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Effect of plant geometry and organic manure on growth and yield of baby corn (*Zea mays* L.)

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Abstract
A field experiment was conducted during Zaid season 2021 at Shuats Model of Organic Farming (SMOF), Central Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P), India to determine the "effect of plant geometry and Organic manures on growth and yield of Baby corn (*Zea mays* L.). The experiment consists of two factors Plant geometry and Organic manure, there were 9 treatments each being replicated thrice *viz.* T1 (35 cm x 20 cm + Farm yard manure), T2((35 cm x 20 cm + Poultry manure), T3(35 cm x 20 cm + Vermicompost), T4 (45 cm x 20 cm + Farm yard manure), T5(45 cm x 20 cm + Poultry manure), T6(45 cm x 20 cm + Vermicompost), T7 (55 cm x 20 cm + Farm yard manure), T8(55 cm x 20 cm + Poultry manure) and T9 (55 cm x 20 cm + Vermicompost) and laid out in Randomized Block Design. The results revealed that there was increase in the growth parameters of baby corn *viz.*, plant height (106.23 cm), dry weight (46.53 g), Crop growth rate (108.76 g/ m2 /day), Relative crop rate (0.053 g/day) with the application of the treatment T9 (55 cm x 20 cm + Vermicompost). Application of treatment T9 (55 cm x 20 cm + Vermicompost) recorded maximum in No of cobs per plant (3.16), cob length (8.40 cm), cob weight with husk (44.80 g), cob weight without husk (13.18 g) and cob yield (5.59 t/ha), Cost of cultivation (46049 INR/ha), Gross returns (163800 INR/ha), net returns (117751 INR/ha) and B:C ratio (2.55). On the basis of this experiment it is concluded T9 (55 cm x 20 cm + Vermicompost) was found to be more productive.

Keywords: Baby corn, organic manures, spacing, economic and yield

Introduction
Baby corn is a dehusked maize ear harvested within 2-3 days of silk emergence, but prior to fertilization (Pandey *et al*. 2002) [5]. Due to its short duration, the crop can easily be fitted in an intensive cropping system (Dass *et al*. 2008). Baby corn production and markets are growing worldwide, especially in Asia, Africa, and South America. Asian countries are the major consumers of baby corn. In Asia, Thailand, China, and Taiwan are the major baby corn producers. Similar to other Asian countries, in India, it is gaining attention among the growers owing to its high demand, promising market, value addition, and high-income opportunities.

Maize is popularly called as "Queen of cereals" as well as "miracle crop" because it has a greater yield potential. Maize is third most important cereal crop, next to rice and wheat. The novelty of maize is cultivating it predominantly for vegetable purpose as "Baby corn". Baby corn is typically a maize ear (*Zea mays* L.)" produced from regular corn plants which are harvested earlier, particularly when the silks have the size of 1-3 cm (Thavaprakaash *et al.*, 2005) [13].

Under organic management, nutrient"s release and crop demand synchrony is very much required; hence, a thorough understanding of nutrient"s release pattern from organic sources is essential to avoid nutrients stress. Thus, the development and implementation of efficient nutrient management practices are pivotal for successful organic baby corn production and to improve the product quality and yield, besides overall soil health improvement. Optimum plant geometry is also one of the important factors for higher production, by efficient utilization of underground resources and also harvesting as much as solar radiation and in turn better photosynthates formation. The planting patterns of baby corn also significantly influence growth and yield parameters (Saif *et al*. 2003).

Maize production has been reported to improve significantly with integration of Farm Yard Manure (FYM) and conventional fertilizers (Sharma and Gupta, 1998). FYM occupies an important position among the organic manures. The FYM seems to act directly by increasing crop yield by acceleration of respiratory process or by cell permeability or by hormonal growth action.

It supplies N, P and K in available form to the plant through biological decomposition; it contains 0,.50, 0.17 and 0.55 percent of N, P and K respectively (Lamani, 2016). Building up of secondary and micronutrients, counteracting deleterious effects of soil acidity, salinity, and alkalinity and substances of soil health are the key beneficial effects associated with FYM application. Use efficiency of N fertilizer is improved in the presence of FYM application. Substitution of 50 percent mineral fertilizer-N by FYM in different agro-eco regions has been found to sustain the productivity in a long term experiments involving various food, fodder crop sequences and inorganic and inorganic sources of nitrogen (Yadav, 2001).

