Effect of Poultry manure, Vermicompost and Boron on growth and yield of Maize

ABSTRACT:

A field experiment titled “Effect of Poultry Manure, Vermicompost and Boron on Growth and Yield of Maize” (*Zea mays* L.) was conducted during *Rabi* 2022 at Crop Research Farm. Department of Agronomy, Naini Agriculture Institute SHUATS, Prayagraj Uttar Pradesh. The experiment was laid out in Randomized Block Design with ten treatments which are replicated thrice. Results obtained that combined application of Poultry Manure 50% (1t/ha) along with Vermicompost 50% (2 t/ha) and Boron – 5% (Treatment) significantly increased higher plant height (234.45 cm), plant dry weight (135.84 g/plant) and also yield attributes like effective Number cobs per plant (2.00), Number of Seeds per cob (302.67), Seed index (24.69 g), Grain yield (6.73t/ha), stover yield (15.20 t/ha) and Harvest index (30.68%).

The economics *viz.*, maximum gross returns (INR/ha 39,832.43), net returns (INR/ha 84,600.00) and benefit cost ratio (2.48) was also recorded in treatment 9 [Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 5%)]

Keywords: *Maize, vermicompost, Poultry manure, boron, growth parameters, yield attributes.*

INTRODUCTION:

Maize *(Zea mays L.)* is one of the most versatile crops grown throughout the tropical as well as temperate regions of the world. Every month of the year, a crop of maize is planted and harvested somewhere in the world. It is sometimes referred to as the "QUEEN OF CEREALS" since no other cereal on the planet has such enormous potential. After rice and wheat, it is the third most significant cereal crop in the world. India ranks eighth in the world for maize production and fifth for acreage. From loamy sand to clay loam, maize can be cultivated successfully in a variety of soil types. Currently, 170 nations produce maize, with an average global productivity of 5.75 t/ha. This results in a total production of around 1147.7 million metric tonnes of maize from an area of 193.7 million hectares. (**FAOSTAT, 2020**).

India accounts for around 4% of the world's total maize acreage and 2% of its production, placing it fourth in both area and production among the nations that cultivate maize. It occupies an area of 9.38 million ha, contributes almost 9% of the country's food supply, produces 28.8 million tonnes annually, and has an average yield of 3.07 tonnes per hectare (**Anonymous 2018**). According to anonymous (2016), Himachal Pradesh has 294 thousand ha, 784.29 thousand tonnes, and 2.68 tonnes /ha of land. Maize has greater nutritional value as it contains about 72% starch, 10% proteins, 4.8% oil, 8.5%, fiber, 3% sugar and 1.7% ash (**Chaudhary, 1993**). A substantial amount of maize is utilized as feed for poultry and cattle. 61% of maize produced worldwide is used as animal feed, 17% as food, and 22% as industrial raw material. Because of its significant involvement (83%) in the feed, starch, and biofuel industries, it has become a recognized

"industrial crop" on a global scale.

The availability of boron (B), an essential nutrient for optimal growth of higher plants, in the soil and irrigation water is a key factor in determining agricultural production. **Saleem *et.al*., (2011).** Boron shortage has various consequences on a wide range of vascular plant functions, including root extension, indole acetic acid oxidase activity, sugar translocation, carbohydrate metabolism, nucleic acid synthesis, and pollen tube formation (**Goldbach and Wimmer, 2007; Saleem *et.al*., 2011)**. When plants were exposed to salinity, their Boron concentration reduced **(Holloway and Alston, 1992; Wimmer *et.al*., 2001)**

Poultry manure is an excellent organic fertilizer, as it contains high nitrogen, phosphorus, potassium and other essential nutrients. When compared to chemical fertilizer, it enhances soil structures, nutrient retention, aeration, soil moisture holding capacity, and water infiltration by adding organic matter to the soil **(Deksissa *et.al*., 2008)**. Additionally, it was found that compared to other organic manure sources, poultry dung more readily provides P to plants **(Garg and Bahla, 2008)**. Poultry manure is a valuable fertilizer and can serve as a suitable alternate to chemical fertilizer. Poultry manure application registered over 53% increases of N level in the soil, from 0.09% to 0.14 % and exchangeable cations increase with manure application **(Boateng *et.al*., 2006).** In agriculture, the main reasons for applying Poultry Manure include the organic amendment of the soil and the provision of nutrients to crops **(Warren *et.al*., 2006).**

