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Influence of bio-fertilizer and organic manures on growth and yield of baby corn (*Zea mays* L.) in Prayagraj condition

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Abstract
A field experiment was conducted at the Crop Research Farm (CRF), Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of *Zaid* season 2022. The experiment comprised of 9 treatments of different combinations of bio-fertilizer and organic manures replicated thrice in a Randomized Block Design. The main objective of the experiment was to evaluate the Influence of bio-fertilizer and organic manures on growth and yield of baby corn (*Zea mays* L.) Prayagraj condition. The three level of organic manure (Vermicompost at 2.5 t/ha), Neemcake at 500 kg/ha) and (Vermicompost at 1.25 t/ha + Neemcake @ 250 kg/ha). Where-as three levels of bio-fertilizer include like Rhizobium at 20 g/kg, PSB at 15 g/kg andRhizobium at 10 g/kg + PSB at 10 g/kg. From the present investigation it may be concluded that the profitable production of baby corn can be secured by Vermicompost at 2.5 t/ha + Neemcake at 250 kg/ha at 10 g/kg + PSB at 10 g/kg (T_9).

Keywords: Growth, yield, bio-fertilizer and organic manure

Introduction
Maize is one of the most important cereal crops next to rice and wheat in world agriculture economy both as food for men and feed for animals. It has high yield potential, there is no crop on earth which has so immense potentiality and that is why it is called queen of cereals. Its botanical name is *Zea mays* L. belonging to the family Gramineae, sub family Poaceae and chromosome number is 20 (2n). Christopher Columbus reported that maize was cultivated in Halti, where it was named "mahiz". He carried maize from America to Europe and later it was carried by Portuguese and others Europeans to Africa and Asia, during 16th and 17th centuries. Already, this crop has been developed into a multi dollar business in foreign countries (Thailand, Taiwan, Singapore, Malaysia, USA, Canada and Germany) because of its potential as a value added product for export and a good food substitute. During recent times, its potentiality has been extended to the field of vegetable production (Mugalkhod *et al.* 2011) **[11]**.
In India, cultivation of baby corn is a recent development and its industry is still at a juvenile stage. Its cultivation is only now picking up seriously in Meghalaya, Western UP, Haryana, Maharashtra, Karnataka and Andhra Pradesh. In India, maize (*Zea mays* L.) is grown on an area of 9.43 m/ha, with production and productivity of 24.35 mt and 2583 kg/ha, respectively (GOI, 2014). Baby corn grown for vegetable purpose is successful in countries like Thailand, Taiwan, Srilanka and Burma. It has been developed into a multi-dollar business because of its potential as a value-added product for export and a good food substitute.
Bio-fertilizers play an important role in the increasing availability of nitrogen and phosphorus. Among several bio agent *Azospirillum* is known to fix atmospheric nitrogen and increased about 10-15% grain yield in maize (Patil *et al.* 2017) [13]. The availability of phosphorous are also low as compared to that of N & K. under such situation, the phosphate solubilizing microorganism (PSB) plays significant role in making the phosphorous available to plants by secretion of organic acids and enzyme phosphatase which solubilizes the insoluble phosphate and thereby it helps in increasing the crop production.
Trace elements are also removed and must be replaced. Use of inorganic fertilizers for increasing cereal production is inevitable in the present circumstances where cereal crop needs and livelihood issues of the people have sustained national priority. But this has declined the soil fertility in the long term. The only way out to this gloomy scenario is to develop sustainable and nutrient balance through organic farming, which would increase the cereal crop production substantially without harming the precious environment. Organic manures and

bio-fertilizers serve as an alternate to chemical inputs and are being increasingly used in vegetable production today. Organic manure serves as an alternate practice to mineral fertilizers for improving soil structure (Imnaakum *et al.* 2021) [7] and microbial biomass (Kumar *et al.* 2018) [9]. In addition to that, the cultivation of baby corn can lead to at least double return to the farmer unlike normal grain maize (Singh *et al.* 2011) [16].

The following objectives have been undertaken to study the "Effect of bio-fertilizer and organic manure on growth and yield of Baby corn (*Zea mays* L.)"