Recently vermicompost as source of organic manure in crop production is gaining popularity due to its higher nutrient content, faster mineralization and acceptability. Vemicompost has been reported to give very high crop productivity along with maintaining higher nutritional quality and improving the physical, chemical and biological properties of soil. Vermicompost is highly nutritive and a powerful plant growth promoter and protector and has scientifically proven to be a miracle plant growth promoter. It also increases the efficiency of added fertilizers in the soil. On the average, Vermicompost contains 0.80 to 1.10% N, 0.40 to 0.80% P2O5 and 0.80 to 0.98% K2O respectively (Sinha and Herat, 2012).

Materials and Methods

The experiment was conducted during the Zaid season 2021, at Shuats Model of Organic Farming (SMOF), Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (U.P.), India which is located at 250 39‟ 42” N latitude, 81067‟56” E longitude and 98 m altitude above the mean sea level (MSL).This area is situated on the right side of the Yamuna river by the side of Prayagraj-Rewa road about 12 km from the city. The experiment consists of two factors Plant geometry (35 cm, 45 cm and 55 cm) and Organic manure (Farm yard manure, Poultry manure and Vermicompost).

It was carried out through a statistical design of Randomized Block Design (RBD) with three replications consisted of „nine treatments‟ *viz.,* T1 (35 cm x 20 cm + Farm yard manure), T2((35 cm x 20 cm + Poultry manure), T3(35 cm x 20 cm + Vermicompost), T4 (45 cm x 20 cm + Farm yard manure), T5(45 cm x 20 cm + Poultry manure), T6(45 cm x 20 cm + Vermicompost), T7 (55 cm x 20 cm + Farm yard manure), T8(55 cm x 20 cm + Poultry manure) and T9 (55 cm x 20 cm + Vermicompost). During the growing season, the mean weekly maximum and minimum temperate, relative humidity and rainfall were 29.94°C, 10.84°C, 91.9%, 32.5% and 2.79 mm respectively. The soil was sandy loam, pH of soil was 7.4 with 0.39% organic C, having available N, P, K (185.5, 36 and 98 kg ha-1 respectively).

The field was uniformly irrigated before two days of sowing and further irrigated based on critical periods. Observations on growth parameters and yield attributes of Baby corn to be recorded and their significance to be tested by the variance ratio. (F-value) at 5% level (Gomez and Gomez, 1984). Relative economics was calculated as per prevailing market prices of inputs and produced during Zaid season.

Results and Discussion

A. Growth attributes

Growth parameters of Baby corn *viz*, Plant height (cm), Plant dry weight (g/plant), Crop growth rate (g/m2/day), Relative growth rate (g/g/day) varied due to different treatments and are presented in Table 1.

Table 1: Effect of Plant Geometry and Organic Manure on growth attributes of Baby corn

No.	Treatments	Plant height (cm) at 45DAS	Plant dry weight (g) at 45 DAS	CGR (g/m2/day) 30-45 DAS	RGR (g/g/day) 30-45 DAS
1	T1: 35 cm x 20 cm + Farm Yard Manure	79.13	39.83	97.56	0.049
2	T2: 35 cm x 20 cm + Poultry Manure	94.80	44.82	99.46	0.053
3	T3: 35 cm x 20 cm + Vermicompost	81.50	44.60	105.27	0.053
4	T4: 45 cm x 20 cm +Farm Yard Manure	82.45	44.68	101.58	0.050
5	T5: 45 cm x 20 cm +Poultry Manure	104.69	42.99	106.53	0.051
6	T6: 45 cm x 20 cm + Vermicompost	89.56	44.01	104.71	0.052
7	T7: 55 cm x 20 cm +Farm Yard Manure	79.36	41.25	108.75	0.053
8	T8: 55 cm x 20 cm +Poultry Manure	90.90	42.76	106.54	0.050
9	T9: 55 cm x 20 cm +Vermicompost	106.23	46.52	108.76	0.054
	S.Em(±)	1.39	1.0	2.0	1.04
	CD(p=0.05)	4.17	2.99	5.0	---

At 45 DAS the treatment combination T9: 55 cm x 20 cm +Vermicompost resulted in the highest plant height (106.23 cm), dry weight (46.53 g), Crop growth rate (108.76 g/m2 /day) which was significantly superior to all other treatments. The highest Relative crop rate (0.053 g/day) was recorded in the treatment T9: 55 cm x 20 cm +Vermicompost which was found to be non- significant.

