Original Research Article

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

ABSTRACT

An experiment was conducted ~~on the~~ at Vegetable Farm ~~at~~ , Division of Horticulture, Faculty of Agriculture, Wadura, SKUAST (Kashmir) to determine the influence of Zinc and Farmyard manure (FYM) nutrition on pea productivity. ~~With sixteen treatments and three replications, the experiment was set up in Factorial RBD~~The experiment was set up in Factorial RBD with sixteen treatments and three replications. ~~Zinc and FYM were sprayed at four different levels in all possible combinations.~~ Pea cultivar PS-1100 was taken as ~~the as~~ experimental material in which Zinc and FYM were sprayed at four different levels in all possible combinations~~.~~. ~~Growth height, yield attributing characteristics, and pod yield were recorded and statistically analysed. Both~~ Treatments with Zinc and FYM ~~nutrition~~ combinations ~~treatments~~ showed a substantial impact on plant ~~height~~growth, yield and yield ~~attributes~~ attributing parameters ~~and pea pod yield~~ in pea. The results revealed that, the treatment combination of Zinc at 5kg ha^{-1} + FYM at 350q ha^{-1} outperformed than~~e~~ other treatment combinations in terms of maximum number of pods per plant (20.8), length of pods (9.4 cm), number of grains per pod (9.8), ~~weight of pod~~pod weight (12.7g), and ~~yield~~ pod yield / grain yield ? (71.2 q ha^{-1}). In conclusion, Zinc at 5kg ha^{-1} with FYM at 350q 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.~~ remove, Plant Growth Zinc, Yield

1. INTRODUCTION

Pea (~~[~~*Pisum sativum* L.)~~; Family Leguminosae (Fabaceae)]~~ is one of the important vegetables commonly used in human diet throughout the world and it is rich in protein (21-25 %), carbohydrates, vitamin A and C, Ca, phosphorous and has high levels of amino acids lysine and tryptophan [1]. Its cultivation maintains soil fertility through biological nitrogen fixation in association with symbiotic rhizobium prevalent in its root nodules and thus plays a vital role in fostering sustainable agriculture [2]. Zinc deficiency has been reported to be the most widespread micro-nutritional disorder of the food crops in India as well as the world over (Source ?). ~~Though marked response of crops to Zn application has been noticed, Zn deficiency is a major nutritional constraint for successful crop production in Tamil Nadu [3]~~ (your experiment conducted in Kashmir). The application of Zn enriched organics improved the soil nutrient status, nutrient availability and crop yield [4-7]. Substantial buildup of available Zn in soil has been observed with the use of organic manures and residual effect of Zn application.

~~Chemical fertilizers are needed to get good crop yields but their abuse and overuse can be harmful for the environment and their cost cannot make economic and profitable~~

agricultural products [8]. The increased use of chemicals under intensive cultivation has not only contaminated the ground and surface water but has also distributed the harmony existing among the soil, plant and microbial population [9]. It has been reported that excessive amounts of inorganic fertilizers are being applied to vegetables in order to achieve a higher yield [10]. Continuous use of in organic fertilizer for crop production will affect the sustainability of environment and as well as the human health. In this context, the use of organics organic manures and bio fertilizers (you have not used any bio fertilizer in experiment) like farmyard manure (FYM), poultry manure, cattle manure is gaining more importance for getting higher yield and quality (Source ?). Cattle manure being bulky organic material releases the soil compactness and improves the aeration in addition to the supply of essential plant nutrients and organic matter and increase soil microbial establishment along with accumulation of excess humus content [11]. Therefore, the current experiment was aimed at determining the influence of Zinc and Farmyard manure on growth and yield of pea. (Introduction is very poor, please rewrite the chapter / add the information regarding crop and material taken as treatments in your experiment)

