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Effect of nitrogen management on growth and yield of sweetcorn

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Abstract
A field experiment was conducted during *kharif* season of 2023 at Crop Research Farm Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Sciences and Technology. To determine "Effect of nitrogen management on growth and yield of sweetcorn". The results revealed that treatment 4 [(75%) Nitrogen through Vermicompost + (25%) Nitrogen through Urea] recorded significantly higher plant height (134.57cm), higher plant dry weight (108.12g), maximum number of cobs/plant (1.83), maximum number of grain rows/cob (18.17), maximum number of grains/row (24.4), highest cob yield (6.47 t/ha), highest green fodder yield (14.90 t/ha), maximum gross return (131360.00 INR/ha), maximum net return (89860.00 INR/ha) and highest B:C ratio (2.17) was recorded in treatment 4 [(75%) Nitrogen through Vermicompost + (25%) Nitrogen through Urea] as compared to the other treatments was found to be productive as well as economically feasible.

Keywords: Nitrogen, vermicompost, urea, growth, yield, economics

1. Introduction
Maize is known as the "Queen of Cereals" because to its high production capacity and tolerance to diverse environments. Maize ranks as the world's third most significant cereal crop, following wheat and rice. Maize, a C_4 plant, can utilize sun light more efficiently than other grains. Maize is grown year-round in all states of the country for diverse reasons, including animal fodder, food grain, sweet corn, baby corn, green cobs, and popcorn. Corn flour is commonly used in Indian cuisine. Maize is India's third most important grain crop, following rice and wheat. To increase agricultural production, either more land should be cultivated, which is not always feasible, or higher yields must be produced on existing areas. Sweet corn is a variety of maize used for table purposes. This vegetable is widely consumed in the United States, Europe, and other developed countries. Approximately 40% of such maize is frozen, and the remainder is canned during processing. Sweet corn is becoming increasingly popular and is being grown in India's maize-growing areas. Sweet corn, a high-value commodity, is becoming increasingly popular in star hotels for soup cooking. Farmers on the edges of cities might reap higher revenues by cultivating this crop. Sweet corn has the added benefit of remaining green after harvesting, making it suitable for use as green fodder for cattle. Because of its short lifetime, it is finding use in a variety of cropping methods.
Globally, maize covers an area of 200.53 million hectares with the production of 1,275.94 million tons with the productivity of 6.36 tons/ha (USDA, 2024). In India, Maize is grown over an area of about 10.04 million hectares with a production of 33.62 million tons and productivity of 3.3 t/ha. Total area coverage under maize in Uttar Pradesh is 2.61 million hectares with a production of 6.09 million tons and the productivity 2.3 t/ha (GOI, 2022).
According to Sarkar *et al.*, (2014) [15] Adopting environmentally friendly farming practices is essential for sustainable agriculture in today's world. Chemical agriculture has negatively impacted soil, microbial populations, and plant health. Organic farming, which eliminates the use of chemical fertilizers and pesticides, is becoming increasingly popular among health-conscious consumers worldwide. Maize's demand has increased due to its many uses as food,

feed, and fodder, overcoming the current low demand condition. Maize has improved farmer income and is grown on 65-75% of acreage. It is mostly utilized for animal feed and industrial purposes, with food grade maize grown with conventional cultivars. Farmers are transitioning to high-yielding hybrids from traditional varieties. (Srivastava and Rajesh, 2023) [16]. Sweet corn is harvested at the green cob stage, before it matures into grain. Plant density, fertilizer levels, and planting methods need to be considered. Rescheduled for this crop. With the advancement of sweet corn production, it is not known how these elements affect seed yield and quality. This crop is profitable for farmers and the seed industry, especially in peri-urban settings. (Kumar and Dawson, 2019) [9].