B. Yield attributes and Yield

Yield attributes such as treatment Number of cobs per plant, cob length (cm), cob weight with husk (g), cob weight without husk (g) and cob yield (t/ha) varied due to different treatment combinations and are presented in Table 2.

Table 2: Effect of Plant geometry and organic manures on yield attributes of Baby corn.

S. No	Treatments	No of cobs per plant	Cob Length (cm)	Weight of cob with husk (g)	Weight of cob without husk (g)	Cob yield (t/ha)
1	T1: 35 cm x 20 cm + Farm Yard Manure	2.00	7.47	35.06	11.14	3.20
2	T2: 35 cm x20 cm + Poultry Manure	2.47	6.20	36.97	8.40	3.82
3	T3: 35 cm x 20 cm + Vermicompost	2.59	7.60	43.07	10.27	4.54
4	T4: 45 cm x 20 cm +Farm Yard Manure	2.94	7.87	41.92	8.32	4.01

5	T5: 45 cm x 20 cm +Poultry Manure	2.45	7.93	39.06	7.27	3.57
6	T6: 45 cm x 20 cm + Vermicompost	1.79	8.07	34.42	12.86	3.77
7	T7: 55 cm x 20 cm +Farm Yard Manure	2.54	8.20	40.42	11.24	4.97
8	T8: 55 cm x 20 cm +Poultry Manure	1.93	7.70	44.41	8.40	3.90
9	T9: 55 cm x 20 cm +Vermicompost	3.16	8.40	44.80	13.18	5.59
	S.Em(±)	0.27	0.06	1.87	0.52	0.81
	CD(p=0.05)	0.82	0.12	5.62	1.58	1.66

The treatment combination T9: 55 cm x 20 cm + Vermicompost was recorded with higher Number of cobs per plant (3.16), cob length (8.40 cm), cob weight with husk (44.80 g) and cob weight without husk (13.18 g). The maximum cob yield (5.59 t/ha) was obtained with application of T9: 55 cm x 20 cm + vermicompost which was significantly superior over rest of the treatments and remained on par with application T3: 35 cm x 20 cm + Vermicompost (4.54 t/ha), T4: 45 cm x 20 cm +Farm Yard Manure (4.0 t/ha) and T7: 55 cm x 20 cm + Farm yard manure (4.97 t/ha).

Economics

The highest Cost of cultivation (46049 INR/ha), Gross returns (163800 INR/ha), net returns (117751 INR/ha) and Benefit Cost ratio (2.55) was recorded in the treatment which has T9: 55 cm x 20 cm + Vermicompost as it had reported highest Cob yield. The lowest Cost of cultivation (45099 INR/ha), Gross returns (81900 INR/ha), net returns (36801 INR/ha) and Benefit Cost ratio (1.25) was recorded in the treatment which has T1: 35 cm x 20 cm + Farm yard manure, as it has reported lowest Cob yield (Table 3).

Table 3: Economics of different treatment combinations in Baby corn

S. No	Treatments	Total cost of cultivation (INR/ha)	Gross returns (INR/ha)	Net Returns (INR/ha)	B:C ratio
1	T1: 35 cm x 20 cm + Farm Yard Manure	45099	81900	36801	1.25
2	T2: 35 cm x20 cm + Poultry Manure	45859	96900	51041	1.11
3	T3: 35 cm x 20 cm + Vermicompost	46049	103800	57751	1.25
4	T4: 45 cm x 20 cm +Farm Yard Manure	45099	109500	64401	1.42
5	T5: 45 cm x 20 cm +Poultry Manure	45859	129000	83141	1.81
6	T6: 45 cm x 20 cm + Vermicompost	46049	146700	100651	2.18
7	T7: 55 cm x 20 cm +Farm Yard Manure	45099	113400	68301	1.51
8	T8: 55 cm x 20 cm +Poultry Manure	45859	153600	97741	2.13
9	T9: 55 cm x 20 cm +Vermicompost	46049	163800	117751	2.55

Conclusion

Among all treatments, the treatment combination T9 (55 cm x 20 cm + Vermicompost) was found to be best by obtaining the highest growth, yield and B:C ratio. Thus, Treatment T9 is more productive, when compared to other treatments.

Future Scope

Based on research work done, it can be used as reliable work for further reference. The findings of the.

present study is based on only one season. Hence, further trails are needed to confirm the findings of the present experiment.

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