Vermicompost is an excellent alternative to synthetic fertilizers since it contains more N, P, and K than regular heap manure **(Srivastava and Beohar, 2004)**. Vermicomposting aids in enhancing and preserving the soil's fertility. Vermicompost gives the soil a black hue and helps to regulate the soil's temperature by doing so. Vermicompost it helps to improves and conserves the fertility of soil. Vermicompost imparts a dark colour of the soil and thereby help to maintain the temperature of soil. Vermicompost is one of the manure used by the farmer in growing crops because of early availability and presence of almost all the nutrients required by plants.

MATERIAL AND METHODS:

The experiment was conducted during winter season of 2022 on "Effects of Poultry manure, Vermicompost and Boron on growth and yield of Maize" was carried out at Crop Research Farm of Sam Higginbottom University, Prayagraj, Uttar Pradesh in 2022. The soil of the field constituting a part of central gangetic alluvium is neutral and deep. The soil of the experimental field was sandy loam in texture, nearly neutral in soil reaction (pH 7.4), low level of organic carbon (0.51%), available N (108.69 Kg/ha), P (80.5 kg/ha), K (83.3 kg/ha). The treatments combination are T1: Poultry Manure - 100% (2 t/ha) + Boron - 1%, T2: Poultry Manure - 100% (2 t/ha) + Boron - 3%, T3: Poultry Manure - 100% (2 t/ha) + Boron -5%, T4: Vermicompost - 100% (4 t/ha) + Boron - 1%, T5: Vermicompost- 100% (4 t/ha) + Boron - 3%, T6: Vermicompost - 100% (4 t/ha) + Boron - 5%, T7: Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 1%, T8: Poultry Manure 50% (1t/ha)+ Vermicompost 50% (2 t/ha) + Boron – 3%, T9: Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 5%, T10: Control – 120:60:40 (N: P: K) Kg/ha are used. To facilitate sowing, the experimental field was thoroughly ploughed and harrowed and brought to fine tilth. Stubbles and weeds were picked up from the field and the land was levelled with the help of a rake and the plots were demarcated according to layout. Manures were applied at 4-5cm deep furrows were made along the seed rows with a hand hoe. Manures used for application were vermicompost, and neem cake Quantity of each manure required for each plot was calculated as per the treatment combinations. Manures like Vermicompost and poultry manure were applied uniformly in seed furrows as basal dose. Maize, Variety (NK 7720) was selected for sowing which can be matured around 85- 90 days. Line sowing was done manually. Seeds were covered with soil immediately after sowing the seeds. The sowing adopted was (60 x 20 cm) and the seeds were drilled at 3-4 cm depth.

RESULTS AND DISCUSSION:

Plant height: significant difference among the treatments. However, maximum plant height (234.45 cm) was observed in the Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 5% and Poultry Manure - 100% (2 t/ha) + Boron - 3% (233.16 cm), Poultry Manure - 100% (2 t/ha) + Boron - 5% (229.94 cm) were found statistically at par with Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 5%. The maximum value of plant height was achieved at higher uptake of Boron due to which translocation of photosynthesis was improved from leaf to grain **Akhtar *et.al.*, (2003)**. The increase in plant height with Poultry Manure was mainly due to the reason of more availability of nutrients by Poultry Manure throughout the growing season. **Warren *et.al.*, (2006).** Vermicompost increases in plant height and LAI with the use of organic sources consequently enhanced the dry matter/plant **Jayaprakash *et.al.*, (2004)**

Plant Dry weight: the significant and higher plant dry weight (135.84 g) was observed in the Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 5%. However, in Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 3% (133.50 g) was statistically at par with Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron –5%. **Ahmed *et. al.*, (2011**) also reported that dry matter yield increased significantly with Boron up to 2.0 kg/ha. Exogenous application of Boron reportedly responded to increasing plant dry matter **(Oyinlola 2007**). Increased biomass production by the application of boron is thought due to the role of boron in cell elongation, photosynthesis and transpiration.

