Original Research Article

"Response of biofertilizer and biochar on growth and yield of baby corn"

Abstract

The field experiment entitled "Response of biofertilizer and biochar on growth and yield of baby corn" was conducted at Crop Research Farm, Department of Agronomy, Naini Agriculture Institute, SHUATS, Prayagraj, UP, during the *Zaid* season of 2023. The experiment was laid out in Randomized Block Design with ten treatment combinations which are replicated thrice viz.., (T1- Azospirillum 20g/kg seed + Biochar 0 t/ha ;T2-Azospirillum 20g/kg seed + Biochar 10 t/ha**,**T3-Azospirillum 20g/kg seed + Biochar 40 t/ha;T4-Azotobacter 20g/kg seed + Biochar 0 t/ha;T5-Azotobacter 20g/kg seed + Biochar 10 t/ha;T6-Azotobacter 20 g/kg seed + Biochar 40 t/ha;T7-Azospirillum 10g + Azotobacter 10 g/kg seed + Biochar 0 t/ha;T8-Azospirillum 10 g + Azotobacter 10 g/kg seed + Biochar 10 t/ha;T9-Azospirillum 10 g + Azotobacter 10 g/kg seed + Biochar 40 t/ha;T10-(Control) 120-60-40 NPK kg/ha l). Among the various treatment combinations in (treatment-9) with the application of Azospirillum 10g/kg seed along with Azotobacter 10 g/kg seed and Biochar 40 t/ha significantly recorded higher plant height (117.13 cm), plant dry weight(34.33 g), crop growth rate (29.08 g/m^2/day), cobs/plant (1.87), cob length with husk(22.62 cm), cob length without husk (14.58 cm), cob girth with husk (7.16 cm), cobweight with husk (41.13 g), cob weight without husk (12.09 g) and cob yield without husk (4.70 t/ha). Maximum gross returns (2,35,000.00 ₹/ha), were obtained in (treatment-9) whereas maximum net returns (1,27,001.00 ₹/ha) and higher benefit cost ratio (1.74) was obtained in (treatment-8) with application of Azospirillum 10g/kg seed along with Azotobacter 10g/kg seed and Biochar 10 t/ha.

Keywords: *Baby corn, Biochar, Biofertilizers, Growth, Yield*

INTRODUCTION

Maize is the third most significant cereal crop close to rice and wheat in India. Baby corn is dehusked young cob of maize collected within 2-3 days of silk rise. Baby corn has high nutrients like vitamin B and of various supplements. Baby corn is a scrumptious, enhancing and nutritious vegetable, without cholesterol. It is low calorie vegetable which helps in weight the executives, it is likewise a low carb, high fiber, fat free vegetable, and has rich value of nutrients and minerals **(Hekmat et al., 2019).** One baby corn can measure up to an 'egg' concerning minerals. Hundred gram of baby corn contained 89.1% moisture, 0.2 g fat, 1.9 g protein, 8.2 mg starch, 0.06 g ash, 28.0 mg calcium, 86.0 mg phosphorus, and 11.0 mg of ascorbic acid **(Rakesh et al., 2017).** India is the fifth-biggest producer of corn on the planet, contributing 3% of worldwide creation across an area of around 9.18 million hectares with a development of 27.23 million tons and a typical efficiency of 2.96 t ha-1. Uttar Pradesh contributes an area of around 0.73 M ha with a 7.98% to the whole nation of India, which has a development of around 1.53 M t. Because of expanding mindfulness about wellbeing combined with superior income the interest of baby corn is expanding in Indian market **(Joshi et al., 2018).**

