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Effect of Organic Manures and Foliar Application of Zinc on Growth and Yield of Field Pea (*Pisum sativum* L.)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Nutrient management is critical in agricultural crops for productivity. Micronutrients, while required in small amounts, are vital for several physiological processes, hence improving crop development, yield and nutritional value. The Department of Agronomy at SHUATS in Prayagraj, U.P., conducted a field experiment on the Field Pea crop during the rabi season of 2022. The soil in the experimental plot was sandy loam in texture, neutral in pH (7.2), with EC- 0.26 (dS/m0, organic carbon (0.72%), and accessible N (178.48kg/ha), P (27.80 kg/ha), and K (233.24kg/ha). The treatment included control 2t/ha neem cake 2t/ha vermicompost, 10t/ha of farm yard manure, and foliar application of zinc at 1.0% resulted in greater plant height 94.82 cm), nodules number per plant (5.63), pod number per plant (19.09) and number of seeds per plant (5.92) and seed yield (2.73 kg/ha).

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1. INTRODUCTION

"Pea (*Pisum sativum* L.) are grain legume and belongs to the member of the Leguminosae family, grown throughout the world. It is a native of central Southeast Asia (Medeterranean basin). It grows well in cool weather in the presence of ample moisture. Peas are recognized as one of the earliest agricultural crops domesticated by human beings. It is most important cultivated legume next to soyabean, groundnuts and beans" [1].

"Organic manures improve the quality of green pods. Therefore, Garden pea is one of the most nutritious leguminous vegetables, high in phytonutrients, minerals, vitamins, antioxidants, proteins, fiber, and low in quantity but high in quality fat, with several health advantages such as reducing stomach cancer, arthritis, Alzheimer's disease, diabetes, and boosting immunity. In addition to benefiting the human body, as a leguminous crop, it fixes nitrogen in the soil and is useful to the agricultural area.

Foliar application of fertilizers is one of the most important ways for crop production management" (Noack et al. 2010). Leaching and soil obstructions are key constraints that restrict the availability of soil nutrients to plants. Foliar spraying can help crops recover from nutritional issues (Fernández and Brown, 2013). As a result, foliar spraying has the ability to supply optimal nutrients to plants via the leaf in order to meet their nutrient requirements. Because plant roots are dormant during cold times, soil nutrients are rendered ineffective and are not absorbed by roots. However, leaf application is the greatest technique for applying nutrients to plants for improved growth and development (Ali et al. 2015). The performance of foliar nutrition application is dependent on the formulation's physicochemical qualities.

"The applications of plant nutrients through organic sources like compost, farm yard manure and bio fertilizers remains the alternative choice of the growers for maintaining its sustainable production. Organic manures can supply practically all the elements of soil fertility that the crops require, though not in adequate amounts and in right proportions. The plant food elements contained in manure are released in an available form upon decomposition by soil microorganism. Neem cake organic manure is the by-product obtained in the process of cold pressing of neem tree fruits and kernels, and the solvent extraction process for neem oil cake and also used as a fertilizer. It is used to enrich the soil by providing essential required nutrients. It also acts as a biofertilizer by providing the required nutrients, nitrogen and phosphorus necessary for growing crops and plants. Its use basically ensures a high yield of crop. It reduces alkalinity in soil, as it produces organic acids on decomposition. Being natural, it is compatible with soil microbes and rhizosphere microflora. Furthermore, Zn, Cu, Mg and Fe indicated a 91%, 67%, 56% and 10% increase in nutrient composition. The peas showed vigour and vitality during the period of growth. Pea can be grown on a variety of soil from light sandy loam to clay though best results are obtained on well drained, loose friable loamy soil. The pH range falls in between 6.0- 7.5" [2].

Farmyard manure are the major source of nutrient supply also on small farm holdings. It is a varying mixture of animal manure, urine, bedding material, fodder residues, and other components is the most common form of organic manure applied. It improves the soil structure and increases the soil capacity to hold more water and nutrients. Vermicompost stimulates growth, seed germination and development, flowering, and fruit production of a variety of plant species. Vermicompost increases soil organic matter and nutrient content, improves the soil structure and cation exchange capacity. The vermicompost serves as organic manure, since it is a source of nutrients, such as nitrogen, phosphate, potassium and micronutrients etc. It increases the availability of oxygen, maintains normal soil temperature, and increases soil porosity and infiltration of water. It is used in farming and small scale sustainable, organic farming and can also be applied for treatment of sewage.

