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Nikita Sharma
Department of Horticulture Science, Institute of Agricultural Sciences, Bundelkhand University Jhansi, Uttar Pradesh, India

Safik Ahamad
Young Professional-I G.S.M Division Indian Grassland and Fodder Research Institute, Jhansi, Uttar Pradesh, India

Rohit Yadav
Department of Horticulture Science, Institute of Agricultural Sciences, Bundelkhand University Jhansi, Uttar Pradesh, India

Rikesh Raj
Department of Horticulture Science, Institute of Agricultural Sciences, Bundelkhand University Jhansi, Uttar Pradesh, India

Corresponding Author:
Safik Ahamad
Young Professional-I G.S.M Division Indian Grassland and Fodder Research Institute, Jhansi, Uttar Pradesh, India

Response of biofertilizer and organic manure on the growth, yield and quality of brinjal (*Solanum melongena* L.) cv. Pusa Uttam under Bundelkhand region of U.P.

Nikita Sharma, Safik Ahamad, Rohit Yadav and Rikesh Raj

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Abstract
The present investigation entitled "Response of biofertilizer and organic manure on the growth, yield and quality of brinjal (*Solanum melongena* L.) cv. Pusa Uttam under Bundelkhand region of U.P" was carried out the organic research farm Karguwan Institute of Agricultural Sciences Bundelkhand University, Jhansi (Uttar Pradesh) during *rabi* season of the year 2019-2020. The experiment was laid out in a randomized complete block design with three replications comprising 8 *viz*. T_0- Control, T_1- Farm yard manure (100%), T_2-Vermicompost (100%), T_3-Poultry manure (100%), T_4-Farm yard manure (100%) +Azotobactor, T_5-Vermicompost (100%) +Azotobactor, T_6-Farm yard manure (50%) +Vermicompost (50%) +Azotobactor, T_7- Poultry manure (50%) +Vermicompost (50%) + PSB + Azotobactor. The result showed that the treatment T_7 having Poultry manure (50%) +Vermicompost (50%) + PSB + Azotobactor gave maximum and significantly, plant height (19.77, 30.66, 47.07 and 66.06), stem diameter (0.56, 0.94, 3.33 and 3.72 cm), number of branches per plant(4.66, 8.66, 15.00 and 23.00) 30, 60, 90 and 120 DAT respectively, days to 1st flowering (35.66 days), number of fruit per plant(7.66), days to 1st picking(60.33 days), fruit length (9.24 cm), fruit diameter (8.04 cm), average fruit weight (131.10 g), total soluble solid (4.84%) and yield (37238.42 kg ha^{-1}). Application of T_7 Poultry manure (50%) +Vermicompost (50%) + PSB + Azotobactor significantly superior to other treatments.

Keywords: Brinjal, organic manures, biofertilizers, growth, yield, quality

Introduction
Brinjal *Solanum melongena* L., is a tropical, herbaceous, perennial plant, closely related to tomato, in the family Solanaceae which is grown for its edible fruit, the chromosome number (2n) 24. The plant is erect, semi-erect or prostate, herbaceous and branched in nature which is about one meter or lower in height. It is wooly or scurf, spiny or non-spiny with or without pigmentation which is mainly anthocyanin. Leaves are opposite or sub-opposite, large, ovate or oblongish-ovate shallowly sinnate-lobbed, glabrous or nearly glabrous above, bit densely tomentose beneath.

Brinjal is originated in Indo- Burma region (Vavliov, 1926) [9]. This proposition was substantiated by the presence of wild *Solanum melongena* in India, which is perennial herb with bitter fruits (Bhaduri, 1951) [3]. Also regarded brinjal as a native of Asia and not of America because wild forms of *Solanum melongena* had been found growing in the former Madras state (now Chennai) of India and Burma (now Myanmar) De-Condolle (1882) [4]. Secondary variability in this crop had been developed in China since the fifth century. Arabians and Persians took this crop to Africa. First recorded of this crop in Europe came in fifteen century, hower, it did not become generally known there until the seventh century.

