCTION

Pea [Pisum sativum L.; Family Leguminosae (Fabaceae)] is one of the important legume vegetable widely throughout tropical, sub-tropical and temperate regions of the world. Peas are a popular vegetable all over the world, and they are used in a variety of ways, including green pea beans for vegetable cooking, preparation of various vegetable meals, and canning. Peas are rich in protein (21-25%), carbohydrates, vitamin A and C, calcium, and phosphorus, as well as the amino acids lysine and tryptophan. [1]. Pea roots have symbiotic Rhizobium bacteria in root nodules that helps in nitrogen fixation and maintain soil fertility, that favour in encouraging the sustainable agricultural production [2].

Zinc is an essential micronutrient in plant nutrition. Zinc accelerates certain enzymes that are involved in the synthesis of some plant proteins. It aids in the production of chlorophyll and certain carbohydrates, the conversion of starches to sugars, and the resistance of plant tissue to low temperature stresses. Zinc deficiency has been found to be the most common micro-nutrient problem of agricultural crops around the world. Zn deficiency is a major nutritional constraint for successful crop production in many parts of India [3]. The distinct response of various crops to Zn treatment has been widely documented. The use of Zn-enriched organics increased soil nutrient status, nutrient availability, and crop output; also, the use of organic manures resulted in a significant increase in accessible Zn in the soil, as well as a residual effect of Zn treatment [4-7].

Chemical fertilizer application in vegetable crops are required for realizing high yields, but their improper use can be harmful to the environment, and high cost of fertilizers may casts negatively on production profitability [8]. The rising use of chemicals in intensive agriculture contaminate ground as well as surface water, and also have interference in the harmony in soil-plant-microbial flora [9]. Following the green revolution, indiscriminate use of inorganic fertilizer for enhancing crop output, including vegetable crops [10] but it has an impact on the environmental sustainability as well as human health. The utilization of organic nutrient sources such as farmyard manure (FYM), chicken manure, and cattle manure is becoming more popular in order to achieve higher yield and quality while also being environmentally and human health friendly. Bulky organic manures such as Cattle manure loosens the soil and promotes aeration while also supplying essential plant nutrients, organic matter [11]. It also increases soil microbial equilibrium and accumulating surplus humus content [11]. Therefore, the current experiment was aimed to determine the Zinc and Farmyard manure nutrition on plant growth and yield of pea.

2. MATERIALS AND METHODS

Present experiment carried out at Vegetable Farm at Division of Horticulture, FOA (SKUAST-K) Wadura, Kashmir (India) during 2019/2021. The experiment was conducted on pea variety PS-1100 with 16 combinations of Zinc and FYM and Factorial randomized block design with three replications was used for laying out the trial. There was four levels of Zinc (0, 2.5, 5, 7.5 kg ha⁻¹) and four level of FYM (0, 150, 250 and 350 t ha⁻¹). The doses of Zinc and FYM as per treatment were applied in mid-October and experimental plots were well pulverized before planting of seeds. Planting of seeds was carried out in last week of October. The plant spacing was maintained at 30 x 10 cm. Other cultural practices adapted to each treatment plots were as per recommendations of SKUAST-Kashmir for pea cultivation in Kashmir valley. Data on plant height (cm), number of pods (plant⁻¹), pod length (cm), grains (pod⁻¹), pod weight (g) and pod yield (q ha⁻¹) were ere collected. Two years data recorded on aforementioned parameters were pooled and analysed statistically and mean
significance difference was performed on the basis of critical difference (CD) at the 5% level of significance [12].

3. RESULTS AND DISCUSSION

Zinc and FYM nutrition had significant influence on the plant height (Fig. 1). The highest plant height was noted with Zn at 7.5 kg ha\textsuperscript{-1} (59.0 cm). But it was at par with Zn at 7.5 kg ha\textsuperscript{-1} (58.1 cm). FYM at 350 q ha\textsuperscript{-1} resulted the highest plant height (56.7 cm) but at par with FYM at 350 q ha\textsuperscript{-1}. Treatment combination of zinc at 5 kg ha\textsuperscript{-1} + 350 q ha\textsuperscript{-1} resulted the highest plant height (59.4 cm), followed by Zn at 7.5 kg ha\textsuperscript{-1} + FYM at 250 q ha\textsuperscript{-1} (59.2 cm) and lowest was recorded in Control (42.1). Furthermore, it was shown that all of the other treatments outperformed the control treatment in terms of plant height.

