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Effect of Organic Manures and Bio-fertilizers on Growth and Yield of Baby Corn

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted during *zaid* 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P) to determine the "Effect of Organic manures and Bio-fertilizers on growth and yield of baby corn". There were nine treatments each replicated thrice and the experiment was laid out in Randomized Block Design. The experiment involves the organic manures like Farm Yard Manure (FYM)- 20t/ha, Poultry Manure- 4t/ha, Vermicompost- 4t/ha along with the combination of biofertilizers such as, *Azotobactor* (20g) and *Azospirillum* (20g). The results revealed that, significant and higher plant height (138.7 cm), plant dry weight (55.49 g), maximum number of cobs/plant (1.93), cob length (19.1 cm), cob weight (52.54 g), stover yield (22.05 t/ha) and harvest index (29.15%) were recorded with poultry manure (4t/ha) + Azotobactor (20g) + Azospirillum (20g).

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1. INTRODUCTION

Baby corn is a vegetable picked from regular maize or sweet corn plants when the ears are still premature and immediately after the emergence of white silk (2–3 cm) length. It is very young cob with undeveloped seeds, obtained from a corn plant at about 45-60 days after sowing or 2-3 days after silking. It is a warm weather crop and optimum temperature for better growth is 28-32℃. It grows well in areas with annual rainfall 250-400 cm. It can be grown successfully in soils with pH ranging from 6.5-7.5. The alluvial soils of Uttar Pradesh are well suitable for raising baby corn. The soils with sandy loam to silty loam texture are best for the crop [1].

Globally maize grown in an area of about 169.81 million hectares with a production of 835.32 million tonnes with the productivity of 49.2 q/ha (USDA, 2023). In India, which is the fifth-largest producer in the world and accounts for 3% of worldwide production, maize is grown over an area of roughly 9.18 million hectares, with a yield of 27.23 million tonnes and an average productivity of 2965 kg/ha. With a contribution of 14.87% (1.37 million tonnes) of the total Indian maize produced area, In Uttar Pradesh gives an area of approximately 0.73 million hectares with a 7.98% to the entire country of India, which has a production of approximately 1.53 million (GOI, 2021).

Application of inorganic fertilizers helps in obtaining maximum production of baby corn but, increases the cost of production along with its hazardous effects on environmental health. Synthetic fertilizers have become the primary nutrient sources for agriculture over the last 50 years because of certain advantages behind their use. But their extravagant use has created several environmental problems like soil acidity and nutrient imbalance, which may result in reduction of crop yield. So, judicious uses of nutrients from different source of organic as well as bio-fertilizers will maintain the environmental sustainability.

Organic fertilizers including Farm yard manure, Poultry manure, Vermicompost may be used for crop production as substitutes or supplements of the chemical fertilizers. FYM occupies an important position among the organic manures. The FYM act directly by increasing crop yield by acceleration of respiratory process or by cell permeability or by hormonal growth action. Soil chemical properties (Soil organic carbon, nitrogen, phosphorus, and potassium levels)m qualities can also be enhanced with the use of FYM. It supplies N, P and K in available form to the plant through biological decomposition. Substitution of 50% 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. Poultry manure is a valuable fertilizer and can serve as a suitable alternate to chemical fertilizers. Poultry manures provide organic matter to soil and nutrients to crops. Poultry manure is a good source of major and minor mineral elements that are capable of enhancing soil fertility on application. Recently vermicompost as source of organic manure in crop production is gaining popularity due to its higher nutrient content, faster mineralization and acceptability. Vermicompost has been reported to enhance 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.

Biofertilizers are microbial inoculants of selective microorganisms like bacteria, algae, fungi, already existing in nature. They increase the biological fixation of atmospheric nitrogen and enhance phosphorous availability to baby corn crop. Therefore, introduction of efficient strain of azospirillum in the soil which is poor in nitrogen may be helpful in boosting up production and consequently more nitrogen fixation. Among several bio agents, azospirillum and azotobacter is known to fix atmospheric nitrogen and increased about 10-15% Sgrain yield in baby corn. On an average 20 and 22 kg of nitrogen/ha can be saved by inoculation of baby corn seed before sowing with azotobacter or azospirillum, respectively. Many researchers optimistically predicted that microorganisms azotobacter and azospirillum associations could be lucratively managed to reduce dependence on chemical fertilizers, but promises concerning the applied value of azotobacter in agriculture have been more rhetorical than deliverable (Dawson *et al*. 2017). Keeping the above points under

consideration the experiment was carried out to determine the "Effect of Organic manures and Bio-fertilizers on growth and yield of baby corn"

