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Response of farm yard manures and zinc application of growth parameters and yield of winter maize *(Zea mays)*

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ABSTRACT

Field experiment was conducted at organic research farm Karguan Ji, Institute of Agricultural Sciences, Bundelkhand University Jhansi (UP) during rabi season. The experiment was laid out in randomized block design comprised three levels of FYM (0, 10and 20t/ha) and three levels of Zinc (0,5 and 10 kg/ha) with three replications. The application of FYM and Zinc obtained significantly higher values in respect to growth,yield attributes and yieldof maize in all the treatments, over control.The maximum values and increased percentage were recorded in respect to plant height, no. of grains/cob, grains weight/cob, weight/cob, 100 seed weight, biological yield, stover yield and grain yield of 146.03cm and 12.35%, 288.66 and 7.4%, 96.86g and 12.36%, 92.30g and 13.72%, 20.1g and 5.0%, 150.33 q/ha and 33.67%, 107.16 q/ha and 33.3%, 42.86 q/ha and 33.4% with T_8 treatment respectively,over control, followed by T_7, T_5 and T_2 treatments. All the treatments were found superior in respect to all parameters, over control, while T_8 treatment was proved most superior among the treatments. The data in respect of harvest index statistically found non significant. The lowest values regarding growth, yield attributes and yield at lower level of10 t/ha FYM along with 5 kg/ha Zinc application in the study.The soil samples were found neutral in reaction, normal in EC, low in organic carbon, low in available nitrogen, medium in available phosphorous& zinc and high in available potassium.

Figure : 00 References : 17 Tables : 03
KEY WORDS : Biological yield, FYM, Grain yield, Harvest index, Stover yield, Zinc.

Introduction

In terms of acreage and productivity, maize (*Zea mays*) is the world's third most significant cereal crop after wheat and rice. Maize is recognised as the "queen of cereals" around the world because it has the highest genetic output potential of all cereals. In world Maize crop area (32 million hectare), production(368 MT) and productivity (5.78 T/ha) has first rank in America followed by Brazil and China in year 2020-2021.In India area of this crop was (9.5 million hectares) and production (29.50 MT) in year 2020-2021. In rabi season highest area(1.2 million hectare) and production (5.8 MT) were in Bihar. Maize has the ability to provide enormous volumes of energy-rich forage for animal diets and its fodder can be provided at any stage of development without causing harm to the animals any danger of oxalic prussic acid[8]. Using fertilisers in conjunction with organic manures is a long-term solution for optimal nutrient usage that improves the efficiency of chemical fertilisers while lowering nutrient losses[16].Organic manures combined with inorganic fertilisers accumulate more total nitrogen in soil, but sole application of farm yard manure (FYM) resulted in increased maize yield, higher SOM content (44 percent), improved soil porosity and 16 times more water holding capacity[4].Farm yard manure (FYM) is the most essential organic source since it provides all of the nutrients required for crop growth, including trace elements in modest quantities. Mineralization of organic forms of nutrients, such as nitrate, is required before they can be used by plants. When cow dung and urine are combined, the plants receive a well-balanced diet.FYM can become a key nutrient source for food crops and reduce the need for fertilisers in families where agricultural and livestock production are combined[12].Maize is one of the cereal crops most vulnerable to zinc deficiency. Because high-yielding maize varieties are planted, chemical fertilisers of higher purity and cropping has got more intensive in recent decades. Zn shortage in soil crop systems has become more common[3]. Zinc treatment has been reported to boost maize grain yields all over the world[6]. Increasing Zn fertiliser rates may provide more accessible Zn to crops, but it may not be cost-effective. Zinc insufficiency is

thought to be the most frequent micronutrient deficit. Maize is vulnerable to Zinc deficiency, according to a vast number of prior studies. Zinc is an essential component of plant metabolism and growth.It is necessary for the creation of auxins and the chlorophyll cytochrome pigment, as well as for the regulation of enzymes, carbohydrates, as well as for proper root development. Photosynthesis and nitrogen metabolism are both dependent on the metal.The zinc nutrient in soil is critical for maize production and it is estimated that 50 percent of cereal-growing soil in India is zinc deficient[10]. High-yielding varieties of many crops rapidly deplete soil micronutrients, resulting in deficiency issues.According to the World Health Organization (2002), zinc deficiency in humans causes a variety of illnesses, particularly in children and women from low-income countries. Given the importance of zinc for human health, Indian soils are deficient in the micronutrient[17], and its deficit in India has increased from 44% to 48% in recent years.It is expected to further increase[15] up to 63% by 2025. Zinc is essential for functional and structural integrity of about 2800 proteins.Field experiment was done with the goals of determining the influence of zinc with or without FYM on maize crop output.