Zinc and FYM nutrition showed significant effect of yield attributing characters of pea i.e. number of pods per plant, length of pod, and number of grains per pod and weight of pod (Table 1). The maximum number of pods per plant (20.3), length of pod (9.1 cm), number of grains per pod (9.2) and weight of pod (12.2 g) recorded with the application of Zinc at 7.5 kg ha\textsuperscript{-1} but it was statistically at par with the level of Zinc at 5 kg ha\textsuperscript{-1} (19.8, 8.8 cm, 9.1 and 11.4 cm, respectively). The FYM application also significantly affected the yield attributing characters (Table 1). The maximum number of pods per plant (20.3), length of pod (8.3 cm), and number of grains per pod (9.0) and weight of pod (10.5 g) recorded with the application of FYM at 350 q ha\textsuperscript{-1} but it was statistically at par with the level of 250 q ha\textsuperscript{-1} (18.5 cm, 8.1 cm and 8.8 and 9.9 cm, respectively). The interaction effect of the Zinc and FYM was noted significant (Table 1). Treatment combination of Zinc at 5 kg ha\textsuperscript{-1} + FYM at 350 q ha\textsuperscript{-1} resulted the highest plant height maximum number of pods per plant (20.8), length of pod (9.4 cm), number of grains per pod (9.8) and weight of pod (12.7 g) followed by Zinc at 7.5 kg ha\textsuperscript{-1} + FYM at 250 q ha\textsuperscript{-1} while lowest in Control.

Zinc and FYM nutrition significantly influenced the pod yield of pea cv. PS-1100 (Fig. 2). The highest pod yield was with Zn at 5 kg ha\textsuperscript{-1} (70.8 q ha\textsuperscript{-1}) which was at par with Zn at 7.5 kg ha\textsuperscript{-1} (70.6 q ha\textsuperscript{-1}). FYM at 350 q ha\textsuperscript{-1} resulted significantly highest pod yield (68.8 q ha\textsuperscript{-1}) than other FYM treatments. Interaction effect of zinc and FYM on pod yield was also significant (Fig. 2). Treatment combination of zinc at 5 kg ha\textsuperscript{-1} + 350 q ha\textsuperscript{-1} resulted the highest pod yield (71.2 q ha\textsuperscript{-1}). All other treatments were also shown to be significantly superior in terms of pod yield when compared to the control.

In our study, increased plant height was found, which can be related to the fact that zinc modulates the regulation of auxin synthesis, a well-known growth promoting hormone that stimulates cell division and enlargement [13]. The enhanced plant height seen in our trial is consistent with Toga et al. [14], Pandey et al. [15], and Nadergoli et al. [16], who all reported a significant influence of Zinc on plant growth. According to Sanyal [17], this could be owing to the joint application of organic manures. Pandey et al. [18] found comparable results for increased crop growth and production metrics of garden pea. Different treatments resulted in significant differences in yield contributing variables including number of grains per pod and yield per hectare. This is because zinc therapy is essentially very beneficial to the crop’s reproductive productivity, since it stimulates male and female gametogenesis, which increases the number of flowers per plant.
Table 1. Effect of Zinc & FYM on yield attributing characters of pea cv. PS-1100