Biofertilizer is a characteristic information that can be applied as a supplement to, or as a substituent of synthetic manure in sustainable farming **(Meena et al., 2013**). Bio composts are substances that contain live microorganisms that colonize the rhizosphere or within plants and invigorate plant development by expanding the stock of essential supplement accessibility and additionally animating objective plant development, when applied to seeds, plant surfaces, or soil **(Fitriatin et al., 2021).** Mycorrhizal advantageous interaction expands ingestion of certain components like phosphorus, nitrogen and micronutrients, further develops water take-up, produces chemicals, lessens harms brought about by ecological pressure, works on nature of soil total **(Marngar et al., 2017).** Bio-manures assume a significant part in the rising accessibility of nitrogen and phosphorus. Among biofertilizers Azospirillum is known to fix air nitrogen and expanded around 10-15 % grain yield in maize **(Rajesh et al., 2023).** Azotobacter, a vigorous free-living soil microorganism broadly utilized as biofertilizer, converts climatic nitrogen and delivery it as ammonium particles into the soil. They are pervasive and richly tracked down in impartial to feebly acidic soils. The oxygen consuming microbes Azotobacter chroococcum known to fix extensive amount of nitrogen in the scope of 20-40 kg of nitrogen for each hectare in the rhizosphere in non-leguminous harvests **(Tejaswi et al., 2021).** Azotobacter was the first and is the most widely recognized biofertilizer for certain plants, for example, maize, wheat, sorghum and rice which delivers some plant development advancing metabolites, catalysts and chemicals (auxin, cytokinin and gibberelin) as well as fixing air nitrogen. On a normal 20 and 22 kg of nitrogen/ha can be saved by applying of biofertilizers of baby corn seed prior to planting with azotobacter or azospirillum, individually **(Sri et al., 2023).**

Biochar is charcoal acquired from biomass intended to be incorporated into soil **(Yeboah et al., 2016).** A couple of significant potential impacts of biochar on surface soil include: soil carbon sequestration, green-house gas releases **(Brassard et al., 2016)**, crop-productivity capacity, soil biome **(Lehmann et al., 2011),** soil and chemical capacities and solution for polluted soils **(Pillala et al., 2023)**. In acidic soils, liming impact of biochar improves soil microbial variety and its capability, along with expanding cation exchange capacity and harvest water accessibility. Applying of biochar to soil further develops soil fertility retention, for example, soil pH, CEC, absolute C, all out N, accessible P, water storage capacity, nutrient cycling and also increase in attraction of beneficial microbial organisms **(Sharma et al., 2022)**. Biochar can work as soil conditioner by enhancing the physical and biological attributes of soils, for example, water holding range and soil nutrient withholding capacity, and furthermore upgrading plant development **(Rathiya et al., 2023)** and as valuable soil conditioner for crop better production **(Huang et al., 2019)**.

Keeping in view the tremendous significance of biofertilizers and biochar application, the current study "Response of biofertilizer and biochar on growth and yield of baby corn" was embraced.

MATERIAL AND METHODS

The experiment on the effect of biofertilizers and biochar on growth and yield of baby corn were conducted in *Zaid* season of 2023 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj which is located is located at 25°39' 42"N latitude, 81°67'56" 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. A composite soil sample was collected at a depth of 0 to 15 cm depth. The soil with reaction of (pH 7.3), organic carbon (1.217%), available nitrogen (2748.48 kg/ha), phosphorus (45.1 kg/ha), potassium (223.5 kg/ha), Electric conductivity (0.724 mm/cm). Baby com (Zea mays L.) variety G5414 were selected for sowing. Seeds were sown in line manually on 2023. Seeds were covered with the soil immediately after sowing. The spacing adopted was plant to plant 10 cm and row to row 45 cm according to the treatment details and the seeds were drilled at 3-4 cm depth. All the treatments were applied by balancing to the initial soil test values and crop requirements to justify the crop response to the supplied nutrients.

RESULTS AND DISCUSSION

Effect of biofertilizers and biochar on growth and yield of baby corn.

