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Efficacy of bio-fertilizers and the combinations of macronutrients on the growth, yield and quality of Brinjal (*Pusa ankur*) under the Agro-climatic conditions of Kanpur

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Abstract

A field study was conducted during summer season of 2022-23 at horticultural field of Rama University, Kanpur India to evaluate "Efficacy of bio-fertilizers and the combinations of macronutrients on the growth, yield and quality of Brinjal (*Pusa ankur*) under the Agro-climatic conditions of Kanpur". The experiment was carried out in a Randomized Block Design (RBD) with 5 treatments. Each treatment was replicated four times. The plants were spaced 60*30 cm, i.e. row to row and plant to plant 30*30 respectively. The total area of the each plot was 1.5 *1.30m². The distance of 1m maintained with in replication. The space of 0.5 meter was kept between the plots. There were 6 rows in each plot and 4 plants were planting in each row. So, there were 24 plants in each plot. 5 sample plants from inner rows were selected for observation and recording of the data. 130 m² total area of field. Five plants will be selected randomly from each unit plot to record yield contributing characters. The data was taken in 30 days of interval i.e, 30 DAT, 60 DAT and in 90 DAT. There are eight treatment i.e, T1(Recommended dose of NPK(200:150:100)Kg/ha), T2(50% Azotobacter + 50% NPK), T3 (25% Azotobacter + 25% Azospirillum + 50% NPK), T4(25% Azospirillum + 75% NPK), T5(70% Azotobacter + 30% NPK), T6(50% Azospirillum + 50% NPK), T7(50% Azospirillum + Azotobacter 50%), T8(30% Azotobacter+30% Azospirillum +40%NPK). Among all the treatments, it is noticed that the growth, yield and yield attributing parameters like plant height, numbers of leaves per plant, number of branches per plant, fruit length, fruit diameter, numbers of fruits, fruit weight, fruit yield per plant, total yield were found maximum in treatment T8 (30%Azotobacter+30%Azospirillum +40%NPK) and the minimum being recorded in T1(RDF). So based on the result it could be concluded that the efficacy of bio-fertilizers and the combinations of macronutrients on the growth, yield and quality of Brinjal 30%Azotobacter+30%Azospirillum +40%NPK favourably a the growth, yield attributing characters of brinjal cv. *Pusa ankur*.

Keywords: Growth, yield and quality, *Pusa ankur*, Agro-climatic, Kanpur

Introduction

Eggplant also known as aubergine or brinjal, belongs to the family of Solanaceae, which comprises of over 3,000 species that are well distributed across 90 genera (Vorontsova and Knapp, 2012). It is one of the major angiosperm groups, and its origin is still a mysterious debate among researchers. Evidently, it was believed that multiple, rather than single, domestication events seem to apply for a heterogenous of crops Olsen and Gross, 2008) including eggplant. Eggplant, as known as *Solanum melongena* L., being cultivated even the most primitive cultivars (Knapp *et al.*, 2013) ^[1]. This species is thought to have evolved from its ancestral wild species *Solanum incanum* (Prohens *et al.*, 2013) while *Solanum insanum* is the closest wild relative (Kaushik *et al.*, 2016; Knapp *et al.*, 2013) ^[1]. It was first reported between 1401-1500 in the fifteenth century in Europe, and the name eggplant was derived from the white egg-like fruits.

Pusa ankur variety of brinjal is released by IARI, New Delhi. Fruits are oval- round and small in sized weighing each 60-80 g. The colour of fruit is dark purple and is glossy and also attractive too it is an early bearing and becomes ready for first picking 45 days transplanting. Its fruits do not lose colour and tenderness even on delayed pickings.

Eggplant generally prefers hot weather, and when it is grown in cold climates or in areas where there is low humidity, the plant fails to set and produce immature fruit. It is susceptible to severe frost. The temperature range of 21-27 °C with long day is most favourable for its successful production. The soil having deep, fertile and well drained is most favourable. The soil pH range of 5.5 to 6.0 for its better growth and development.

The largest volume of eggplant production countries, China (34 million tonnes) with approximately 63.1% of total production, followed by India and Egypt with 12.8 and 1.4 million tonnes respectively (FAOSTAT, 2020). China and India are among the top eggplant producing countries in the world followed by Egypt, Turkey, Indonesia, Iran, Philippines, Spain, Mexico, Japan, Italy and Syrian (FAOSTAT, data/QC).