Plants require a lot of nitrogen during vegetative growth to maintain photosynthetic capacity, expand leaves, and grow stems and roots. Nitrogen is the primary plant nutrient that impacts plant growth, quality, and mineral content of kernels. Crop growers are being pushed to use N fertilizers more efficiently due to rising production costs. Effective plant nutrition management is crucial for establishing self-reliance in agriculture. Consider all plant-available nitrogen sources to improve crop production and quality while minimizing environmental impact of fertilizer use. Improving N fertilizer recommendations will boost efficiency and reduce overall use. Crops often use less than half of their nitrogen fertilizers. N dosages are greatly affected by mechanisms such as leaching, volatilization, and denitrification. To improve N-use efficiency and management practices, it's important to avoid heavy N fertilization and develop an effective recommendation scheme based on soil fertility studies.

Urea accounts for approximately 82% of fertilizer consumption in India and 55% of global fertilizer nitrogen consumption. Plants use approximately 30-40% of urea nitrogen, while the remainder is lost owing to chemical transformations such as leaching, volatilization, denitrification, and runoff, resulting in low utilization efficiency. Urea offers great nitrogen efficiency and is environmentally beneficial. This fertilizer is referred to as "smart fertilizer" because to its ability to reduce nitrous oxide emissions, which pollute soil, air, and water. It also contributes to reducing global warming. These qualities make it a possible alternative to traditional urea. Microorganisms are essential for fixing, solubilizing, mobilizing, and recycling macro and micronutrients in agricultural ecosystems. Although naturally existing in soil, their number is insufficient for optimal nutrient mobilization.

Vermicompost is an effective alternative to commercial fertilizers, with higher levels of N, P, and K compared to traditional heap manure. Vermicomposting increases and preserves soil fertility. Vermicompost darkens soil and helps regulate its warmth. Vermicompost is a popular manure among farmers due to its early availability and high nutrient content. (Khatik *et al* 2019) [10].

Poultry manure is an effective organic fertiliser with high nitrogen, phosphorous, potassium, and other necessary nutrients. Adding organic matter to soil improves its structure, nutrient retention, aeration, moisture holding capacity, and water infiltration, compared to chemical fertilisers. It offers more phosphorus to plants than other organic manure sources. Poultry dung is an effective alternative to chemical fertilisers. Poultry manure application increased N levels in soil by approximately 53%, from 0.09% to 0.14%. It also increased exchangeable cations. Poultry manure is mostly used in agriculture for organic soil enrichment and supply. (Chappidi *et al*., 2023) [4]. Keeping in view of the above fact, the experiment was conducted to find out "Effect of nitrogen management on growth and yield of sweetcorn".

2. Materials and Methods

The experiment was conducted during *kharif* season 2023 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of the experimental field was sandy loam in texture, nearly neutral in soil reaction (pH 7.8), low level of organic carbon (0.62%), available N (225 Kg/ha), P (38.2 kg/ha), K (240.7 kg/ha) and zinc (2.32 mg/kg). The treatment consists of nitrogen applied in the form of urea, vermicompost and poultry manure. The experiment was laid out in RBD with 9 treatments each replicated thrice. The treatment combinations are T1-100% Nitrogen through Urea, T2- 25% Nitrogen through Vermicompost + 75% Nitrogen through Urea, T3-50% Nitrogen through Vermicompost + 50% Nitrogen through Urea, T4-75% Nitrogen through Vermicompost + 25% Nitrogen through Urea, T5-100% Nitrogen through Vermicompost, T6-25% Nitrogen through Poultry manure + 75% Nitrogen through Urea, T7-50% Nitrogen through Poultry manure + 50% Nitrogen through Urea, T8-75% Nitrogen through Poultry manure + 25% Nitrogen through Urea, T9-100% Nitrogen through Poultry manure. Data recorded on different aspects of crop, *viz.*, growth, weed management practices, yield attributes and yield were subjected to statistically analysed by analysis of variance method as described by Gomez and Gomez, (1976) [5].