Materials and Methods

The current study was carried out in the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj, during the *Zaid* season 2022, (U.P.). The experimental field is situated on the left side of the Prayagraj-Rewa Road, about seven kilometers from Prayagraj city and close to the Yamuna River. The subtropical region of Uttar Pradesh, where Prayagraj is located, has scorching summers and nice winters. The region's typical temperature ranges from 23 °C to 38 °C, seldom falling below 3 °C or 4 °C. The relative humidity levels range from 28.57% to 95%. In this location, the average annual rainfall is 1050 mm. The soil chemistry analysis revealed a sandy loam texture with a pH of 7.70, low amounts of organic carbon (0.84 percent) and potassium (160.0 kg/ha), and a low quantity of accessible phosphorus (29.0 kg/ha). The soil was electrically conductive and had a conductivity of 0.22 dS/m. For each of the nine treatment combinations, three replications were employed. The therapy details and treatment combinations are shown in Tables 1 and 2, respectively. Bio fertilizer and organic manure were maintained according to the treatment combinations. Plant height (cm) at harvest, dry weight at harvest, number of cobs/plant, weight of cob (g) and baby corn yield (t/ha) were all successfully measured, and an economic analysis of each treatment was completed to determine the best treatment combination for baby corn cultivation.

Table 1: Treatment details

Bio fertilizer (B): Three levels	B_1	Rhizobium at 20 g/kg
	B_2	PSB at 15 g/kg
	B_3	Rhizobium at 10 g/kg + PSB at 10 g/kg
Organic manure (O): Three levels	O_1	Vermicompost at 2.5 t/ha
	O_2	Neemcake at 500 kg/ha
	O_3	Vermicompost at 1.25 t/ha + Neemcake @ 250 kg/ha

Table 2: Treatment combinations

Treatment symbol	Treatment combinations Symbol	Treatment combinations
T_1	O_1B_1	Vermicompost at 5 t/ha + Rhizobium at 20 g/kg
T_2	O_1B_2	Vermicompost at 5 t/ha + PSB at 15 g/kg
T_3	O_1B_3	Vermicompost at 5 t/ha + Rhizobium at 10 g/kg + PSB at 10 g/kg
T_4	O_2B_1	Neem cake at 500 kg/ha + Rhizobium at 20 g/kg
T_5	O_2B_2	Neem cake at 500 kg/ha + PSB at 15 g/kg
T_6	O_2B_3	Neem cake at 500 kg/ha + Rhizobium at 10 g/kg + PSB at 10 g/kg
T_7	O_3B_1	Vermicompost at 2.5 t/ha + Neemcake at 250 kg/ha + Rhizobium at 20 g/kg
T_8	O_3B_2	Vermicompost at 2.5 t/ha + Neemcake at 250 kg/ha + PSB at 15 g/kg
T_9	O_3B_3	Vermicompost at 2.5 t/ha + Neemcake at 250 kg/ha at 10 g/kg + PSB at 10 g/kg

Results and Discussion

Growth parameters

Plant height (cm)

Table 3 shows bio-fertilizer and organic manure on plant height at harvest. The Data indicated that spacing had significant impact on plant height at harvest during the crop growth period. At 35 DAS, highest plant height (114.43 cm) was observed in Vermicompost at 2.5 t/ha + Neemcake at 250 kg/ha at 10 g/kg + PSB at 10 g/kg and lowest was obtained in Neem cake at 500 kg/ha + Rhizobium at 20 g/kg (83.71 cm). There was non-significant difference among the treatments. Application of Fe improves photosynthesis and activates many enzymes and helps in transport of assimilates towards stem. Bio fertilizer plays major role in plant physiology and morphology. Plant height was significantly affected by foliar application of Fe (Zayed *et al.* 2011) [17]. Similar observation was also reported by (Akongwubel *et al.* 2012) [1]. They observed significant improvement on plant height and leaf area index in corn with ultimate increase in organic manure rates. Bio fertilizer supply essential nutrient elements to promote vigorous growth and physiological activities in the plant system. Increased the rate of bio fertilizer application significantly get higher plant height, leaf area index and dry matter production. Similar result was also observed by (Igua *et al.* 2009) and (Channal, 2017) [6].