Brinjal contains Energy 24 Kcal, 1% ; Carbohydrates, 5.7 g, 4% ; Protein, 1 g, 2% ; Total Fat, 0.19 g, 1%.Calories: 20.5 • Fat: 0.1g • Sodium: 1.6mg • Carbohydrates: 4.8g • Fiber: 2.4g • Sugars: 2.9g • Protein: 0.8g. Brinjal is rich in phosphorus, iron, magnesium, copper and vitamins A, B and C. and are mostly helpful in controlling blood pressure, high cholesterol and Diabetes. They also helps to improve the cardiovascular system.

Biofertilizers are natural and low cost fertilizer which contains large population of specific or group of microorganism. Microorganisms like Azotobacter, Azospirillum, Phosphate Solubilizing Bacteria (PSB) and VAM (Vesicular Arbuscular Mycorrhiza) are used as biofertilizers in brinjal production. They are considered as a feasible and sustainable attractive biotechnological alternative to increase crop yield, improve and restore soil fertility, stimulate plant growth, reduce production costs and the environmental impact associated with chemical fertilization.

As the fertility of the soil is diminishing day by day due to the over use of the chemical fertilizers and other chemicals for the higher production. The productivity is high but the products are more chemical containing which leads to adverse effect to the human health. Thus, the appropriate dose of biofertilizers and the chemical fertilizers is required for the optimum performance of the crop. Thus, this study will help to determine the appropriate dose of NPK for brinjal to some

extent.

Material and Methods

The details of experimental materials, techniques and procedures adopted during the experiment entitled “Efficacy of bio-fertilizers and the combinations of macronutrients on the growth, yield and quality of Brinjal (*Pusa ankur*) under the Agro-climatic conditions of Kanpur ”are described under this chapter. Pusa Ankur variety of brinjal was selected for the study. There are eight treatment i.e, T1(Recommended dose of NPK(200:150:100)Kg/ha), T2(50% Azotobacter + 50% NPK), T3 (25% Azotobacter + 25% Azospirillum + 50% NPK), T4 (25% Azospirillum + 75% NPK), T5(70% Azotobacter + 30% NPK), T6 (50% Azospirillum + 50% NPK), T7 (50% Azospirillum + Azotobacter 50%), T8(30%Azotobacter+30%Azospirillum +40%NPK).

The experiment was carried out in a Randomized Block Design (RBD) with 5 treatments .Each treatment was replicated four times .The plants were spaced 60×30 cm, i.e . row to row and plant to plant 30×30 respectively. The total area of the each plot was 1.5 ×1.30m². The distance of 1m maintained with in replication. The space of 0.5 meter was kept between the plots. There were 6 rows in each plot and 4 plants were planting in each row. So, there were 24 plants in each plot .5 sample plants from inner rows were selected for observation and recording of the data .130 m² total area of field .Five plants will be selected randomly from each unit plot to record yield contributing characters. The data was taken in 30 days of interval i.e, 30 DAT, 60 DAT and in 90 DAT.

The data were collected and put in excel and analysis was done by the help of data analysis. The treatment means will be compared by the Least Significant Difference (LSD) test at 5% levels of probability.

Result and Discussion

An experiment entitled“ Efficacy of bio-fertilizers and the combinations of macronutrients on the growth, yield and quality of Brinjal (*Pusa ankur*) under the Agro-climatic conditions of Kanpur ”was done in the horticultural field of Rama University, Kanpur India during Feb to June 2022 and the results were noted below.