3. Results and Discussion

3.1 Growth Attributes

3.1.1 Plant height (cm)

The data revealed that significant and higher plant height (134.57 cm) was recorded in the treatment 4 [(75%) Nitrogen through Vermicompost + (25%) Nitrogen through Urea]. However, treatment 7 [(50%) Nitrogen through Poultry manure + (50%) Nitrogen through Urea] and treatment 9 [(100%) Nitrogen through Poultry manure] were found to be statistically at par with treatment 4 [(75%) Nitrogen through Vermicompost + (25%) Nitrogen through Urea].Significant and higher plant height was observed with application of vermicompost might be due to it contains significant quantities of nutrients, a large beneficial microbial population and biologically active metabolites, particularly gibberellins, cytokinins, auxins and group B vitamins which applied alone or in combination result in better growth of crops. These results are in conformity with those of Kumar *et al*. (2016) [7]. Further, significant increase in plant height with the application of urea may be due to it can improve a number of physiological functions in plants, including enzyme activity, photosynthesis, and nutrient uptake. These advancements in plant physiology may lead to improved growth and development which may result in tall plants. Similar results were also reported by Srivastava and Singh (2023) [16] in maize.

3.1.2 Plant dry weight (g)

Significant and higher plant dry weight (108.12 g) was recorded in treatment 4 [(75%) Nitrogen through Vermicompost + (25%) Nitrogen through Urea]. However, treatment 7 [(50%) Nitrogen through Poultry manure + (50%) Nitrogen through Urea] and treatment 9 [100% Nitrogen through Poultry manure] were found to be statistically at par with the treatment 4 [(75%) Nitrogen through Vermicompost + (25%) Nitrogen through Urea]. The significant and higher plant dry weight was with the application of vermicompost may be due to higher nitrogen rates caused vegetative development, which in turn increased the surface area available for photosynthesis and increased the size of leaf blades. Similar results were noticed by Ninama *et al*. (2023) [11] in maize. Further, significantly increase in plant dry weight was with the application of urea might be due to the amount of sunlight a plant receives determines both the effectiveness of photosynthesis and the quantity of photosynthetic organisms generated andlarger plant organs as a result of increased photosynthetic activity might have raise the dry weight of plants. These findings were similar to Aher and Umesha (2023) [1] in baby corn.

3.1.3 Crop Growth Rate (g/m2/day)
During 60-80 DAS interval treatment 7 [(50%) Nitrogen through Poultry manure + (50%) Nitrogen through Urea] recorded highest crop growth rate (20.629 g/m2/day. However, treatment 9 [100% Nitrogen through Poultry manure] were found to be statistically at par with the treatment 7 [(50%) Nitrogen through Poultry manure + (50%) Nitrogen through Urea]. The significant and higher plant dry weight was with the application of poultry manure may be due to a sufficient supply of nutrients, especially phosphorus and nitrogen, which improved crop performance. Similar results were noticed by Shiyam *et al*. (2017) [14] in maize. Further, significantly increase in crop growth rate was with the application of urea might be due to the increased nutrient availability for plant growth, which may have improved the plant's overall growth by increasing the production of dry matter, photosynthetic rate, and chlorophyll. These findings were similar to Srivani *et al*., (2022) [13] in maize.

3.1.4 Relative Growth Rate (g/g/day)
During 60-80 DAS interval significantly higher relative growth rate (0.0239 g/g/day) was observed in treatment 5 [(100%) Nitrogen through Vermicompost]. However, treatment 7 [(50%) Nitrogen through Poultry manure + (50%) Nitrogen through Urea] and treatment 9 [100% Nitrogen through Poultry manure] were found to be statistically at par with the treatment 5 [(100%) Nitrogen through Vermicompost].The significant and higher plant dry weight was with the application of vermicompost may be due to it is a rich source of macro- and micro-nutrients and growth hormones not only provides vital nutrients to the soil but also improves its physicochemical and biological qualities. Similar results were noticed by Khatik *et al*. (2019) [10] in maize.