Number of cobs per plant: Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 5% (2.00) was recorded maximum significant value of the number of cobs per plant and the minimum was recorded in control (1.28). However, Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 3% (2.00) was statistically at par with the Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 5%. The application of boron activates several enzymes that are involved in carbohydrate metabolism, protein synthesis and pollen formation **George *et.al.*, (2002**).

Seed index (g): Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 5% (24.69 g) was recorded maximum significant value of seed index and the minimum was recorded in control (21.48 g). However, Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 3% (24.23 g), was statistically at par with the Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 5%.

Zhang *et.al.*, (1998) who observed increase in grain weight with increased level of Poultry manure which could be due to balanced supply of food nutrients throughout development of the maize plant and concluded that maximum grain weight (g) can be obtained by the high rate of poultry manure application.

Number of Seeds per Cob:

Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron-5% (302.67) was recorded maximum significant value of the number of Seeds per cob and the minimum was recorded in control (221.33). However, Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 3% was statistically at par with the Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 5%.

The increase in number of grains per row may be attributed to the availability of more nitrogen and other nutrients from Poultry Manure required for plant development up to cob formation **(Farhad 2009)**.

Grain yield (t/ha)

Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 5% (6.73 t/ha) was recorded higher significant of grain yield. However, Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 3% (6.40 t/ha) were found statistically at par with the Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 5%.

The boron application has been reported to increase grain yield up to 33% **Gunnes *et.al., (*2003). Rahim *et.al.,* 2004** reported increased dry weight plant, a number of grains cob and grain weight cob in maize plants which support the findings of the present study that boron application significantly increased various yield attributes of maize hybrids. Significantly increased with application of poultry manure which resulted in an overall increase in grain yield. **(Zhang*et.al.,* 1998)** who stated that maximum grain yield can be obtained by the high rate of poultry manure application.

Stover yield (t/ha)

Higher number of stover yield is in Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron–5% (15.20 t/ha) was recorded. However, Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron –1% (14.98 t/ha), Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 3% (15.11 t/ha) were found statistically at par with the Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 5%.

Farhad *et.al.,* (2009) and Zhang *et.al.,* (1998) that the maximum biological yield can be obtained by the high rate of poultry manure application that due to the proper and balanced supply of nutrients to the plants throughout the growth period.

Harvest index (%)

Significantly higher harvest index is recorded in Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 5% of (30.68 %). However, Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 1% (29.43%), Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron –3% (29.75%) were found statistically at par with the Poultry Manure 50% (1t/ha) +Vermicompost 50% (2 t/ha) + Boron – 5%.

Many researchers **(Renukadevi *et.al.,* 2003; Wrobel *et.al.,* 2006; Malhi *et.al.,* 2007)** suggested the application of boron for enhancing the yield of crop plants. Boron helps in better uptake and utilization of nitrogen which helps in enhancing the photosynthetic activity, vegetative growth, accumulation of metabolites in reproductive organs and the overall yield (**Rizk and Abdo 2001**).

Vermicompost is a good substitute to commercial fertilizers and has more N, P and K content than the normal heap manure **(Srivastava and Beohar, 2004).**The increase in grain and stover yield, weight of cob/ plant, number of grains /cob and test weight of maize due to application of vermicompost might be attributed mainly to higher content of available nutrients in vermicompost, presence of beneficial micro flora such as nitrogen fixers, phosphate solubalizers, VAM fungi and higher activity of dehydrogenase enzyme in soil. The finding of this investigation close conformity with finding of **Ramesh *et.al.*, (2008)** and **Meena *et.al.*, (2013).**

Poultry manure is rich source of nutrients like Nitrogen and Phosphorous and thus improving soil properties, enhancing availability of nutrients and thereby important for development. optimum plant growth and development **Dauda *et.al.*, (2008)**

ECONOMICS

Cost of cultivation (INR/ha)

Higher cost of cultivation (38,586.20 INR/ha) was found in Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 5%. Whereas, (31,966.20 INR/ha) Control - 120: 60: 40 (N: P: K) kg/ha require less in comparison of other treatment.

Gross returns (INR/ha)

Higher gross returns (1,34,600.00 INR/ha) was found in Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 5%. Whereas, (96,400.00 INR/ha) Poultry Manure- 100% (2 t/ha) + Boron 1% require less in comparison of other treatment.