Table 1: Efficacy of bio-fertilizers and the combinations of macronutrients on germination percentage, plant height, No of leaves/plant and No of flowers/plant

Treatment	Treatment combination	Germination %	Plant height (cm)			No of leaves/plant			No of flowers/plant		
			30 DAT	60 DAT	90 DAT	30DAT	60 DAT	90 DAT	30DAT	60 DAT	90 DAT
T ₁	Recommended dose of NPK)200:150:100(Kg/ha)	62.88	13.52	70.9	81.9	9.71	50.9	55.07	5.88	30.59	40.79
T ₂	50 %Azotobacter +50 %NPK	68.49	15.66	74.36	85.6	11.63	53.33	57.13	7.42	32.6	42.75
T ₃	25 %Azotobacter +25 %Azospirillum +50 %NPK	66.18	18.37	76.2	88.8	13.71	54.22	59.33	8.34	34.3	44.17
T ₄	25 %Azospirillum +75 %NPK	64.29	16.27	72.13	84.08	10.82	51.26	55.07	7.76	32.46	41.61
T ₅	70 %Azotobacter +30 %NPK	66.2	16.61	73.69	84.49	12.58	51.63	55.3	7.61	32.3	41.64
T ₆	50 %Azospirillum +50 %NPK	72.59	17.01	74.1	86.46	13.45	53.99	57.8	8.45	32.68	42.75
T ₇	50 %Azospirillum +Azotobacter 50%	76.72	17.19	74.97	87.93	13.45	54.66	58.47	8.38	33.45	43.12
T ₈	30%Azotobacter+30%Azospirillum +40%NPK	66.55	18.82	78.73	89.59	14.03	54.9	61.31	9.75	34.56	44.86
	CD	0.407	1.241	1.159	1.352	1.47	1.43	1.301	1.248	1.456	0.919
	S.E.)m(0.109	0.332	0.31	0.362	0.393	0.389	0.348	0.334	0.39	0.246