3.2 Yield and Yield Parameters
3.2.1 Number of Cobs/plant
Significant and maximum number of cobs/plant (1.83) was recorded in treatment 4 [(75%) Nitrogen through Vermicompost + (25%) Nitrogen through Urea]. However, treatment 7 [(50%) Nitrogen through Poultry manure + (50%) Nitrogen through Urea] and treatment 9 [(100%) Nitrogen through Poultry manure] were found to be statistically at par with treatment 4 [(75%) Nitrogen through Vermicompost + (25%) Nitrogen through Urea]. Significant and maximum number of cobs/plant was recorded with the application of *vermicompost* might be due to supply of necessary proportions of plant nutrients to the crop during its growth period, which leads to increase in number of cobs/plant. These findings are in accordance with the findings of Gebrehiwot *et al*. (2020) [6] in wheat. Further significant and maximum number of cobs/plant was recorded with the application of urea may be due to more nutrients and metabolites available in order to meet the needs of each reproductive structure's growth and development which resulted in maximum number of cobs/plant. These results are in conformity with those of Wahidullah *et al.* (2022) [20].

3.2.2 Number of grain rows/cob
Significantly maximum number of grain rows/cob (18.17) was recorded in treatment 4 [(75%) Nitrogen through Vermicompost + (25%) Nitrogen through Urea].However, treatment 3 [(50%) Nitrogen through Vermicompost + (50%) Nitrogen through Urea], treatment 6 [(25%) Nitrogen through Poultry manure + (75%) Nitrogen through Urea], treatment 7 [(50%) Nitrogen through Poultry manure + (50%) Nitrogen through Urea] and treatment 9 [(100%) Nitrogen through Poultry manure] were found to be statistically at par with treatment 4 [(75%) Nitrogen through Vermicompost + (25%) Nitrogen through Urea]. Significant and maximum number of grain rows/cob was recorded with the application of vermicompost may be due to the fact that nitrogen fertilization boosts and improves the efficiency of plant roots' cation exchange capacity, leading to increased growth and yield characteristics and, ultimately, increased crop uptake of nitrogen. The result was in collaboration with Choudhary *et al.* (2014) [3] in pearl millet. Further significant and maximum number of rows/cob obtained with the application of urea might be due to the enhanced nitrogen availability, improved photosynthate synthesis and effective photosynthate translocation for the development of reproductive organs. These results of present investigation are in line with those of Bhatt *et al*. (2012) [2].

3.2.3 Number of Grains/row
Significant and maximum number of grains/row (24.4) was recorded in treatment 4 [(75%) Nitrogen through Vermicompost + (25%) Nitrogen through Urea]. However, treatment 1[(100%) Nitrogen through Urea], treatment 2 [(25%) Nitrogen through Vermicompost + (75%) Nitrogen through Urea], treatment 3 [(50% Nitrogen through Vermicompost + 50% Nitrogen through Urea], treatment 5 [(100%) Nitrogen through Vermicompost], treatment 7 [(50%) Nitrogen through Poultry manure + (50%) Nitrogen through Urea], treatment 8 [(75%) Nitrogen through Poultry manure + (75%) Nitrogen through Urea] and treatment 9 [(100%) Nitrogen through Poultry manure] were found to be statistically at par with treatment 4 [(75%) Nitrogen through Vermicompost + (25%) Nitrogen through Urea]. Significant and maximum number of grains/row was recorded with the application of vermicompost might be due to enhanced microbial activity, as well as a greater decrease in the negative consequences of excessive nitrogen treatments increased competition for assimilates leads to stronger flower abortion due to higher vegetative development. These findings are in accordance with the findings of Zaremanesh *et al.* (2017) [21] in wheat. Further significant and maximum number of grains/row was recorded with the application of urea may be due to more photosynthetic assimilation, photosynthate translocation from the source to the sink, and a timely nitrogen supply all promote the start of grain formation, which contributes to the development of grains/row. These results are in conformity with those of Sahu *et al.* (2022) [17] in rice.