"Zinc plays an outstanding role in synthesis of chlorophyll, protein and regulates water absorption. Moreover, it also plays role in carbohydrates metabolism and activation of various enzymes which help in inducing alkalinity tolerance in crops by enhancing Na/K and Na/Ca ration. Zinc plays a vital role in metabolism processes including carbohydrate, lipid, protein and nucleic acid synthesis and degradation. It also plays a key role in pollination and seed set processes, so their deficiency can cause

decrease in seed formation and subsequent yield reduction. Zinc is required for pollen function and fertilization nodule formation" [3] "Unfortunately, about 50% of Indian soils are deprived of which lead to visible abnormalities in plants like stunted growth, chlorosis, smaller leaves, spikelet sterility and increases the plant susceptibility to high light or temperature injury and fungal infections. The foliar spraying of Zinc significantly effects on chemical constituents including protein content, NPK % as well as oil %, they added that increasing zinc concentrations from 0.5-1.0 g/L significantly increase the characteristics chemical constituents" [4].

"The deficiency of zinc is most widely spread as reported" [5]. "Zinc deficiency is particularly reported from Punjab tarai area of U.P, some parts of Haryana, Western U.P, and Delhi. If zinc deficiency acute, a dose of 50 kg Znso4/ha is recommended. The deficiency of zinc has increase from 44%- 48% and it is expected to further increase up to 63% by 2025" [6]. "The poor use efficiency of zinc application has compelled the search for alternatives and hence different modes have been widely studied and adopted" [7-10].

Considering different reports, application of zinc is necessary for healthy crop growth and higher yields and its foliar application has shown some positive effects in various crops. Based on this background, the present investigation was carried out for assessing the growth and yield of garden pea as influenced by foliar application of zinc, in the form of ($ZnSO_4$) in SHUATS, Prayagraj, (U.P.).

2. MATERIALS AND METHODS

The experiment was carried out during *Rabi* season of 2022-2023 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P) which is located at 25.39"42" N latitude, 81.50"56" E longitude, and 98m altitude above the mean sea level. This area is situated on the right side of the river Yamuna and by the opposite side of Prayagraj City. All the facilities required for crop cultivation were available. The soil of the experimental field constituting a part of central Gangetic alluvial is neutral and deep. The soil was sandy loam in texture, low in organic carbon (0.112%) and medium in available nitrogen (278.93 kg/ha), phosphorus (10.8 kg/ha), and low in potassium. Nutrient sources were urea, and Muriate of Potash to fulfil the requirement of Nitrogen and Potassium. The phosphorus was applied in 40, 50, and 60 kg/ha through Single Super Phosphate nutrient source. The crop was sown on 5th November 2022. The experiment was laid out in Randomized Block Design with 10 treatments each replicated thrice viz., T1- 2t/ha Neem cake + 0.50% Zinc, T2- 2t/ha Neem cake + 0.75% Zinc, T3- 2t/ha Neem cake + 1.0% Zinc, T4- 2t/ha Vermicompost + 0.50% Zinc, T5- 2t/ha Vermicompost + 0.75% Zinc, T6- 2t/ha Vermicompost + 1.0% Zinc ,T7- 10t/ha FYM +0.50 % Zinc, T810t/ha FYM +0.75 % Zinc, T9- 10t/ha FYM +1.0 % Zinc T10- Control (20-50-50 NPK kg/ha). The growth parameters reading such as plant height (cm), Number of nodules/plant, plant dry weight (g) and also, yield parameters such as number of pods/plant, number of seeds/pod, seed yield (kg/ha), and stover yield (kg/ha). The growth parameters were recorded at an intervals of 20, 40, 60, 80, 100 DAS and at harvest stage, from the randomly selected five plants in each treatment. Statistically analysis was done using all the parameters in one-way Anova and means were compared at 0.05 probability level of significant results.

3. RESULTS

3.1 Influence of Organic Matter and Foliar Application of Zinc Growth Attributes of Field Pea

3.1.1 Plant height (cm)

Significantly highest plant height (94.82cm) was observed in treatment 9 (10t/ha FYM+ 1.0% Zinc*).* However, treatment 8 (10t/ha FYM + 0.50% Zinc) was statistically at par with treatment 9. The application 10t/ha FYM+ 1.0% Zinc resulted in significantly superior plant height to the rest of the treatments. The increase in plant height may be owing to the improvement in vigour of plants possibly by balanced supply and higher uptake of nitrogen and phosphorus [2].

3.1.2 Dry weight (g/plant)

Significantly maximum dry weight (30.35g) was observed in treatment 9 (10t/ha FYM+ 1.0%) However, treatment 9 (10t/ha FYM + 1.0% Zinc) was statistically at par with treatment 8. The seed inoculation with PSB + *Rhizobium sp*. improved the dry matter accumulation as compared to uninoculated treatment [2].

Table 1. Influence of organic manures and zinc on growth attributes of field pea.