2. MATERIALS AND METHODS

A field experiment was conducted during *Zaid* 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P) to study the "Effect of Organic manures and Bio-fertilizers on growth and yield of baby corn. The experiment involves the organic manures like Farm Yard Manure (FYM)- 20t/ha, Poultry Manure- 4t/ha, Vermicompost- 4t/ha along with the combination of biofertilizers such as, *Azatobactor* (20g) and *Azospirillum* (20g). The soil of experimental plot was sandy loam in texture, soil pH (8.0), low in organic carbon (0.62 %), available N (225 kg/ha), available P (38.2 kg/ha) and available K (240.7 kg/ha). The experiment was laid out in randomized block design with 9 treatments which were replicated thrice. The treatment combinations involves FYM 20t/ha + Azotobactor (20g), FYM 20t/ha + Azospirillum (20g), FYM 20t/ha + Azotobactor (20g) + Azospirillum (20g), poultry Manure 4t/ha + Azotobactor (20g), Poultry Manure 4t/ha + Azospirillum (20g), poultry Manure 4t/ha + Azotobactor (20g) + Azospirillum (20g), Vermicompost 4t/ha + Azotobactor (20g), Vermicompost 4t/ha + Azospirillum (20g) and Vermicompost 4t/ha + Azotobactor (20g) + Azospirillum (20g). The data recorded on different aspects of crop such as, growth and yield were subjected to statistical analysis by analysis of variance method [2].

3. RESULTS AND DISCUSSION

3.1 Growth Parameters of Baby Corn

3.1.1 Plant height (cm)

The data revealed that, significantly higher plant height (138.7 cm) was recorded with application of poultry Manure (4t/ha) + Azotobacter (10g) + Azospirillum (10g)] as compared to rest of the treatments. However, the application of poultry Manure (4t/ha) + Azospirillum (20g)] was found to be statistically at par with application of [poultry Manure (4t/ha) + Azotobacter (10g) + Azospirillum (10g)]. Significant higher plant height was recorded with poultry manure (4t/ha) might be due to poultry manure improves soil fertility by adding essential nutrients and soil organic matter in the soil, which improves soil moisture and nutrient retention, results in better growth and development of the crop. Similar result was also reported by Hossain et al. [3]. Significant higher plant height was recorded with *Azotobacter* might be due to seed treatment with bio-fertilizers increases nitrogen availability by fixing the appreciable amount of molecular nitrogen and makes available for plant growth and enhance plant in synthesis of growth-promoting enzyme like indole acetic acid (IAA), gibberellins, vitamins, which altered the microbial balance in the rhizosphere and producing metabolites results in growth and development of Plant. Similar result was also reported by Patel et al. (2014) Further, significantly higher plant height was recorded with Azospirillum might be due to increasing nutrients up taking by plant and improving soil properties such as organic content, which enhance plant growth through increasing availability nitrogen. Similar result was also reported by Hoshang et al. [4] in maize.

3.1.2 Plant dry weight (g)

The data revealed that, significantly higher plant dry weight (55.49 g) was recorded with the application Poultry Manure (4t/ha) + Azotobacter (10g) + Azospirillum (10g)] as compared to rest of the treatments. Which was found to be statistically at par with the application of [Poultry Manure (4t/ha) + Azospirillum (20g)] Significant higher plant dry weight was recorded with Poultry manure (4t/ha) might be due to optimum availability of essential nutrients through poultry manure leads to increase in leaf area enhance the photosynthesis rate and plant biomass, which may have attributed to achieve higher dry matter accumulation. Similar result was also reported by Kharche et al. [5]. Significant and higher plant dry weight was recorded with *Azotobacter* might be due to azotobacter fixes atmospheric nitrogen and enhance plant growth promoters, which increase in plant growth and increases ability to uptake more water and nutrients results in production of more biomass. Similar result was also reported by Marngar and Dawson, (2017) in maize. Further, significant and higher plant dry matter was recorded with *Azospirillum* might be due to seed treatment with azospirillum fixes air nitrogen which promotes plant growth, increases root hairs, uptake of water and nutrients results in accumulation of more dry matter. Similar result was also reported by Marngar and Dawson, (2017) in maize.