3.2.4 Cob Yield (t/ha)
Significant and higher cob yield (6.8 t/ha) was recorded in treatment 4 [(75%) Nitrogen through Vermicompost + (25%) Nitrogen through Urea]. However, treatment 7[(50%) Nitrogen through Poultry manure + (50%) Nitrogen through Urea] and treatment 9 [(100%) Nitrogen through Poultry manure] were found to be statistically at par with treatment 4 [(75%) Nitrogen through Vermicompost + (25%) Nitrogen through Urea]. Significant and higher cob yield was obtained with the application of vermicompost might be due to increase in soil-

plant nutrition by helping in variety of physiological functions in plants, which in turn led to enhanced cob yield through more effective nutrient source and an increase in the soil's ability to exchange cations with organic matter. The similar results were obtained by Tufa (2023) [19] in maize. Further significant and higher cob yield was recorded with the application of urea may be due to enhanced photosynthesis along with other metabolic processes in plants, which lead to a greater accumulation of photosynthates and their translocation to the parts of the plant that are economically valuable. These results are similar with those of Ninama *et al.* (2023) [11] in maize.

3.2.5 Green Fodder Yield (t/ha)

Significant and higher green fodder yield (15.9 t/ha), was observed in treatment-4 [75% Nitrogen through Poultry manure + (25%) Nitrogen through Urea]. However, treatment 2 [(25%) Nitrogen through Vermicompost + (75%) Nitrogen through Urea], treatment 3[(50% Nitrogen through Vermicompost + 50% Nitrogen through Urea], treatment 9[(100%) Nitrogen through Vermicompost], treatment 5 [(100%) Nitrogen through Vermicompost], treatment 6 [(25%) Nitrogen through Poultry manure + 75% Nitrogen through Urea], treatment 7[(50%) Nitrogen through Poultry manure + (50%) Nitrogen through Urea], treatment 8 [(75%) Nitrogen through Poultry manure + (75%) Nitrogen through Urea] and treatment 9 [(100%) Nitrogen through Poultry manure] were found to be statistically at par with treatment 4 [(75%) Nitrogen through Vermicompost + (25%) Nitrogen through Urea]. The significant and higher green fodder yield with the application of vermicompost may be due to enhanced ion exchange capability in the soil, which has enhanced the soil's biological and physical activity and as a result, plants have shown faster and better nourishment. These results were in similar with those of Oktem (2020) [12] in dent corn**.** Further significant and higher green fodder yield was obtained with the application of urea may be because it is a vital component of plant tissue that has a role in the elongation and division of cells. These results are in agreement with those of Srivani (2022) [13] in maize.

3.2.6 Harvest Index (%)

Statistically highest harvest index (33.04%) was recorded in Treatment 5 [100% Nitrogen through Vermicompost]. Though, there is no significant difference found among all the treatments.

3.2.7 Economics

Highest gross return (131360.00 INR/ha), net returns (89860.00INR/ha), benefit cost ratio (2.17) was recorded in treatment-4 [(75%) Nitrogen through Vermicompost + (25%) Nitrogen through Urea] as compared to other treatments. Maximum benefit cost ratio was recorded with application of vermicompost might be due nitrogen and can lower agricultural costs, boost farmers' income, and stabilise and enhance yield. Similar results were obtained by Thakur *et al.* (2021) [18] in maize. Further, increase in benefit cost ratio was recorded with the application of urea might be due to owing to better nitrogen use efficiency increased green fodder yield resulting in higher gross returns and net returns. These findings are similar with those of Srivani *et al.* (2022) [13] in maize.