Dry weight of plant

Table 3 shows bio-fertilizer and organic manure on dry weight per plant at harvest. The Data indicated that, At 35 DAS, highest plant dry weight (g/plant) (68.35 cm) was observed in Vermicompost at 2.5 t/ha + Neemcake at 250 kg/ha at 10 g/kg + PSB at 10 g/kg and lowest was obtained in Neem cake at 500 kg/ha + Rhizobium at 20 g/kg (53.09 cm). There was non-significant difference among the treatments. Application of organic manures may have helped improve physico-chemical properties of the soil, imparting favorable soil structure for root growth and soil enzymes (the latter continue to break down organic matter in the soil to release nutrients and make them available near the rhizosphere for absorption by plant roots, thereby improving quality) (Chaoui *et al.* 2003) [4]. In addition to that the influence of organic fertilization through vermicompost on LAI could be attributed by increment of metabolic process in plants which seems to have promoted meristematic activities causing apical growth.

This result is in agreement with the findings of Atarzadeh *et al.* (2013) [2]. Jat *et al.* (2011) [8] also reported a significant increase in shoot dry weight by Fe application under both aerobic and flooded plots.

Yield parameters

Number of cobs per plant

Observations regarding the response of different levels of bio-fertilizer and organic manure on yield and yield attributes of baby corn are given in table 4 the results revealed that there was ear from the data that among different treatments, Number of cobs/plant recorded at harvest stage. The data shown that there was a significant effect among treatments. However, highest number of cobs/plant (2.83) were recorded in Vermicompost at 2.5 t/ha + Neemcake at 250 kg/ha at 10 g/kg + PSB at 10 g/kg. While lowest number of cobs/plant was observed in control plot (1.08), respectively. Application of bio fertilizer and inorganic combination along with foliar application of zinc and iron ultimately accrued huge quantity of biomass and partitioned a large fraction of assimilates to the sink, resulting in enhanced yield structures (cobs) as displayed by all the yield attributes. The finding of Nagavani *et al*. (2010) [12] confirmed these results.

Weight of cob (without husk) (g)

Observations regarding the response of different levels of bio-fertilizer and organic manure on yield and yield attributes of baby corn are given in table 4 the results revealed that there was ear from the data that among different treatments, cob weight (g) without husk recorded at harvest stage. The data shown that there was a significant effect among treatments. However, highest cob weight (g) without husk (9.21) were recorded in Vermicompost at 2.5 t/ha + Neemcake at 250 kg/ha at 10 g/kg + PSB at 10 g/kg. While lowest cob weight (g) without husk was observed in control plot (5.35), respectively. From this study, it was inferred that combination of potassium and Iron micronutrients gives higher yield as they play major role in assimilation rate and metabolic activities in plant. The cob weight is increased mainly due to balanced supply of nutrients from bio fertilizer in combination with inorganic fertilizers throughout the grain filling and development period Salomone and Dobereiner (2004) [14].

Weight of cob (with husk) (g)

Table 4 shows bio-fertilizer and organic manure on weight of cob (with husk). Shows bio-fertilizer and organic manure on weight of cob (with husk). The data revealed that various treatments of the highest, Cob weight (g) with husk recorded at harvest stage. The data shown that there was a significant effect among treatments. However, highest cob weight (g) with husk (51.41) were recorded in Vermicompost at 2.5 t/ha + Neemcake at 250 kg/ha at 10 g/kg + PSB at 10 g/kg. While lowest cob weight (g) with husk was observed in control plot (40.80), respectively. From this study, it was inferred that combination of potassium and Iron micronutrients gives higher yield as they play major role in assimilation rate and metabolic activities in plant. The cob weight is increased mainly due to balanced supply of nutrients from organic manure in combination with inorganic fertilizers throughout the grain filling and development period Salomone and Dobereiner (2004) [14].

Cob yield with husk (t/ha)

The data on cob yield with husk (t/ha) as influenced by different bio-fertilizers and organic manure. It is evident from this data the cob yield was significantly influenced by different bio-fertilizers and organic manure. Cob yield (t/ha) with husk recorded at harvest stage, is presented in Table 4. The data shown that there was a significant effect among treatments. However, highest cob yield (t ha-1) with husk (13.07) were recorded in Vermicompost at 2.5 t/ha + Neemcake at 250 kg/ha at 10 g/kg + PSB at 10 g/kg. While lowest cob yield (t/ha) with husk was observed in control plot (7.65), respectively. Similar results were found with Shanmugam *and* Veeraputhran (2000) [15].