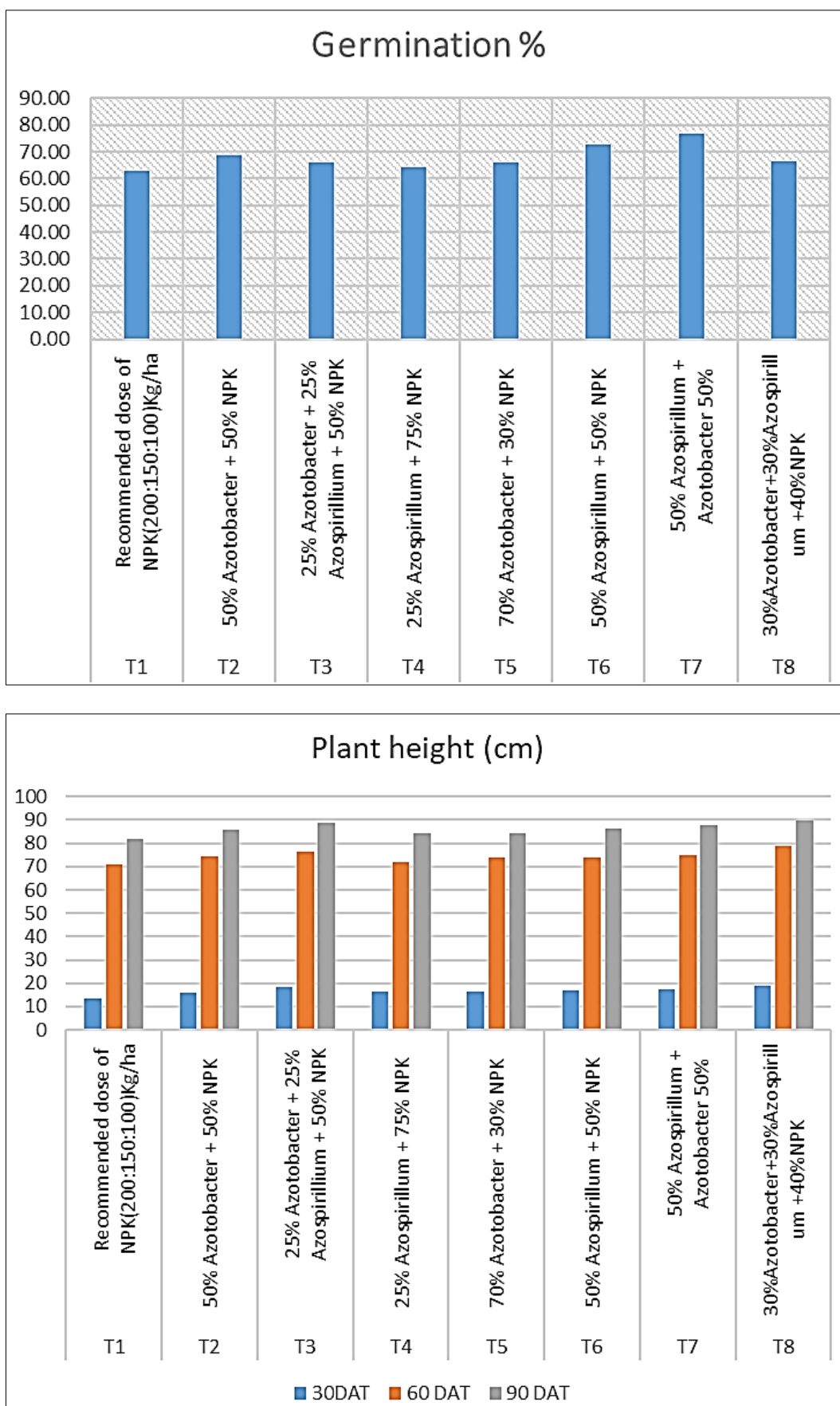


Fig 1: Efficacy of bio-fertilizers and the combinations of macronutrients on germination percentage and plant height of brinjal