2. MATERIAL AND METHODS

The present investigation was conducted on theat Vegetable Farm at , Division of Horticulture Faculty of Horticulture Wadura, SKUAST (K) Shalimar, during *Kharief* season of 2017 and 2018. The experiment was laid out in factorial randomized block design with three replications. The PS-1100 variety of pea crop was selected for this study. Experiment was conducted in pea variety PS-110 with comprised of for levels of Zinc and Four level of FYM constituting sixteen treatments combinations of Zinc and FYM. Seeds were sown on last week of October(year) at the seed rate of 70 kg ha^{-1}. The seeds were placed 3-4 cm deep in the open furrow distance of 30 cm row to row and 10 cm plant to plant and then covered with a thin layer of soil. The pods of garden pea were harvested in three pickings at weekly intervals. At 30 days after sowing a light hoeing was done to remove the weeds along with the thinning operations maintaining a plant spacing of 8 to 10 cm. A second weeding was done at 60 days after sowing and all the cultural practices were followed as per package of practices. To avoid water stress condition three irrigation were given during the crop growth. The data collected from five plants of each plot (one replication) on for various growth parameters and yield attributes characters, nodule and pod yield were recorded under various treatments. Data were collected from five plants of each plot (one replication). Before sowing composite soil samples representing the whole field and after harvest plot wise samples were collected. For determination of performance of variety over treatment Factorial Randomized Block Design was applied. Test of significance were recorded on the basis of critical difference at 5% per cent level of significance as per standard procedure [12]. Reference missing
Statustical analysis ?
Parameters takens for data collection?

3. RESULTS AND DISCUSSION

Add introduction about crop performance for growth and yield by Zinc and FYM based on past literature then come to the results part of your experiment

Data revealed that Zinc and FYM had significantly influenced the plant height (Fig 1). The highest plant height was found recorded with application of Zn @ at 7.5 kg ha^{-1} (59.0 cm) which was at par with Zn @ at 7.5 kg ha^{-1} (58.1 cm). FYM @ at 350 q ha^{-1} resulted the highest plant height (56.7 cm) but at par with FYM @ at 350 q ha^{-1}. Treatment combination of zinc @ at 5kg ha^{-1} + 350 q ha^{-1} resulted the highest plant height (59.4 cm), followed by Zinc @ at 7.5 kg ha^{-1} + FYM @ at 250 q ha^{-1} (59.2 cm) and lowest was recorded in Control

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(42.1 cm). Further, it was also observed that all the other treatments were significantly superior for plant height compared to control ~~treatment~~.

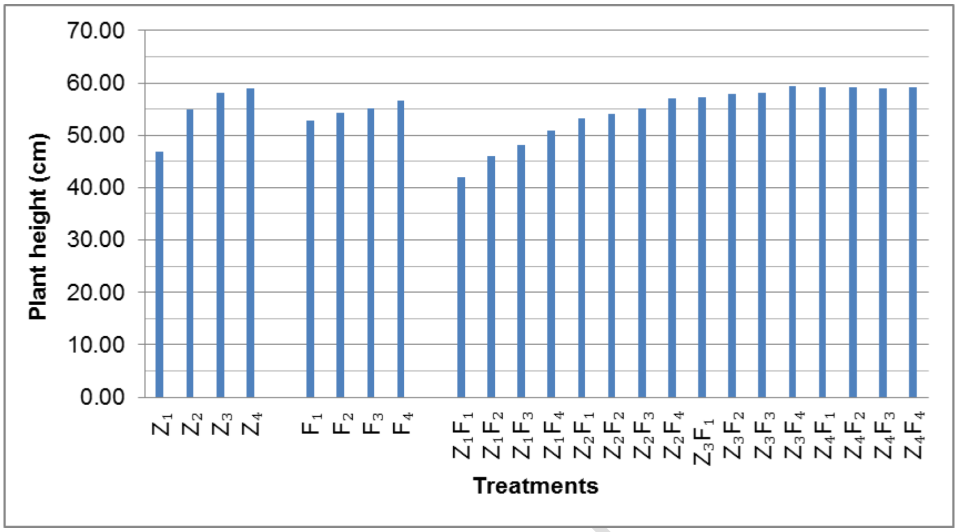

Fig. 1. Plant height of pea ~~cv.~~ (Cv or Var. ?) PS-1100 as affected by different levels of zinc and FYM