Table 1: Effect of nitrogen management on growth attributes of sweetcorn

S No	Treatments	Plant height (cm)	Plant dry weight (g)	CGR ($g/m^2/day$)	RGR (g/g/day)
1.	100% Nitrogen through Urea	107.57	90.03	16.111	0.0195
2.	25% Nitrogen through Vermicompost + 75% Nitrogen through Urea	115.77	91.49	17.958	0.0218
3.	50% Nitrogen through Vermicompost + 50% Nitrogen through Urea	117.43	91.06	17.183	0.0207
4.	75% Nitrogen through Vermicompost + 25% Nitrogen through Urea	134.57	108.12	19.326	0.0194
5.	100% Nitrogen through Vermicompost	118.67	94.93	19.889	0.0239
6.	25% Nitrogen through Poultry manure + 75% Nitrogen through Urea	119.90	97.47	20.389	0.0237
7.	50% Nitrogen through Poultry manure + 50% Nitrogen through Urea	128.84	102.90	20.629	0.0224
8.	75% Nitrogen through Poultry manure + 25% Nitrogen through Urea	117.03	96.94	20.354	0.0238
9.	100% Nitrogen through Poultry manure	126.55	102.33	20.056	0.0219
	F-test	S	S	NS	NS
	SEm(±)	3.75	2.45	1.45	0.0019
	CD (p=0.05)	11.24	7.34	-	-

Table 2: Effect of nitrogen management on yield attributes and yield of sweetcorn

S No	Treatments	Number of cobs/plant	Number of grain rows/cob	Number of rains/row	Cob yield (t/ha)	Green fodder yield (t/ha)	Harvest Index (%)
1.	100% Nitrogen through Urea	1.34	14.37	18.10	5.71	12.50	26.58
2.	25% Nitrogen through Vermicompost + 75% Nitrogen through Urea	1.50	14.77	19.31	5.51	14.00	28.23
3.	50% Nitrogen through Vermicompost + 50% Nitrogen through Urea	1.44	16.23	20.30	4.70	13.93	29.36
4.	75% Nitrogen through Vermicompost + 25% Nitrogen through Urea	1.83	18.17	24.43	6.83	15.90	26.99
5.	100% Nitrogen through Vermicompost	1.48	14.00	22.60	6.50	13.80	33.04
6.	25% Nitrogen through Poultry manure + 75% Nitrogen through Urea	1.46	15.97	23.53	5.43	14.13	24.22
7.	50% Nitrogen through Poultry manure + 50% Nitrogen through Urea	1.68	16.23	21.50	5.12	15.56	26.08
8.	75% Nitrogen through Poultry manure + 25% Nitrogen through Urea	1.41	14.20	22.03	5.50	15.37	29.63
9.	100% Nitrogen through Poultry manure	1.73	16.40	22.51	6.21	14.67	31.99
	F-test	S	S	S	S	S	NS
	SEm (±)	0.10	0.80	0.35	0.14	0.43	0.80
	CD (p=0.05)	0.30	2.39	1.41	0.42	1.28	--

Table 3: Effect of nitrogen management on economics of sweetcorn

S. No	Treatments	Total cost of cultivation (INR/ha)	Gross Return (INR/ha)	Net Return (INR/ha)	B:C ratio
1.	100% Nitrogen through Urea	36910.00	114380.00	77470.00	2.10
2.	25% Nitrogen through Vermicompost + 75% Nitrogen through Urea	38510.00	113720.00	75210.00	1.95
3.	50% Nitrogen through Vermicompost + 50% Nitrogen through Urea	40100.00	115990.00	75890.00	1.89
4.	75% Nitrogen through Vermicompost + 25% Nitrogen through Urea	41500.00	131360.00	89860.00	2.17
5.	100% Nitrogen through Vermicompost	43300.00	118380.00	75080.00	1.73
6.	25% Nitrogen through Poultry manure + 75% Nitrogen through Urea	39260.00	110790.00	71530.00	1.82
7.	50% Nitrogen through Poultry manure + 50% Nitrogen through Urea	41600.00	123890.00	82290.00	1.98
8.	75% Nitrogen through Poultry manure + 25% Nitrogen through Urea	43750.00	112910.00	69160.00	1.58
9.	100% Nitrogen through Poultry manure	46300.00	107910.00	61610.00	1.33

4. Conclusion

From the results, it is concluded that in sweetcorn (treatment 4), application of (75%) nitrogen through *vermicompost* along with (25%) nitrogen through urea recorded highest grain yield and benefit cost ratio.

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