Cob yield without husk (t/ha)

The data on cob yield without husk (t/ha) as influenced by different bio-fertilizers and organic manure is tabulated in table 4. It is evident from this data the cob yield was significantly influenced by different iron and bio-fertilizers. Cob yield (t/ha) without husk recorded at harvest stage. The data shown that there was a significant effect among treatments. However, highest cob yield (t/ha) without husk (2.12) were recorded in Vermicompost at 2.5 t/ha + Neemcake at 250kg/ha at 10 g/kg + PSB at 10 g/kg. While lowest cob yield (t/ha) without husk was observed in control plot (1.06), respectively. Similar results were found with Kumar *et al*. (2009) [9].

Table 3: Effect of biofertilizer and organic manures on growth parameters of baby Corn

Treatment details		Growth Parameters	
		Plant height (cm)	Plant dry weight (g/ plant)
1.	Vermicompost at 5 t/ha + Rhizobium at 20 g/kg	91.01	61.80
2.	Vermicompost at 5 t/ha + PSB at 15 g/kg	94.31	60.15
3.	Vermicompost at 5 t/ha + Rhizobium at 10 g/kg + PSB at 10 g/kg	106.44	62.73
4.	Neem cake at 500 kg/ha + Rhizobium at 20g/kg	83.71	53.09
5.	Neem cake at 500 kg/ha + PSB at 15g/kg	103.53	65.66
6.	Neem cake at 500 kg/ha + Rhizobium at 10 g/kg + PSB at 10 g/kg	108.71	63.44
7.	Vermicompost at 2.5 t/ha + Neemcake at 250 kg/ha + Rhizobium at 20 g/kg	108.03	66.38
8.	Vermicompost at 2.5 t/ha + Neemcake at 250 kg/ha + PSB at 15 g/kg	106.75	67.21
9.	Vermicompost at 2.5 t/ha + Neemcake at 250 kg/ha at 10 g/kg + PSB at 10 g/kg	114.43	68.35
F Test		S	S
S.Ed. (+)		2.064	1.788
CD (p= 0.05)		4.375	3.790

Table 4: Effect of biofertilizer and organic manures on yield and yield attributes of baby Corn

Treatments		Cobs /plant (No.)	Cob weight (g without husk)	Cob weight (g) with husk	Cob yield (t/ha without husk)	Cob yield husk with (t/ha)
1.	Vermicompost at 5 t/ha + Rhizobium at 20 g/kg	2.24	5.01	48.84	1.65	10.75
2.	Vermicompost at 5 t/ha + PSB at 15 g/kg	2.29	7.77	45.74	1.34	8.75
3.	Vermicompost at 5 t/ha + Rhizobium at 10 g/kg + PSB at 10 g/kg	2.33	7.51	47.87	1.36	10.45
4.	Neem cake at 500 kg/ha + Rhizobium at 20 g/kg	1.08	5.35	40.80	1.06	7.65
5.	Neem cake at 500 kg/ha + PSB at 15 g/kg	1.43	8.23	46.59	1.54	10.13
6.	Neem cake at 500 kg/ha + Rhizobium at 10 g/kg + PSB at 10 g/kg	1.86	8.32	46.23	1.36	10.27
7.	Vermicompost at 2.5 t/ha + Neemcake at 250 kg/ha + Rhizobium at 20 g/kg	2.76	8.76	48.32	2.12	11.35
8.	Vermicompost at 2.5 t/ha + Neemcake at 250 kg/ha + PSB at 15 g/kg	2.63	8.50	49.87	2.02	11.07
9.	Vermicompost at 2.5 t/ha + Neemcake at 250 kg/ha at 10 g/kg + PSB at 10 g/kg	2.83	9.21	51.41	2.12	13.07
F Test		S	S	S	S	S
S.Ed. (+)		0.184	0.0358	1.455	0.085	0.154
CD (p= 0.5)		0.391	0.758	3.084	0.0181	0.326

Fig 1: A and B at tagging for observation to be recorded and B during growth stage for respecter research trail

Conclusion

On the basis of results obtained in present investigation, it is concluded that the profitable production of baby corn can be secured by Vermicompost at 2.5 t/ha + Neemcake at 250 kg/ha (T_9). These practices may be passed on to the farmers for obtaining higher returns in this agro-climatic zone. It has also recorded the maximum gross return, net return and benefit cost ratio.

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