3.1.3 Yield and yield attributes number of cobs/plant

The data revealed that, significant maximum number of cobs/plant (1.93) was recorded

[poultry Manure (4t/ha) + Azotobacter (20g) + Azospirillum (20g) Which was statistically at par with the application of [poultry Manure (4t/ha) + Azospirillum (20g)] and [Vermicompost (4t/ha) + Azotobacter (20g) + Azospirillum (20g). Significant maximum number of cob/plant was recorded with Poultry manure (4tn/ha) might be due to greater availability of photosynthates, metabolites and nutrients results in develop of reproductive parts and increased number of cobs/ plant. Similar result was also reported by Addepalli and Debbarma, [6] in maize.

3.1.4 Length of cob (cm)

The data revealed significant length of cob (19.1 cm)was recorded with the application of [poultry Manure (4t/ha) + Azotobacter (20g) + Azospirillum (20g)] which was statistically at par with [poultry Manure (4t/ha) + Azospirillum (20g)]. Significant higher length of cob was recorded with Poultry manure (4tn/ha) might be due to increasing photosynthetic rate and translocation of photosynthates towards the sink results in development of cob length. Similar results were reported by Sawant et al. (2020). Further, significantly higher length of cob was recorded with Azotobacter might be due to adequate availability of nutrients, Photosynthates and metabolites, which help in development of reproductive parts and results in increase of cob length. Similar result was also reported by Raj *et al*. (2016).

3.1.5 Weight of cob (g)

Significant and higher Weight of Cob (52.54 g) was recorded with application of [poultry Manure (4t/ha) + Azotobacter (20g) + Azospirillum (20g)] as compared to rest of the treatments. However, [poultry Manure (4t/ha) + Azospirillum (20g)] was found to be statistically at par with [poultry Manure (4t/ha) + Azotobacter (20g) + Azospirillum (20g)]. Significant and higher weight of cob was recorded with poultry manure (4t/ ha) might be due to greater availability of photosynthates, metabolites and nutrients to develop reproductive structures which, leads to increase in cob weight. Similar result was also reported by Kumar et al. [7]. Further, significant and higher weight of cob was recorded with *Azotobacter* and *Azospirillum* might be due to increased cob weight appears to be the result of more photosynthates, metabolites and nutrients being available to build reproductive structures in cob weight. Similar result was also reported by Jinjala et al. [8].

3.2 Cob Yield (t/ha)

I. With Husk (t/ha)

The data revealed that, Significant and higher seed yield (9.07 t/ha) was recorded with application of [poultry Manure (4t/ha) + Azotobacter (20g) + Azospirillum (20g). [poultry Manure (4t/ha) + Azospirillum (20g)] and treatment 9 [Vermicompost (4t/ha) + Azotobacter (20g) + Azospirillum (20g)]. Significantly higher cob yield with husk was recorded with poultry manure (4tn/ha) might be due to higher mineralization potential of poultry manure enabling it to active and fast release of its nutrients for plant uptake. Similar result was also reported by Kharche et al. [5]. Further, significantly higher cob yield with husk was recorded with Azotobacter and Azospirillum might be due to nitrogen fixing bacteria could be beneficial source to enhance plant growth and produce considerable amounts of biologically active substances such as, auxin, gibberellin etc. that promote growth of reproductive organs and increase plants productivity. higher mineralization potential of poultry manure enabling it to active and its nutrients uptake of plants.

II. Without Husk (t/ha)

Significant highest seed yield (3.90 t/ha) was recorded with application of Poultry Manure (4t/ha) + Azotobacter (20g) + Azospirillum (20g)] Which was statistically at par with the application of [Poultry Manure (4t/ha) + Azospirillum (20g)].

3.3 Stover Yield (t/ha)

The data revealed that a significant higher Stover yield (22.05 t/ha) was recorded with application of poultry Manure (4t/ha) + Azotobacter (20g) + Azospirillum (20g)] as compared to rest of the treatments. However, Application of [poultry Manure (4t/ha) + Azospirillum (20g)] and [Vermicompost (4t/ha) + Azotobacter (20g) + Azospirillum (20g)] was found to be statistically at par with application of [poultry Manure (4t/ha) + Azotobacter (20g) + Azospirillum (20g)]. Significant higher Stover yield was recorded with poultry manure (4tn/ha) might be due to incorporation of organic manures increases the availability of plant nutrients and helps in formation of organic acids through decomposition process, which develops native nutrients within the soil and increases their availability to plants for better vegetative growth and leads to increase in stover yield. Similar result was also reported by Kharche et al. [5].