| Treatment          | Number of pods (plant$^{-1}$) | Pod length (cm) | Number of grains (pod$^{-1}$) | Pod weight (g) |
|--------------------|--------------------------------|-----------------|------------------------------|----------------|
| Zinc               |                                |                 |                              |                |
| Z$_1$ - Control    | 14.9                           | 6.2             | 6.9                          | 6.0            |
| Z$_2$ - 2.5 kg ha$^{-1}$ | 17.6                           | 7.4             | 8.9                          | 8.8            |
| Z$_3$ - 5 kg ha$^{-1}$ | 19.8                           | 8.8             | 9.1                          | 11.4           |
| Z$_4$ - 7.5 kg ha$^{-1}$ | 20.3                           | 9.1             | 9.3                          | 12.2           |
| SEM±               | 0.11                           | 0.04            | 0.03                         | 0.03           |
| CD                 | 0.24                           | 0.08            | 0.07                         | 0.06           |
| FYM                |                                |                 |                              |                |
| F$_1$ – Control    | 17.4                           | 7.4             | 8.4                          | 8.6            |
| F$_2$ - 150 q ha$^{-1}$ | 17.9                           | 7.8             | 8.6                          | 9.3            |
| F$_3$ - 250 q ha$^{-1}$ | 18.5                           | 8.1             | 8.8                          | 9.9            |
| F$_4$ - 350 q ha$^{-1}$ | 18.8                           | 8.3             | 9.0                          | 10.5           |
| SEM±               | 0.11                           | 0.04            | 0.04                         | 0.03           |
| CD                 | 0.24                           | 0.08            | 0.08                         | 0.06           |
| Zinc x FYM        |                                |                 |                              |                |
| Z$_1$F$_1$         | 13.9                           | 5.3             | 6.0                          | 4.5            |
| Z$_1$F$_2$         | 14.7                           | 6.2             | 6.6                          | 5.7            |
| Z$_1$F$_3$         | 15.2                           | 6.6             | 7.0                          | 6.6            |
| Z$_1$F$_4$         | 15.8                           | 6.8             | 8.0                          | 7.2            |
| Z$_2$F$_1$         | 16.6                           | 7.0             | 8.6                          | 7.8            |
| Z$_2$F$_2$         | 17.1                           | 7.3             | 8.7                          | 8.6            |
| Z$_2$F$_3$         | 18.2                           | 7.6             | 9.0                          | 9.1            |
| Z$_2$F$_4$         | 18.5                           | 7.9             | 9.3                          | 9.7            |
| Z$_3$F$_1$         | 18.8                           | 8.2             | 9.4                          | 10.0           |
| Z$_3$F$_2$         | 19.6                           | 8.6             | 9.6                          | 11.0           |
| Z$_3$F$_3$         | 20.1                           | 9.1             | 9.7                          | 12.0           |
| Z$_3$F$_4$         | 20.8                           | 9.4             | 9.8                          | 12.7           |
| Z$_4$F$_1$         | 20.4                           | 9.3             | 9.4                          | 12.4           |
| Z$_4$F$_2$         | 20.2                           | 9.2             | 9.3                          | 12.2           |
| Z$_4$F$_3$         | 20.3                           | 9.1             | 9.4                          | 12.1           |
| Z$_4$F$_4$         | 20.2                           | 9.1             | 9.2                          | 12.3           |
| SEM±               | 0.11                           | 0.08            | 0.05                         | 0.06           |
| CD                 | 0.24                           | 0.17            | 0.11                         | 0.13           |

Fig. 2. Pod yield of pea cv. PS-1100 as affected by different levels of zinc and FYM
Zinc nutrition may benefit pea pod yield as noted in our study might be attributed to the facts that Zinc increases stigma receptivity and function, as well as pollen viability, all of which contribute to healthy pollen grain germination and development, as well as an increase in yield metrics like the quantity, size, and weight of pods and seeds [19]. Furthermore, the incorporation of organic and zinc may be the cause of increased crop plant development and nodulation, resulting in increased pod production [20]. FYM and zinc integration for plant nutrition increased nutrient concentration and helped mobilize the unavailable fractions of nutrients in soil, prompting the acquisition of optimal nutrient supply across important crop stages [18].

The higher efficiency of organic matter could be attributed to the fact that organic manure, particularly FYM, would have given micronutrients at optimal levels. Plant nutrients play a vital part in chlorophyll creation, which increases the rate of photosynthesis and, as a result, the plant’s growth and economic yield. These findings are consistent with those of Navrang and Tomar [21]. The beneficial response of the pigeon pea to zinc fertilization, either soil or foliar, with and without FYM has previously been documented by many researchers [22,23].

The accumulation of dry matter in the plant at various stages is a reasonable assessment of growth as a cumulative expression of various growth factors. The beneficial benefits of zinc spraying on crop productivity could be attributed to the Zinc promotes mineral absorption in the roots and the production of the plant growth regulator. Indole acetic acid, glucose, and nitrogen metabolism result in high yield and yield components, and eventually improved plant nutrition, which boost photosynthetic efficiency, assimilation, and yield [24].