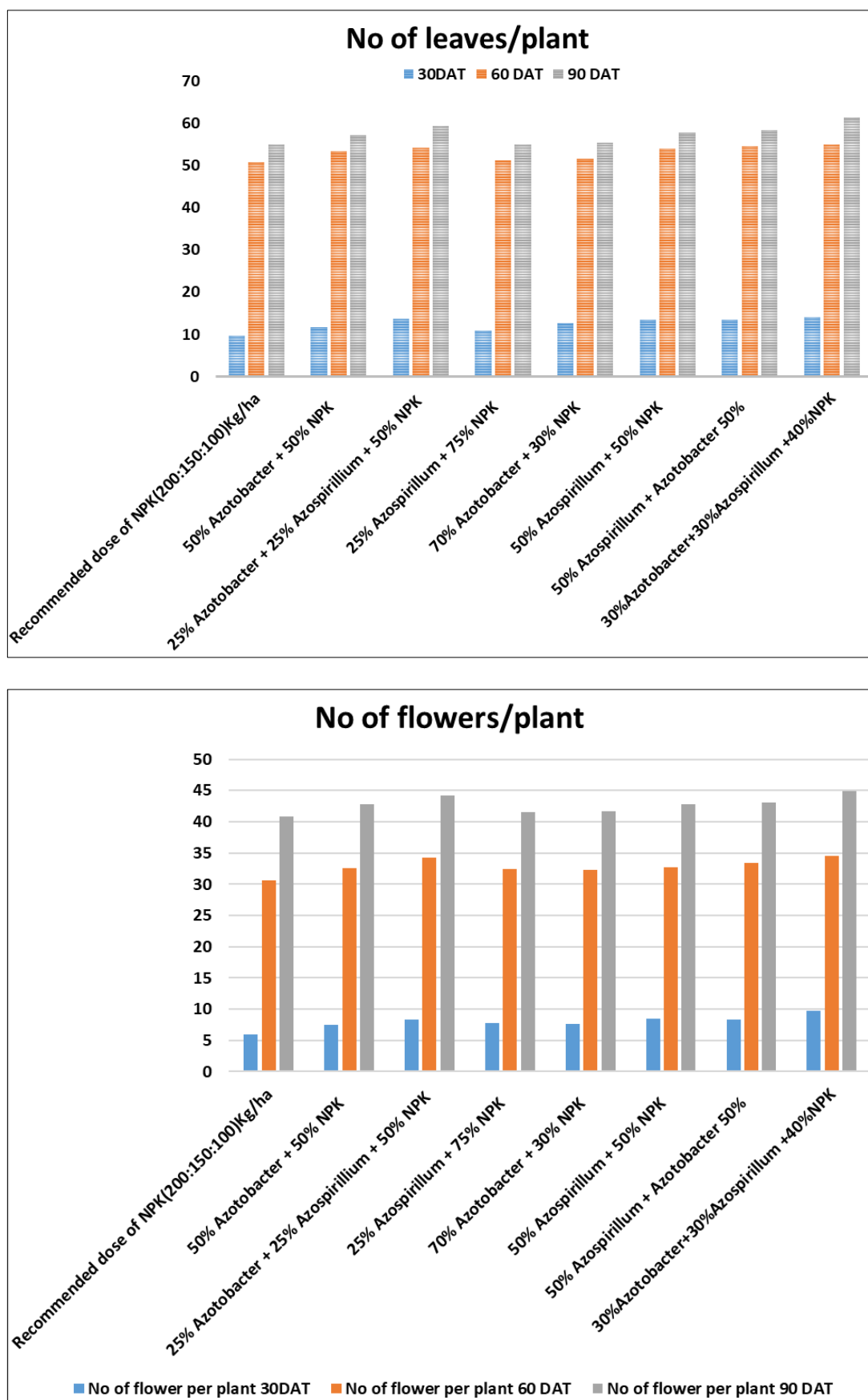


Fig 2 :Efficacy of bio-fertilizers and the combinations of macronutrients on number of leaves/plant and number of flowers/plant of brinjal

1. Germination percentage %

The maximum (76.72%) germinated seeds was observed in T7 (50% Azospirillum + Azotobacter 50%) followed by

T6(72.59%) (50% Azospirillum + 50% NPK) and the minimum germination percentage of seeds was recorded in T1(62.88%)(Recommended dose of NPK).

2. Plant height (cm)

Data recorded at 30 DAT the plant height was observed maximum (18.82 cm) in T8 (30% Azotobacter+30% Azospirillum +40%NPK) followed by T7 (17.19 cm) (50% Azospirillum + Azotobacter 50%), T6 (17.01) (50% Azospirillum + 50% NPK) and the minimum plant height was recorded in T1(13.52 cm) (Recommended dose of NPK(200:150:100)Kg/ha). Data recorded at 60 DAT the plant height was observed maximum (78.73 cm) in T8 (30%Azotobacter+30%Azospirillum +40%NPK) followed by T7 (74.97 cm) (50% Azospirillum + Azotobacter 50%), T2 (74.36 cm) (50% Azotobacter + 50% NPK) and the minimum plant height was recorded in T1(70.9 cm) (Recommended dose of NPK(200:150:100)Kg/ha). Data recorded at 90 DAT the plant height was observed maximum (89.59 cm) in T8 (30%Azotobacter+30%Azospirillum +40%NPK) followed by T3 (88.8 cm) (25% Azotobacter + 25% Azospirillum + 50% NPK), T7 (87.93 cm) (50% Azospirillum + 50% NPK) and the minimum plant height was recorded in T1(81.9cm) (Recommended dose of NPK(200:150:100)Kg/ha).

3. Number of leaves /plant

Data recorded at 30 DAT the number of leaves per plant was observed maximum (14.03) in T8 (30% Azotobacter+30% Azospirillum +40%NPK) followed by T3 (13.71) (25% Azotobacter + 25% Azospirillum + 50% NPK)T6 (13.45) (50% Azospirillum + 50% NPK) and the minimum number of leaves per plant was recorded in T1(9.71) (Recommended dose of NPK(200:150:100)Kg/ha). Data recorded at 60 DAT the number of leaves per plant was observed maximum (54.9)

in T8 (30%Azotobacter+30% Azospirillum +40%NPK) followed by T7 (54.66) (50% Azospirillum + Azotobacter 50%), and the minimum number of leaves per plant was recorded in T1(50.9) (Recommended dose of NPK(200:150:100)Kg/ha). Data recorded at 90 DAT the number of leaves per plant was observed maximum (61.31) in T8 (30%Azotobacter+30%Azospirillum +40%NPK) followed by T7 (58.47) (50% Azospirillum + 50% NPK) and the minimum number of leaves per plant was recorded in T1(55.07) (Recommended dose of NPK(200:150:100)Kg/ha).

4. Number of flowers/plant

Data recorded at 30 DAT the number of flowers per plant was observed maximum (9.75) in T8 (30% Azotobacter+30% Azospirillum +40%NPK) followed by T6 (8.45) (50% Azospirillum + 50% NPK) and the minimum number of flower per plant was recorded in T1(5.88) (Recommended dose of NPK (200:150:100)Kg/ha). Data recorded at 60 DAT the number of flower per plant was observed maximum (34.56) in T8 (30%Azotobacter+30%Azospirillum +40%NPK) followed by T3 (34.3) (25% Azotobacter + 25% Azospirillum + 50% NPK), and the minimum number of flower per plant was recorded in T1(30.59) (Recommended dose of NPK(200:150:100)Kg/ha). Data recorded at 90 DAT the number of flower per plant was observed maximum (44.86) in T8 (30%Azotobacter+30%Azospirillum +40%NPK) followed by T7 (43.12) (50% Azospirillum + 50% NPK) and the minimum number of flower per plant was recorded in T1(55.07) (Recommended dose of NPK(200:150:100)Kg/ha).