1.Growth Parameters:

1.1. Plant height

At 40 DAS, significantly higher plant height (117.13 cm) was recorded in (treatment-9) with application of Azospirillum 10g along with Azotobacter 10g/kg seed and Biochar 40 t/ha, whereas (treatment 7) and

(treatment-8) were found to be statistically at par with the (treatment-9). The significant response in plant height was recorded with application of biofertilizers along with biochar in baby corn. This might be due to the combined effect of biofertilizers along with use of biochar that have increased the nutrient availability to the plant. Increase in vigorous growth of internode length due to accessibility and uptake of nutrients that might have increased the plant height **(Reddy et al. 2021).**

1.2. Plant dry weight

At 40 DAS, superiorly higher plant dry weight (34.33 g) was recorded in (treatment 9) with application of Azospirillum 10g along with Azotobacter 10g/kg seed and Biochar 40 t/ha, whereas (treatment 8) was found to be statistically at par with the higher. The significant increase in plant dry weight might be due to the role of biofertilizers and biochar on enhancing soil moisture status that can indirectly help in better crop establishment and nutrient uptake. The application of biochar with the appropriate dose in plants will help increase microbial activity in the soil and will have an effect on increasing the availability of organic matter in the soil. Optimal organic content in the soil helps in maintaining growth and development in plants **(Rahayu et al. 2021; Babu and Mehera, 2022).**

1.3. Crop growth rate

During 30-40 DAS, significantly higher crop growth rate (29.08 g/m2/day) was recorded with (treatment 9) with application of Azospirillum 10g along with Azotobacter 10g/kg seed and Biochar 40 t/ha, However, (treatment-7), (treatment-8) were found to be statistically at par with the higher. The significant increase in crop growth rate might me due to the synergetic effect of biofertilizers and biochar might have attributed the crop growth and microbial activity of biofertilizers which have enhanced the supply of nutrients to the plant.

1.4. Relative growth rate

During 30-40 DAS, the higher relative growth rate (0.0565 g/g/day) was recorded (treatment-9) with application of Azospirillum 10g + Azotobacter 10g/kg seed + Biochar 40 t/h and also, which was found to be statistically at par with higher among all treatments.

2.Yield Parameters:

2.1. Number of cobs/plant

Significantly maximum number of cobs/plant (1.87) was recorded with (treatment-9) with application of Azospirillum 10g along with Azotobacter 10g/kg seed and Biochar 40 t/ha, whereas (treatment -8) were found to be statistically at par with the higher.

2.2. Cob length with husk

Significantly higher cob length with husk (22.62 cm) was recorded in (treatment-9) with application of Azospirillum 10g along with Azotobacter 10g/kg seed and Biochar 40 t/ha, whereas (treatment -8) were found to be statistically at par with the higher.

2.3. Cob length without husk

Significantly higher cob length with husk (14.58 cm) was recorded in (treatment-9) with application of Azospirillum 10g along with Azotobacter 10g/kg seed and Biochar 40 t/ha, whereas (treatment -8) were found to be statistically at par with the higher.

2.4. Cob girth with husk

Significantly higher cob girth with husk (7.16 cm) was recorded in (treatment-9) with application of Azospirillum 10g along with Azotobacter 10g/kg seed and Biochar 40 t/ha, whereas (treatment -8) were found to be statistically at par with the higher.

2.5. Cob weight with husk

Significantly higher cob weight with husk (41.13 g) was recorded in (treatment-9) with application of Azospirillum 10g along with Azotobacter 10g/kg seed and Biochar 40 t/ha, whereas (treatment -8) and (treatment-7) were found to be statistically at par with the higher.

2.6. Cob weight without husk

Significantly higher cob weight without husk (12.09 g) was recorded in (treatment-9) with application of Azospirillum 10g along with Azotobacter 10g/kg seed and Biochar 40 t/ha, whereas (treatment -8) were found to be statistically at par with the higher.

2.7. Cob yield without husk

Significantly higher cob weight without husk (4.70 t/ha) was recorded in (treatment-9) with application of Azospirillum 10g along with Azotobacter 10g/kg seed and Biochar 40 t/ha, whereas (treatment -8) were found to be statistically at par with the (treatment-9).