4. CONCLUSION

Zinc and FYM nutrition affects the plant growth and yield attributing parameters and pod yield of pea var. PS-1100. Application of Zinc at 5 kg ha⁻¹ + FYM at 350 q ha⁻¹ is determined the suitable dose for increasing higher pod yield in pea. It may be effective in sustaining crop productivity and improving soil health in Kashmir valley.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Bhat TA, Gupta M, Ganai MA, Ahanger RA, Bhat HA. Yield, soil health and nutrient utilization of field pea (Pisum sativum L.) As affected by phosphorus and biofertilizers under subtropical conditions of Jammu. Intl J. Modern Plant Animal Sci. 2013;1(1):1-8.
2. Negi S, Sing RV, Dwivedi OK. Effect of Biofertilizers, nutrient sources and lime on growth and yield of garden pea. Legume research. 2006;29(4):282-285.
3. Ramadass R, Krishnasamy R, Dhakshinamoorthy M. Response of paddy cultivars to Zinc application. Madras Agric J. 1995;82(2):143-144.
4. Devarajan R. Zinc nutrition in green gram. Madras Agric J. 1987;74:518-521.
5. Gupta VK, Potalia BS, Karwasra PS. Micronutrient contents and yield of pigeon pea and wheat as influenced by organic manures and zinc in a pigeon pea-wheat cropping sequence. Haryana Agric Univ J Res. 1988;17:346-355.
6. Singh SP, Rakipov NG. Effect of Zinc enriched clover and inorganic Zinc on wheat. Acta Agronomica Hungarica. 1990; 39(1/2):43-47.
7. Thennarasu L. Bioconversion and fortification of organic wastes for maize under garden land ecosystem. M.Sc. Thesis, TNAU, Coimbatore; 1994.
8. Bobade KP, Kolte SO, Patil BG. Affectivity of cyanobacterial technology for transplanted rice. Phykos. 1992:31:33-35.
9. Bahadur A, Singh J, Singh KP, Upadhay AK, Rai M. Effect of organic amendments and biofertilizers on growth, yield and quality attributes of Chinese cabbage (Brassica pekinensis). Indian J Agric Sci. 2006;76:596-598.
10. Abou-El-Magd MM, El-Shourbagy T, Shehata SM. Comparative study on the productivity of four egyptian garlic cultivars grown under various organic material in comparison to conventional chemical fertilizer. Australian Journal of Basic and Applied Sciences, 2012;6(3):415-421.
11. Greene C. An overview of organic agriculture in the United States. In: Organic Food. New York: Springer; 2007.
12. Panse VG, Sukhatme, PV. Statistical Methods for Agricultural Workers, 4th Edn. ICAR Publication: New Delhi: 1985.
13. El-Tohamy WA, El-Greedly NHM. Physiological responses, growth, yield and...
quality of snap beans in response to foliar application of yeast, vitamin E and zinc under sandy soil conditions. Aust. J Basic Appl Sci. 2007;1:294-299.

14. Togay N, Ciftci V, Togay Y. The effects of zinc fertilization on yield and some yield components of dry bean (Phaseolus vulgaris L.). Asian J Plant Sci. 2004; 3(6):701-704.

15. Pandey SK, Bahuguna RN, Pal M, Trivedi AK, Hemantaranjan A, Srivastava JP. Effects of pre-treatment and foliar application of zinc on growth and yield components of mungbean (Vigna radiata L.) under induced salinity. Indian J Plant Physiol. 2010;15(2):164-167.

16. Nadergoli MS, Yarnia M, Khoei, FR. Effect of zinc and manganese and their application method on yield and yield components of common bean (Phaseolus vulgaris L. cv. Khomein). Middle-East J Sci. Res 2011;8(5):859-865.

17. Sanyal SK. Colloidal chemical properties of humic substances: A Relook. J Indian Soc Soil Sci. 2001;49(4):567-69.

18. Pandey AK, Gopinath KA, Bhattacharya R, Hooda KS, Sushil SN, Kundu S, Selvakumar G, Gupta HS. Effect of source and rate of organic manures on yield attributes, pod yield and economics of garden pea grown under organic farming system. Indian J Agric Sci. 2006; 76(4):230234.

19. Pandey N, Gupta B. Improving seed yield of black gram (Vigna mungo L. var. DPU-88-31) through foliar fertilization of zinc during the reproductive phase. J Plant Nutr 2012;35(11):1683-1692.

20. Gopinath KA, Mina BL. Effect of organic manures on agronomic and economic performance of garden pea (Pisum sativum) and on soil properties. Indian J Agric Sci. 2011;81:236-239.

21. Navrang, S, Tomar, GS. Effect of integrated use of FYM and urea on yield, nutrient uptake and protein content of wheat (Triticum aestivum L.). Supplement Agron. 2016;11(1):663-668.

22. Shah KA, Gurjar R, Parmar HC, Sonani VV. Effect of sulphur and zinc fertilization on yield and quality of pigeon pea in sandy loam soil. Green Farming. 2016;7(2):495-497.

23. Purushottam BK, Puhup CS, Kumar K, Sodi B. Effect of irrigation scheduling and zinc application on chlorophyll content, zinc content, uptake and yield of chickpea (Cicer arietinum L.). J Pharmacog Phytochem. 2018;7(1):1834-1837.

24. Ali H, Khan MA and Randhawa SA. Interactive effects of seed inoculation and phosphorous application on growth and yield of chick pea (Cicer arietinum L.). International Journal of Agriculture and Biology 2004;6(1):110-112.