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~~pod weight (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~~pod weight (12.2 g) recorded ~~with~~ from the treatment in which application of Zinc at 7.5 kg ha^{-1} but it was statistically at par with the application level of Zinc @ 5.0 kg ha^{-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~~pod weight (10.5 g) recorded with the application of FYM at 350 q ha^{-1} but it was statistically at par with the level of 250 q ha^{-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 @ 5 kg ha^{-1} + FYM @ 350 q ha^{-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 @ 7.5 kg ha^{-1} + FYM @ 250 q ha^{-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 @ 5 kg ha^{-1} (70.8 q ha^{-1}) which was at par with Zn @ 7.5 kg ha^{-1} (70.6 q ha^{-1}). FYM @ 350 q ha^{-1} resulted significantly highest pod yield (68.8 q ha^{-1}) than other FYM treatments. Interaction effect of zing and FYM on pod yield was also significant (Fig 2). Treatment combination of zinc @ 5 kg ha^{-1} + 350 q ha^{-1} resulted the highest pod yield (71.2 q ha^{-1}). Further, it was also observed that all the other treatments were significantly superior for plant height compared to control treatment.

In our study, the growth in terms of increased plant height was observed. This can be attributed to the fact that Zinc affects the regulation of auxin synthesis which is well known growth promoting hormone activating the cell division and enlargement [32]. Our

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results are in close conformity with Toga *et al*. [14], Pandey et al. [15] and Nadergoli et al. [16] those also reported considerable influence of Zinc on shoot length or height of the plant, and showed its positive effect on the same. Our results closely related to the results of Sanyal [7] who suggest that this might be due to the combined application of organic manures.

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Table 1. Effect of Zinc & FYM on yield attributing characters of pea cv. PS-1100.

Treatment	Number of. pods per plant	Length of pod (cm)	Number of grains per pod	~~Weight of pod (g)~~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	0.07	0.06
Zinc x FYM				
Z_1F_1	13.9	5.3	6.0	4.5
Z_1F_2	14.7	6.2	6.6	5.7
Z_1F_3	15.2	6.6	7.0	6.6
Z_1F_4	15.8	6.8	8.0	7.2
Z_2F_1	16.6	7.0	8.6	7.8
$Z2F_2$	17.1	7.3	8.7	8.6
Z_2F_3	18.2	7.6	9.0	9.1
Z_2F_4	18.5	7.9	9.3	9.7
Z_3F_1	18.8	8.2	9.4	10.0
Z_3F_2	19.6	8.6	9.6	11.0
Z_3F_3	20.1	9.1	9.7	12.0
Z_3F_4	20.8	9.4	9.8	12.7
Z_4F_1	20.4	9.3	9.4	12.4
Z_4F_2	20.2	9.2	9.3	12.2
Z_4F_3	20.3	9.1	9.4	12.1
Z_4F_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

Inorganic sources, produced the best response on growth parameters due to high initial microbial load supported by sufficient quantity of organic carbon to be later used for microbial proliferation and consequently releasing the nutrients that readily assimilates, supporting the biotic principle of carbon sequestration through improved biomass production. Similar results were also obtained by Pandey *et al*. [18] for better crop growth and yield attributes of garden pea under organic management. Yield contributing characteristics like number of grains per pod and yield per hectare showed the significant differences due to different treatments. This can be attributed to the fact that, application of zinc is essentially very beneficial for the reproductive yield of the crop, as it stimulates the

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male and female gametogenesis, which increases the number of flowers per plant. Then again, zinc application also stimulates the sporogenous tissue production, resulting in increase of pollen grain number per anther.

In addition, zinc also facilitates the pollen stigma interaction by improving the stigma receptivity and functioning and also the pollen viability, and together, all these lead to proper germination of pollen grains and normal development as well as increase in yield parameters like number, size and weight of the pods and seeds [19]. This might be due to integration of organic and inorganic sources of nutrients enhanced the growth and nodulation of crop and in turn produced more pod yield [20]. Such response of integrated combination was due to relatively high nutrient concentration and initial microbial population helped in mobilizing the unavailable pool of nutrients in soil, thereby triggering the acquisition of optimum nutrient supply across critical crop stages [18].