Material and Methods

The field experiment was conducted at Kargunwa-ji Organic Research Farm, Deptt. of soil science & agricultural chemistry, Institute of Agricultural Sciences, Bundelkhand University, Jhansi, in the rabi season 2018-2019. The experimental soil was red loam(Parwa) with slightly alkaline in nature. The experimental soil is low(0.19%) in organic matter, available nitrogen(98.0 kg/ha), available phosphorus(14.5 kg/ha), available potassium(208 kg/ha) and medium (11.31 and 0.58 ppm) in sulphur and zinc. Three levels of FYM (0,10 and 20 t/ha) and three levels Zinc (0, 5 and 10 kg/ha.) were applied before sowing in the field trail .The recommended doses of fertilizers- N 100kg/ha, P 60 kg/ha ,K40 kg/ha were applied in the form of Urea, DAP and MOP. The half quantity of nitrogen, whole quantity of phosphorus, potassium and whole quantity of Zinc were applied as basal dressing and rest half of nitrogen was applied as top dressing. The experiment was carried out in randomized block design with three replications.The treatment combinations were as T_0control (FYM 0+ Zn 0),T_1 (FYM 0+ Zn 5 kg/ha),T_2 (FYM 0+ Zn 10 kg/ha), T_3(FYM 10 t/ha + Zn 0), T_4 (FYM 10 t/ha + Zn 5 kg/ha), T_5 (FYM 10 t/ha + Zn 10 kg/ha), T_6 (FYM 20 t/ha + Zn0), T_7(FYM 20 t/ha + Zn 5 kg/ha) and T_8(FYM 20 t/ha + Zn 10 kg/ha)The net unit plot size 2.0×1.0 m^2 seed of maize K-25 (variety) were sown on 24th Nov 2018 at spacing of 60cm×20 cm. The maize crop was harvested on 20th March 2019, when plants showed the maturity and drying up of the maximum grains.The hansiyais used for the harvesting without injuring the cobs and plants .When necessary, the agronomical packages of practises were implemented. The observations on plant growth traits and grain yield were collected, and the data were analysed using the MS STAT programme and the DMRT teat for mean separation.The soil pH and available Potassium were determined[7], EC, OC, available Nitrogen, available Phosphorus, and available Sulphur extracted from soil with 0.15%calcium chloride($Cacl_2$) solution and the extracted sulphur was determined by turbidi metric method[2]. The available zinc in these soils was extracted by DTPA[11] and Zinc in the extract was determined on Atomic Absorption Spectrophotometer.The NPK content in seed and straw were determined according to the method described by A.O.A.C. and protein content in seed was calculated by multiplying total nitrogen content in grain by 6.25. The harvest index (HI) determined by

TABLE-1: Response of FYM and Zinc on growth and yield attributes of winter maize.

Treat-ments	Plant height (cm)	Grains /cob (no)	Grains weight/ cob (g)	Weight/ cob (g)	100 seed Weight (g)
T_0	129.53	212.90	86.20	81.16	19.0
T_1	131.03	216.36	87.43	82.46	19.0
T_2	134.67	218.80	89.20	84.13	18.9
T_3	133.43	217.23	87.76	83.46	19.1
T_4	135.20	218.53	90.36	84.63	19.5
T_5	136.86	220.50	93.66	88.33	19.6
T_6	136.07	219.73	89.43	87.76	19.4
T_7	141.20	224.33	90.90	90.56	19.7
T_8	146.03	228.66	96.86	92.30	20.1
SE $(M)^{+-}$	0.350	0.126	0.116	0.098	0.054
CD at 5%	**1.058**	**0.380**	**0.352**	**0.298**	**0.164**

dividing the total grain yield by biological yield and multiply with 100. The nutrient uptake by following formula-

$$\text{Nutrient uptake kg/ha} = \frac{\text{Content \% x dry matter accumulation kg/ha}}{100}$$

Results and Discussion

Effect of Farm Yard Manure

A critical examination of data (Table-1 and 2) reveal that the plant height, no. of grains/cob, grains weight/cob, weight/cob and 100 seed weight were increased significantly with increasing each level of FYM application over control. The maximum plant height and corresponding percentage (136.70 cm and 5.53%), no. of grains/cob (219.73 and 3.20%), grains weight/cob (89.43g and 3.7%), weight /cob (87.76g and 8.3%) and 100 seed weight (19.4g and 5.0%), biological yield (131.95 q/ha and 17.3%), stover yield (94.25 q/ha and 17.3%) and grain yield (37.70q/ha and 17.4%) were reported. The maximum values were observed at 20 t/ha FYM application. The harvest index was found statistically at par.Applications of FYM in soil improved the physical properties thus ultimately increasing the plant height. Similar results were also reported[10,13] that stimulated plant height on soil application of FYM to maize crop.The results indicated that the treatment 6(20 t FYM) is superior among the treatments.

TABLE-2: Response of FYM and Zinc on yield of winter maize.