Brinjal fruits are a good source of calcium, phosphorus, iron and vitamins particularly 'B' group. Analysis of 100g of edible fruit contains 91.5g of water, 6.4g of Carbohydrates, 1.3g of Protein, 0.3g of fat and 0.5g of mineral matters. Its green leaves are the main source of vitamin C (Raigon *et al.*, 2008) [7].

The beneficial effects of FYM and Vermicompost on crop yield and soil productivity is the result of their usefulness as a store house of plant nutrients. These average sources of nutrients

Improve soil aeration, root development and increase microbial and biological activities in the rhizosphere. Besides supply of micronutrients Vermicompost being a rich source of macro and micronutrients and vitamins, plant growth regulators and beneficial micro flora appeared to be the best organic source in maintaining soil fertility on sustainable basis towards and eco-friendly environment.

The extensive use of biofertilizers in crop production is the major breakthrough as a pollution free low-cost input technology during recent years. Hence organic manures and biofertilizers are the important components of integrated nutrient management. The use of vermicompost with inorganic fertilizers enhance utilization of nutrients by the soil microbial process. Worm casts contain 5 times more N, 7 times more P and 11 times more K than ordinary soils. Also observed an increased growth, yield and quality of brinjal, respectively when plots were fertilized with both biofertilizer and organic sources. The quality parameters such as TSS and the maximum fruit set, fruit weight, number of fruits per plant and the highest yield per plant grown highest.

The effect of biofertilizer fertilizer applied with organic manures on the yield and quality brinjal was investigated during rabi-2000/01 in Bangalore, Karnataka, India. In general, biofertilizer or farmyard manure at 25 t/ha recorded the highest values for the different yield (plant height, branches per plant, clusters per plant, fruits per cluster, fruits per plant, fruit weight, fruit weight per plant, estimated fruit yield) and quality total soluble solids parameters.

These treatments also recorded the longest shelf life and the lowest physiological weight loss of fruit thus, use of bio fertilizers and organic manures has become an accepted strategy to bring about improvement in soil fertility and protecting the environment. This strategy utilizes a judicious combination of organic manures and bio fertilizers. Hence the investigation was carried out to study the effect of bio fertilizers and organic manures on the growth, yield attributes, yield and quality of brinjal.

Response of biofertilizers and organic manure has become an accepted strategy to bring about improvement in soil fertility and protecting the environment. This strategy utilizes a judicious combination of fertilizers, organic manures and biofertilizers. Hence the investigation was carried out to study the response of biofertilizers and organic manures on the growth, yield attributes, yield and quality of brinjal.

Material and Methods

The present investigation was carried out at organic research farm karguwan ji, Bundelkhand University, Jhansi (Uttar Pradesh) during *rabi* season 2019-2020. The soil of experimental field was sandy loam with good drainage and uniform texture with low to N (128.46 kg ha^{-1}), medium to P (17.36 kg ha^{-1}), K (182.31 kg ha^{-1}) status and soil pH (7.22). Seed of Pusa Uttam variety of brinjal were used in the experiment. The layout was under Randomized Block Design (R.B.D.) with eight treatment and randomized design in three replications. The different organic manures and biofertilizer treatments tried were.

T_0- Control @ (no manure)
T_1- Farm yard manure @ 20 t ha^{-1}
T_2- Vermicompost @ 6 t ha^{-1}
T_3- Poultry manure @ 3 t ha^{-1}
T_4- Farm yard manure @ 20 t ha^{-1}+Azotobactor
T_5- Vermicompost @ 3 t ha^{-1}+Azotobactor
T_6- Farm yard manure @ 12 t ha^{-1}+Vermicompost @ 3 t ha^{-1}+Azotobactor
T_7- Poultry manure @ 1.5 t ha^{-1} +Vermicompost @ 3 t ha^{-1} +PSB + Azotobactor

There were altogether twenty four plots each of 2.40 x 1.80 m^2 size. The plant roots are dipped in biofertilizers like azotobacter and phosphorus solublizing bacteria (PSB) according to treatment just before transplanting and sowing was done on November, 2019-2020 with spacing 60 x 45 cm. During the life cycle of the plants, hoeing, weeding and irrigation were provided at proper time so as facilitate better growth and development of crop. The observation were recorded i.e. plant height, stem diameter, number of branches per plant, days to 1st flowering, number of fruit per plant, days to 1st picking, fruit characters, fruit length, fruit diameter, average fruit weight, total soluble solid and yield.