Significant increase in the yield parameter and yield of baby corn might be due the application of biofertilizer that have been proved beneficial for development of corn yield attributing characters mainly due to availability of optimum amount of nutrients during reproductive phase of the crop. (**Tejaswi *et al*. 2021**). Usage of biochar might have increased the organic carbon in the soil, that helps the roots of baby corn in nutrient uptake and rapid photosynthesis and supply of nutrients from source to sink. Biofertilizers increases the nitrogen availability in the soil that might have improved the yield of baby corn (**Barlal and Adhikari. 2013**). The increase in the yield attributes and yield of baby corn might be due to the synergetic effect of biofertilizers and biochar that have enhanced water holding capacity, increased cation exchange capacity (CEC) and provision of a medium for adsorption of plant nutrients and improved conditions for soil micro-organisms and direct nutrients from NPK. The rise in corn yield could be credited due to the overall enhancement in soil chemical, physical and biological properties (**Dzomeku *et al.* 2018; Sashi *et al.* 2018**).

3. Economics

3.1. Cost of cultivation

The cost of cultivation of treatments varies between 93,007.80 ₹/ha and 52,974.80 ₹/ha.

3.2. Gross returns

Maximum gross returns (2,35,000.00 ₹/ha) were recorded in (treatment -9) Azospirillum 10g and Azotobacter 10g/kg seed along with Biochar 40 t/ha and minimum gross return (78,333.33 ₹/ha) was recorded in control.

3.3. Net returns

Maximum net returns (1,27,001.00 ₹/ha) were recorded in (treatment-8) Azospirillum 10g and Azotobacter 10g/kg seed along with Biochar 10 t/ha and minimum (25,358.53 ₹/ha) was recorded in control.

3.4. Benefit cost ratio

Higher benefit cost ratio (1.74) was recorded in (treatment-8) Azospirillum 10g and Azotobacter 10g/kg seed along with Biochar 10 t/ha and lowest (0.22) was recorded in Azospirillum 20g/kg seed + Biochar 40t/ha.

CONCLUSION

It is concluded that in baby corn treatment-8 with application of Azospirillum 10g and Azotobacter 10g/kg seed along with application of Biochar 10 t/ha is recommended under Eastern Uttar Pradesh Agro-Climatic conditions for higher yields and economic returns.

Table.1 Effect of biofertilizers and biochar on growth attributes of baby corn

S.No	Treatments	Plant height(cm) At 40 DAS	Plant dry weight (g/plant) At 40 DAS	Crop growth rate(g/m^2/day) During (30-40DAS)	Relative growth Rate(g/g/day) During (30-40DAS)
1.	Azospirillum 20g/kg seed + Biochar 0t/ha	109.13	29.61	24.61	0.0550
2.	Azospirillum 20g/kg seed + Biochar 10t/ha	110.60	30.09	25.00	0.0548
3.	Azospirillum 20g/kg seed + Biochar 40t/ha	111.13	30.59	25.42	0.0549
4.	Azotobacter 20g/kg seed + Biochar 0t/ha	112.67	31.01	25.80	0.0550
5.	Azotobacter 20g/kg seed + Biochar 10t/ha	114.07	31.74	26.44	0.0551
6.	Azotobacter 20g/kg seed + Biochar 40t/ha	114.60	32.41	27.22	0.0558
7.	Azospirillum 10g+Azotobactor 10g/kg seed & Biochar 0t/ha	115.13	32.85	27.64	0.0559
8.	Azospirillum 10g+Azotobactor 10g/kg seed & Biochar 10t/ha	115.87	33.13	27.90	0.0560
9.	Azospirillum 10g+Azotobactor 10g/kg seed & Biochar 40t/ha	117.13	34.33	29.08	0.0565
10.	Control (120-60-40 NPK kg/ha)	107.47	29.84	24.98	0.0555
	F-Test	S	S	S	NS
	SEm (±)	0.67	0.40	0.57	0.0010
	CD (p=0.05)	2.01	1.19	1.70	-