S. No.	Treatments	Plant height (cm)	Dry weight (g/plant)
1.	2 t/ha Neem Cake + 0.50 % Zinc	91.39	26.47
2.	2 t/ha Neem Cake + 0.75 % Zinc	90.43	27.18
3.	2 t/ha Neem Cake + 1.00 % Zinc	91.68	28.20
4.	2 t/ha Vermicompost + 0.50 % Zinc	91.55	27.76
5.	2 t/ha Vermicompost + 0.75 % Zinc	92.63	28.04
6.	2 t/ha Vermicompost + 1.00% Zinc	93.62	29.20
7.	10t/ha Farm Yard Manure + 0.50 % Zinc	92.99	27.74
8.	10t/ha Farm Yard Manure + 0.75 % Zinc	93.02	28.08
9.	10t/ha Farm Yard Manure + 1.00 % Zinc	94.82	30.35
10.	Control (20-50-50 NPK kg/ha)	90.11	26.08
	F test	S	S
	SEm(±)	0.49	0.17
	CD (p=0.05)	1.46	0.52

3.2 Influence of Organic Matter and Foliar Application on Yield Attributes and Yield of Field Pea

3.2.1 Number of pods/plant

The treatment 10t/ha Farm Yard Manure + 1.00% Zinc produced the most pods per plant (19.09) significantly, however, 10t/ha Farm Yard Manure + 0.75 % Zinc, 2 t/ha Vermicompost + 1.00% Zinc and 2 t/ha Vermicompost + 0.75 % Zinc was statistically at par with the treatment of 10t/ha Farm Yard Manure + 0.75% Zinc [4].

3.2.2 Number of seeds/pod

The treatment 10t/ha Farm Yard Manure + 1.00% Zinc produced the most seeds/pod (5.81) significantly, the treatment of 10t/ha Farm Yard Manure + 0.75 % Zinc, 2 t/ha Vermicompost + 0.75 % Zinc and 2 t/ha Vermicompost + 1.00% Zinc which was statistically at par with the treatment 10t/ha Farm Yard Manure + 1.00% Zinc [4].

3.2.3 Seed yield (kg/ha)

The treatment 10t/ha Farm Yard Manure + 1.00% Zinc produced the most seed yield (2.73) significantly, the treatment of 2 t/ha Vermicompost + 1.00% Zinc, 10t/ha Farm Yard Manure + 0.75 % Zinc and 2 t/ha Vermicompost + 0.75 % Zinc was statistically at par with the treatment 10t/ha Farm Yard Manure + 1.00% Zinc [4].

Table 2. Influence of organic manures and zinc on yield attributes and yield of field pea varieties

S. No.	Treatments	No. of pods/plant	No. of seeds/ pod	Seed yield (kg/ha)	Stover Yield (kg/ha)
1.	2 t/ha Neem Cake + 0.50 % Zinc	15.67	4.92	1.14	3.12
2.	2 t/ha Neem Cake + 0.75 % Zinc	16.22	5.08	1.19	3.16
3.	2 t/ha Neem Cake + 1.00 % Zinc	17.20	5.20	1.20	3.23
4.	2 t/ha Vermicompost + 0.50 % Zinc	16.66	5.12	1.06	3.29
5.	2 t/ha Vermicompost + 0.75 % Zinc	17.83	5.49	1.32	3.50
6.	2 t/ha Vermicompost + 1.00% Zinc	18.13	5.53	2.29	2.90
7.	10t/ha Farm Yard Manure + 0.50 % Zinc	17.44	5.38	1.19	3.45
8.	10t/ha Farm Yard Manure + 0.75 % Zinc	18.61	5.66	1.97	3.51
9.	10t/ha Farm Yard Manure + 1.00 % Zinc	19.09	5.92	2.73	4.08
10.	Control (20-50-50 NPK kg/ha)	15.19	4.65	1.04	2.31
	F test	S	S	S	S
	SEm(±)	0.03	0.35	0.15	0.24
	CD (p=0.05)	0.10	1.06	0.46	0.74

3.2.4 Stover yield (kg/ha)

The treatment 10t/ha Farm Yard Manure + 1.00% Zinc produced the most stover yield (4.08) significantly. The treatment of 10t/ha Farm Yard Manure + 0.75 % Zinc, 2 t/ha Vermicompost + 0.75 % Zinc and 10t/ha Farm Yard Manure + 0.50 % Zinc was statistically at par with the treatment 10t/ha Farm Yard Manure + 1.00% Zinc [9].

4. CONCLUSION

Pea is one of the most valued vegetables in the world. It is critical to focus on improving the yield-related features of this crop. Foliar application is an efficient, method of delivering micronutrients. Furthermore, foliar treatment of blend of various micronutrients Organic manure is good for increase pea production. As a result, Foliar application of zinc at 1.0% in combination with the application of farm yard manure at 10t/ha resulted in increased production and benefit-cost ratio.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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