Result and Discussion

Growth parameter

The results presented in Table 1 and Table 2 clearly that the Poultry manure + Vermicompost + PSB + Azotobactor as well as other organic and biofertilizer in various combinations had a significant influenced on growth parameter of brinjal in the presence of different doses of organic manure and biofertilizer. Furthermore, the results indicated that Plant height (cm), Stem diameter (cm), Number of branches per plant and Days to first flowering increased significantly with all these treatments. In the treatment of Poultry manure @ 1.5 t ha^{-1} +Vermicompost @ 3 t ha^{-1} + PSB + Azotobactor show the maximum Plant height (30 DAT 19.77 cm, 60 DAT 30.66 cm, 90 DAT 47.07 cm and 120 DAT 66.06 cm), Stem diameter (30 DAT 0.56 cm, 60 DAT 0.94 cm, 90 DAT 3.33 cm and 120 DAT 3.72 cm), Number of branches per plant (30 DAT 4.66, 60 DAT 8.66, 90 DAT 15.00 and 120 DAT 23.00) and Days to first flowering lowest days of flowering 35.66 DAT). Compared to the untreated Control (the height of plant 30 DAT 13.23 cm, 60 DAT 20.44 cm, 90 DAT 35.07 cm and 120 DAT 48.07 cm, Stem diameter 30 DAT 0.23 cm, 60 DAT 0.42 cm, 90 DAT 1.71 cm and 120 DAT 1.79 cm, Number of branches per plant 30 DAT 1.33, 60 DAT 3.66, 90 DAT 8.66 and 120 DAT 12.00 and Days to first flowering the late days flowering 41.33 DAT). Similar finding were reported by Angadi *et al.*, (2017) [2], Doifode and Nandkar (2014) [5], Singh *et al.*, (2017) [8].

Our results were also in line up with that of Prabhu *et al.*, (2003) they revealed that the application of organic and biofertilizer rate directly help in increasing plant height, which might be due to the nutrient uptake of plants, that is important to improved chlorophyll content, carbohydrate synthesis and increased the activity of hormones.

Table 1: The effect of biofertilizer and organic manure and their Combinatoion on plant height 30, 60, 90 and 120 DAT and Stem diameter 30, 60, 90 and 120 DAT of brinjal (*Solanum melongena* L.)

Tr. No.	Plant height (cm)				Stem diameter (cm)			
	30 (DAT)	60 (DAT)	90 (DAT)	120 (DAT)	30 (DAT)	60 (DAT)	90 (DAT)	120 (DAT)
T_0	13.23	20.44	35.07	48.07	0.23	0.42	1.71	1.79
T_1	14.24	22.32	38.81	51.86	0.29	0.61	1.85	1.91
T_2	15.30	26.30	42.07	58.33	0.37	0.81	2.19	2.32

T_3	15.18	25.79	42.48	56.58	0.37	0.67	2.10	2.15
T_4	14.32	24.57	40.74	54.25	0.32	0.63	2.00	2.10
T_5	16.81	27.84	43.32	61.03	0.44	0.85	2.72	2.99
T_6	17.29	28.52	44.74	62.44	0.50	0.87	2.88	2.92
T_7	19.77	30.66	47.07	66.06	0.56	0.94	3.33	3.72
SE(m) ±	0.26	0.48	0.50	0.45	0.006	0.011	0.018	0.033
C.D. at 5%	0.81	1.49	1.53	1.38	0.017	0.032	0.055	0.100

Table 2: The effect of biofertilizer and organic manure and their combinatoion on number of branches 30, 60, 90 and 120 DAT, plant spread and Days to 1st flowering of brinjal (*Solanum melongena* L.)