Table 1. Effect of Organic manures and Bio-fertilizers on Growth Parameters of baby corn

		Growth Parameters	
S.No.	**Treatments combination**	**Plant Height 60 DAS**	**Plant Dry weight 60 DAS**
1	FYM 20t/ha + Azotobactor (20g)	122.4	45.64
2	FYM 20t/ha + Azospirillum (20g)	125.4	46.91
3	FYM 20t/ha + Azotobactor (10g) + Azospirillum (10g)	131.9	50.27
4	Poultry Manure 4t/ha + Azotobactor (20g)	131.1	49.05
5	Poultry Manure 4t/ha + Azospirillum (20g)	137.0	54.73
6	Poultry Manure 4t/ha + Azotobactor (20g) + Azospirillum (20g)	138.7	55.49
7	Vermicompost 4t/ha + Azotobactor (20g)	128.6	48.39
8	Vermicompost 4t/ha + Azospirillum (20g)	132.7	50.70
9	Vermicompost 4t/ha + Azotobactor (20g) + Azospirillum (20g)	134.3	52.09
	S Em (±)	0.6	0.27
	CD (p =0.05)	1.9	0.82

Table 2. Effect of organic manures and bio-fertilizers on yield and yield attributes of baby corn

S. No. Treatment combinations	**Number of Cobs/plant**	**Length of cob (cm)**	**Weight of cob (g)**	**Cob yield With husk (t/ha)**	**Cob yield With out husk (t/ha)**	**Stover Yield (t/ha)**	**Harvest Index (%)**
1. FYM 20t/ha + Azotobactor (20g)	1.27	16.3	43.79	7.81	2.11	20.41	27.65
2. FYM 20t/ha + Azospirillum (20g)	1.47	16.8	45.84	7.94	2.29	20.53	27.89
3. FYM 20t/ha + Azotobactor (20g) + Azospirillum (20g)	1.67	17.8	48.40	8.56	2.60	21.02	28.93
4. Poultry Manure 4t/ha + Azotobactor (20g)	1.53	17.5	48.31	8.37	2.47	20.86	28.65
5. Poultry Manure 4t/ha + Azospirillum (20g)	1.87	18.6	51.42	8.84	3.68	21.64	29.00
6. Poultry Manure 4t/ha + Azotobactor (20g) + Azospirillum(20g)	1.93	19.1	52.54	9.07	3.90	22.05	29.15
7. Vermicompost 4t/ha + Azotobactor (20g)	1.47	17.1	46.70	8.02	2.36	20.61	28.01
8. Vermicompost 4t/ha + Azospirillum (20g)	1.73	18.0	48.61	8.63	2.84	21.17	28.97
9. Vermicompost 4t/ha + Azotobactor (20g) + Azospirillum (20g)	1.80	18.2	49.52	8.71	3.15	21.30	29.01
S Em (±)	0.06	0.25	0.37	0.13	0.10	0.26	0.40
CD (p =0.05)	0.19	0.74	1.13	0.39	0.31	0.78	1.22

Significant higher stover yield was recorded with *Azotobacter* might be due to bacterization with azotobacter culture helping in fixation of atmospheric nitrogen, secretion of growth promoting substances, resulting in better seed germination and expanded root system for nutrient uptake, which results in production of more stover yield. Similar result was also reported by Laxminarayana [9] in maize. Further, significant and higher stover yield was recorded with *Azospirillum* might be due to fixation of atmospheric nitrogen, enhance production of indoleacetic acid, gibberellin and cytokinine like substances results in more nutrient uptake and crop production. Similar result was also reported by Laxminarayana [9] in maize.

3.4 Harvest Index (%)

The data revealed that, Significant higher harvest index (29.15 %) was recorded with the application of Poultry Manure (4t/ha) + Azotobacter (20g) + Azospirillum (20g)] as compared to rest of the treatments. However, application [Poultry Manure (4t/ha) + Azospirillum (20g)], treatment 7 [Vermicompost (4t/ha) + Azotobacter (20g)], [Vermicompost (4t/ha) + Azospirillum (20g)] and [Vermicompost (4t/ha) + Azotobacter (20g) + Azospirillum (20g)] was found to be statistically at par with the application of [Poultry Manure (4t/ha) + Azotobacter (20g) + Azospirillum (20g)].

Significant higher harvest index was recorded with *Azotobacter* and *Azospirillum* might be due to use of biofertilizers may lead to higher availability of nitrogen and phosphorus that promoted growth and development and ultimately resulting in higher yields. Similar result was also reported by Sandhya et al. (2018) in sorghum [10-15].

4. CONCLUSION

It is concluded that, application of Poultry manure along with azotobacter and Azospirillum observed highest yield of baby corn and benefit cost ratio.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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