Treatments	Grain yield (q/ha)	Stover yield (q/ha)	Biological yield (q/ha)	Harvest Index (%)
T_0	32.13	80.33	112.46	28.57
T_1	33.33	83.33	116.50	28.61
T_2	35.90	89.75	125.56	28.59
T_3	36.40	91.00	128.73	28.28
T_4	38.23	95.58	133.69	28.59
T_5	40.53	101.33	141.86	28.57
T_6	37.70	94.25	131.95	28.57
T_7	39.30	98.25	137.55	28.57
T_8	42.86	107.16	150.33	28.57
SE (M)$^{+-}$	0.075	0.188	0.498	0.101
CD at 5%	0.226	0.568	1.505	N/S

Effect of Zinc

The data Table-2 indicated that the significant increasement in growth parameters were noted with increasing each level of zinc application. The maximum plant height, no. of grains/cob, grains weight/cob, weight/cob and 100 seed weight were recorded as 134.63 cm ,218.80, 89.20g, 84.13g and 18.97g respectively, over control with 10 kg/ha zinc application. The data revealed that 10 kg/ha zinc application proved as beneficial and superior treatment. The maximum biological yield(125.96), stover yield (89.75) and grain yield (35.90)q/ha were noted, while in case of harvest index data were indicated statically non-significant. Zinc is one of the most important limiting micronutrient in maize crop, affecting both stover and grain output. Proteins require zinc for functional and structural integrity. The availability and solubility of zinc in soil may be responsible for the rise in grain and stover yields. Similar findings were also reported[1,10,17]. Zinc sulphate treatment (10 kg/ha zinc) of zinc-deficient soils prevented considerable improvements in maize crop development and production. The purpose of this study was to see how farm yard waste and zinc sulphate affected maize growth, yield characteristics, and yield, as well as zinc sulphate affected maize phenology yield and quality.

Combined effect of FYM and Zinc

The results of present study were indicated(Table-1 and 2) that the significant increasement in plant height, no. of grains/cobs, grains weight/cobs, weight/cob and 100 seed weight with increasing levels of FYM and Zinc application as 12.35%, 7.4%, 12.36%, 13.72% and 5.0% respectively, over control. The maximum values irrespective of plant height, no.of grains/cob, grains weight/cob, weight/cob and 100 seed weight were recorded 146.03cm 288.66, 96.86g, 92.30g,and 20.1g at the application of 20 t/ha FYM along with 10 kg/ha Zinc. The significant increasement in biological yield, stover yield and grain yield were also reported with the maximum values and percentage increasement in biological yield (150.33 q/ha and 33.7%), stover yield (107.16 q/ha and 33.3%), grain yield(42.86 q/ha and 33.40%).Our findings are in agreement with the results reported earlier[10,13] on the application of FYM and Zinc to maize crop. There was a considerable increasement in growth, yield characteristics and yield. It could be attributed to an increase in the soil's physico-chemical and biological qualities as a result of the FYM and individual zinc

TABLE-3: Physico-chemical characteristics of experimental soil.

Parameters	Before showing	After harvest Range	Mean values
Soil pH (1:2.5)	7.9	7.60 - 7.3	7.45
EC ($dsm^{-1)}$	0.5	0.40 - 0.32	0.36
Organic carbon (%)	0.19	0.20 - 0.26	0.23
Available N (kg/ha)	98.0	101 – 107	104
Available P (kg/ha)	14.5	15.4 - 21.0	18.2
Available K (kg/ha)	208	210 – 214	212
Available Zn (ppm)	0.58	0.61 - 0.68	0.64

application. The FYM promotes growth and the availability of other micronutrients, while zinc plays an important role in protein synthesis in grains.

Soil studies

The integration of FYM and zinc were slightly reduced in pH and EC of soil varies from (7.60 - 7.3 and 0.40 - 0.32 dS/m) with a mean value of 7.45 and 0.36 dS/m. The result has shown slightly alkaline category in respect of pH and normal range of EC. The organic carbon content in soil samples were ranged between (0.20% to 0.26%) with a mean value of 0.23% the result has shown low in the soil organic carbon content. The available nutrients(N, P and K) varied from (101 – 107 kg/ha, 15.4 - 21.0kg/ha and 210 – 214 kg/ha) with the mean value of 104 kg/ha,18.2 kg/ha and 212 kg/ha. The soil samples were found low available nitrogen, medium available phosphorous, high available potassium and the DTPA extractable zinc ranged from (0.61-.068 ppm) with a mean value of 0.64 ppm. The result[11] was found in medium soil fertility status, over initial soil samples.

Conclusion and Recommendation

The field experiment shows that FYM and zinc have significant improvement on various growth and yield attributes in winter maize. The finding shows steady increases in grain yield after applying FYM (20 t/ha) along with zinc (10 kg/ha). However the increase in grain and stover yield from 10 to 20 t/ha FYM was low as compared to application of 10 t/ha FYM as soil application. The FYM and zinc supplementation improved the soil health and crop productivity. The results, however, indicate for further detailed studies to asses the dose optimisation of FYM along with zinc supplementation in winter maize.

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