Table.2 Effect of biofertilizers and biochar on yield attributes of baby corn

S.No	Treatments	Number of cobs/plant	Cob length with husk (cm)	Cob length without husk (cm)	Cob girth with husk (cm)	Cob weight with husk (g)	Cob weight without husk (g)	Cob yield without husk (t/ha)
1.	Azospirillum 20g/kg seed + Biochar 0t/ha	1.20	19.29	10.95	5.45	35.99	07.33	1.67
2.	Azospirillum 20g/kg seed + Biochar 10t/ha	1.40	20.02	11.64	5.63	36.13	10.54	2.83
3.	Azospirillum 20g/kg seed + Biochar 40t/ha	1.53	20.38	12.08	5.88	37.03	11.06	3.23
4.	Azotobacter 20g/kg seed + Biochar 0t/ha	1.40	20.98	12.49	5.99	37.40	08.19	2.23
5.	Azotobacter 20g/kg seed + Biochar 10t/ha	1.47	21.20	12.81	6.30	38.43	10.81	3.10
6.	Azotobacter 20g/kg seed + Biochar 40t/ha	1.60	21.47	13.48	6.34	39.42	11.15	3.77
7.	Azospirillum 10g+Azotobactor 10g/kg seed & Biochar 0t/ha	1.40	21.91	13.76	6.46	40.00	08.41	2.33
8.	Azospirillum 10g+Azotobactor 10g/kg seed & Biochar 10t/ha	1.60	22.29	14.10	6.93	40.43	11.79	4.00
9.	Azospirillum 10g+Azotobactor 10g/kg seed & Biochar 40t/ha	1.87	22.62	14.58	7.16	41.13	12.09	4.70
10.	Control (120-60-40 NPK kg/ha)	1.13	18.87	10.76	5.37	35.31	07.21	1.57
	F-Test	S	S	S	S	S	S	S
	SEm (±)	0.10	0.22	0.23	0.10	0.34	0.10	0.23
	CD (p=0.05)	0.30	0.65	0.69	0.32	1.02	0.31	0.71

Table.3 Effect of biofertilizers and biochar on economics of baby corn

S.No	Treatments	Cost of cultivation (₹)	Gross returns (₹)	Net returns (₹)	Benefit cost ratio
1.	Azospirillum 20g/kg seed + Biochar 0t/ha	52,990.20	83,333.33	30,343.13	0.57
2.	Azospirillum 20g/kg seed + Biochar 10t/ha	72,990.20	1,41,666.67	68,676.47	0.94
3.	Azospirillum 20g/kg seed + Biochar 40t/ha	1,32,990.20	1,61,666.66	28,676.47	0.22
4.	Azotobacter 20g/kg seed + Biochar 0t/ha	53,007.80	1,11,666.67	58,658.87	1.11
5.	Azotobacter 20g/kg seed + Biochar 10t/ha	73,007.80	1,55,000.00	81,992.20	1.12
6.	Azotobacter 20g/kg seed + Biochar 40t/ha	1,33,007.80	1,88,333.33	55,325.53	0.42
7.	Azospirillum 10g+Azotobactor 10g/kg seed & Biochar 0t/ha	52,999.00	1,16,666.67	63,667.67	1.20
8.	Azospirillum 10g+Azotobactor 10g/kg seed & Biochar 10t/ha	72,999.00	2,00,000.00	1,27,001.00	1.74
9.	Azospirillum 10g+Azotobactor 10g/kg seed & Biochar 40t/ha	1,32,999.00	2,35,000.00	1,02,001.00	0.77
10.	Control (120-60-40 NPK kg/ha)	52,974.80	78,333.33	25,358.53	0.48

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