Tr. No.	Number of branches				Days to 1st flowering (DAT)
	30 (DAT)	60 (DAT)	90 (DAT)	120 (DAT)	
T_0	1.33	3.66	8.66	12.00	41.33
T_1	2.33	5.33	9.33	13.33	40.33
T_2	3.33	6.66	11.66	15.66	38.33
T_3	3.00	6.33	11.33	14.66	39.00
T_4	2.66	6.00	10.66	14.33	39.33
T_5	3.66	7.00	12.00	16.66	37.33
T_6	4.00	7.33	13.00	19.00	37.00
T_7	4.66	8.66	15.00	23.00	35.66
SE(m) ±	0.25	0.34	0.41	0.27	0.29
C.D. at 5%	0.78	1.05	1.27	0.85	0.90

Yield parameter

The yield parameters such as number of fruit per plant, days to 1st picking, fruit length, fruit diameter, and average fruit weight and yield. The treatments of combined application of Poultry manure +Vermicompost + PSB + Azotobactor recorded higher number of fruit per plant (7.66), days to 1st picking (60.33 days), fruit length (9.24 cm), fruit diameter (8.04 cm), average fruit weight (131.10 g) and yield (37238.42 kg ha^{-1}). These parameters were found highest in this treatment compared to control. These results are in conformity with the reports of Mishra *et al.* (2018) [6] in brinjal, Singh *et al.* (2017) [8], Angadi *et al.* (2017) [2] in tomato and Amrithalingam (1988) [1].

Table 3: The effect of biofertilizer and organic manure and their combinatoion on number of fruit per plant, days to 1st picking, fruit length, fruit diameter, and average fruit weight and yield of brinjal (*Solanum melongena* L.)

Tr. No.	Number of fruit per plant (DAT)	Days to 1st picking	Fruit length (cm)	Fruit diameter (cm)	Average Fruit weight (g)	Fruit yield (kg ha^{-1})
T_0	5.00	65.00	5.19	4.48	121.36	22497.68
T_1	5.00	64.00	5.58	5.43	125.57	23155.86
T_2	5.66	62.66	6.30	6.62	127.83	26825.62
T_3	5.66	63.00	6.07	6.61	127.64	26805.55
T_4	5.33	63.66	5.59	5.59	123.40	24619.59
T_5	6.00	62.33	8.20	6.89	128.50	28586.41
T_6	6.66	62.00	8.39	7.03	130.33	32186.72
T_7	7.66	60.33	9.24	8.04	131.10	37238.42
SE(m) ±	0.22	0.25	0.066	0.10	0.31	1061.87
C.D. at 5%	0.68	0.77	0.20	0.31	0.96	3252.08

Quality parameter

The statistical analysis that proved Poultry manure + Vermicompost + PSB + Azotobactor recorded maximum total soluble solid 4.84% (T.S.S.) of brinjal. Compared to the untreated Control (T.S.S. 3.66%). The higher quality attributes of fruit quality may be due to organic source of nutrients and optimum availability of all the micro nutrients to plant contributing to better fruit quality. The results are in confirmation with the reports of Amrithalingam (1988) [1] and Singh *et al.* (2017) [8].

Table 4: The effect of biofertilizer and organic manure and their combinatoion on T.S.S

T. No.	Total Soluble Solid (%)
T_0	3.66
T_1	3.92
T_2	4.26
T_3	4.11
T_4	4.04
T_5	4.39
T_6	4.63
T_7	4.84
SE(m) ±	0.020
C.D. at 5%	0.063

Conclusion

All the treatment show significantly differences for most of the trait under study. The treatment T_7-Poultry manure (50%) +Vermicompost (50%) + PSB + Azotobactor was found as the best treatment for majority of traits *viz*. plant height (cm), stem diameter (cm), number of branches per plant, days to 1st flowering, number of fruit per plant, days to 1st picking, fruit, fruit length (cm), fruit diameter (cm), average fruit weight (g), total soluble solid (TSS) and yield (kg ha^{-1}) Maximum yield per hectare were also obtained from T_7 with 37238.42 (kg ha^{-1}).

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