Net returns (INR/ha)

Higher net returns (96,013.80 INR/ha) was found in Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 5%. Whereas, (61,409.80 INR/ha) Poultry Manure- 100% (2 t/ha) + Boron 1% require less in comparison of other treatment.

B:C Ratio

Higher benefit cost ratio (2.48) was found in Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 5%. Whereas, (1.62) Vermicompost-100% (4 t/ha) + Boron - 1% require less in comparison of other treatment.

CONCLUSION

It can be concluded that application of Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron-5% (foliar spray) as performed better in growth parameters and yield attributes of Maize (NK 7720). Since the findings are based on research done in one season in Prayagraj it may be repeated for confirmation.

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Table 1: Effect of Poultry manure, vermicompost and boron on growth and yield attributes of maize.

S. No	Treatments	100 DAS		Cobs/ Plant (No)	Seeds/ Cob (No)	Seed index (g)	Grain yield (t/ha)	Stover Yield (t/ha)	Harvest index (%)
		Plant height (cm)	Plant dry weight						
1.	Poultry Manure-100% (2 t/ha) + Boron 1%	226.80	130.83	1.60	232.67	21.80	4.82	13.84	25.83
2.	Poultry Manure-100% (2 t/ha) + Boron 3%	228.80	131.76	1.80	245.67	21.91	5.08	13.95	26.69
3.	Poultry Manure-100% (2 t/ha) + Boron 5%	227.30	132.28	1.80	253.33	22.01	5.27	14.29	26.94
4.	Vermicompost-100% (4 t/ha) + Boron 1%	224.60	129.66	1.21	260.67	22.61	5.52	14.46	27.62
5.	Vermicompost-100% (4 t/ha) + Boron 3%	224.60	129.95	1.24	271.67	23.02	5.83	14.57	28.57
6.	Vermicompost-100% (4 t/ha) + Boron 5%	226.90	131.25	1.21	277.00	23.64	6.05	14.82	28.98
7.	Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron 1%	230.94	132.17	1.90	284.67	23.92	6.25	14.98	29.43
8.	Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron 3 %	234.90	133.50	2.00	293.60	24.23	6.40	15.11	29.75
9.	Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron 5 %	236.45	135.84	2.00	302.60	24.69	6.73	15.20	30.68
10.	Control - 120: 60: 40 (N:P: K) kg/ha	223.43	127.95	1.60	232.67	21.80	4.69	13.72	25.47
	F- test	S	S	S	S	S	S	S	S
	SEm(±)	2.23	0.81	0.02	3.13	0.20	0.13	0.07	0.43
	CD(p=0.05)	6.63	2.42	0.07	9.30	0.58	0.38	0.22	1.54

Table 2: Effect of poultry manure, vermicompost and boron on Economics of Maize.

S. No.	Treatments	Total cost of Cultivation (INR/ha)	Gross Return (INR/ha)	Net return (INR/ha)	Benefit Cost Ratio
1.	Poultry Manure - 100% (2 t/ha) + Boron - 1%	34,990.20	96,400.00	61,409.80	1.75
2.	Poultry Manure - 100% (2 t/ha) + Boron - 3%	35,038.20	1,01,600.00	66,561.80	1.89
3.	Poultry Manure - 100% (2 t/ha) + Boron - 5%	35,086.20	1,05,400.00	70,313.80	2.00
4.	Vermicompost-100% (4 t/ha) + Boron - 1%	41,990.20	1,10,400.00	68,409.80	1.62
5.	Vermicompost-100% (4 t/ha) + Boron - 3%	42,038.20	1,16,600.00	74,561.80	1.77
6.	Vermicompost-100% (4 t/ha) + Boron - 5%	42,086.20	1,21,000.00	78,913.80	1.87
7.	Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 0.25 kg/ha	38,490.20	1,25,000.00	86,509.80	2.24
8.	Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 3%	38,538.20	1,28,000.00	89,461.80	2.32
9.	Poultry Manure 50% (1t/ha) + Vermicompost 50% (2 t/ha) + Boron – 5%	38,586.20	1,34,600.00	96,013.80	2.48
10.	Control – (120: 60: 40 N:P: K kg/ha)	31,966.20	93,800.00	61,833.80	1.93