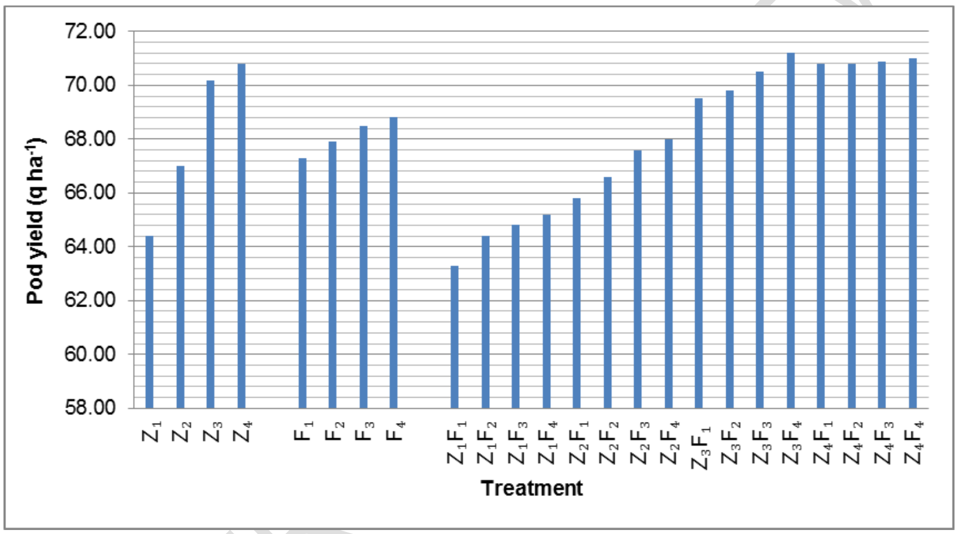

Fig. 2. Pod yield of pea (Cv or Var. ?) ~~cv.~~ PS-1100 as affected by different levels of zinc and FYM

The increase in yield of garden pea due to the application of organic and inorganic fertilizers alone or in combination maybe due to the improvement of yield attributes and the beneficial effect of combined use of organic and inorganic fertilizers influencing the physical, chemical and microbiological properties of soil. The better efficiency of organic matter might be due to the fact that the organic manure especially FYM would have provided micronutrient at optimum level which play important role in chlorophyll formation which increase rate of photosynthesis and ultimately growth of the plant. These results are in accordance with the findings of Navrang and Tomar [21]. The positive response of the pigeon pea to zinc fertilization either through soil or foliar with and without FYM has already been reported by different researchers in diverse [22,23].

The positive effects of zinc application to crop yield might be due to the Zinc fertilizer (as $ZnSO_4$) decreases pH of soil and increases root absorption of minerals and improved Zn nutrition of plants improves biosynthesis of the plant growth regulator Indole acetic acid, carbohydrate and nitrogen metabolism which lead to high yield and yield components. The enhanced plant nutrition increases photosynthesis efficiency, assimilation and production

[24]. Dry matter accumulation in the plant at progressive stages is a justified assessment of growth as a cumulative expression of different growth parameters. ~~Mohamed [25] reported that the zinc element contributes to the process of building and forming chlorophyll molecules and has important role in the process of building and forming the protein and activates many of the enzymes, including starch production.~~ Quality parameters not studied according this manuscript so no need to close up with quality.

4. CONCLUSION

Zinc and FYM nutrition affects the plant growth and yield attributing parameters and pod yield of pea **(Cv or Var. ?)** ~~cv.~~ PS-1100. Application of Zinc ~~@~~ at 5kg ha-^{1} + FYM ~~@~~ at 350 q ha^{-1} is ~~determined~~ the suitable dose ~~of Zinc and FYM~~ for ~~realizing~~ increasing higher ~~pea~~ pod yield in pea. ~~than control and also i~~It may be effective in sustaining crop productivity and improving soil health in Kashmir valley.

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