Table 2: Efficacy of bio-fertilizers and the combinations of macronutrients on number of fruits/plant, fruit length,fruit diameter, average fresh fruit weight, fruit yield/plant and total yield (t/ha)

Treatment	Treatment combination	No of fruits/plant	Fruit length (cm)	Fruit diameter (cm)	Average fresh fruit weight (g)	Fruit yield / plant (kg)	Total Yield (t/ha)
T ₁	Recommended dose of NPK)200:150:100(Kg/ha)	9.42	22.3	3.01	96.23	10.52	17.36
T ₂	50 %Azotobacter +50 %NPK	10.33	23.2	3.47	106.5	12.71	19.17
T ₃	25 %Azotobacter +25 %Azospirillum +50 %NPK	13.85	26.4	4.33	114.6	15.35	23.94
T ₄	25 %Azospirillum +75 %NPK	10.49	22.4	3.11	104.2	11.58	21.14
T ₅	70 %Azotobacter +30 %NPK	10.21	22.6	3.32	106	11.73	20.6
T ₆	50 %Azospirillum +50 %NPK	12.66	24.7	3.67	105.6	13.64	23.73
T ₇	50 %Azospirillum +Azotobacter 50%	13.46	25.2	4.33	108.2	14.57	23.49
T ₈	30%Azotobacter+30%Azospirillum +40%NPK	15.58	28.7	4.6	116.7	16.35	24.88
	CD	1.37	0.3	0.258	0.84	0.237	0.346
	S.E).m(0.37	0.08	0.069	0.23	0.063	0.072

5. Number of fruits per plant

The maximum (15.58) number of fruit was observed in T8 (30%Azotobacter+30%Azospirillum +40%NPK) followed by T3(13.85)(25% Azotobacter + 25% Azospirillum + 50% NPK) and the minimum number of fruit was recorded in T1(9.42)(Recommended dose of NPK).

6. Fruit length (cm)

The maximum (28.65 cm) length of fruit was observed in T8 (30%Azotobacter+30%Azospirillum +40%NPK) followed by T3(26.42cm)(25% Azotobacter + 25% Azospirillum + 50% NPK) and the minimum length of fruit was recorded in T1(22.31 cm)(Recommended dose of NPK).

7. Fruit diameter (cm)

The maximum (4.6 cm) diameter of fruit was observed in T8(30%Azotobacter+30%Azospirillum +40%NPK) followed

by T3(4.33cm)(25% Azotobacter + 25% Azospirillum + 50% NPK) and the minimum diameter of fruit was recorded in T1(3.01 cm)(Recommended dose of NPK).

8. Average fresh fruit weight (g) per plant

The maximum (116.74 g) Average fruit weight (g) per plant was observed in T8 (30%Azotobacter+30%Azospirillum +40%NPK) followed by T3(114.56 g)(25% Azotobacter + 25% Azospirillum + 50% NPK) and the minimum average fruit weight (g) per plant was recorded in T1(96.23 g)(Recommended dose of NPK).

9. Fruit yield per plant (kg)

The maximum (16.35 kg) fruit yield per plant was observed in T8 (30%Azotobacter+30%Azospirillum +40%NPK) followed by T3(15.35 kg) (25% Azotobacter + 25% Azospirillum + 50% NPK) and the minimum fruit yield per plant was

recorded in T1(10.52 kg) (Recommended dose of NPK).

(30%Azotobacter+30%Azospirillum +40%NPK) followed by T3(23.94 t/ha) (25% Azotobacter + 25% Azospirillum + 50% NPK) and the minimum fruit yield was recorded in T1(17.36 t/ha) (Recommended dose of NPK).

10. Fruit yield (t/ha)

The maximum (24.88 t/ha) fruit yield was observed in T8

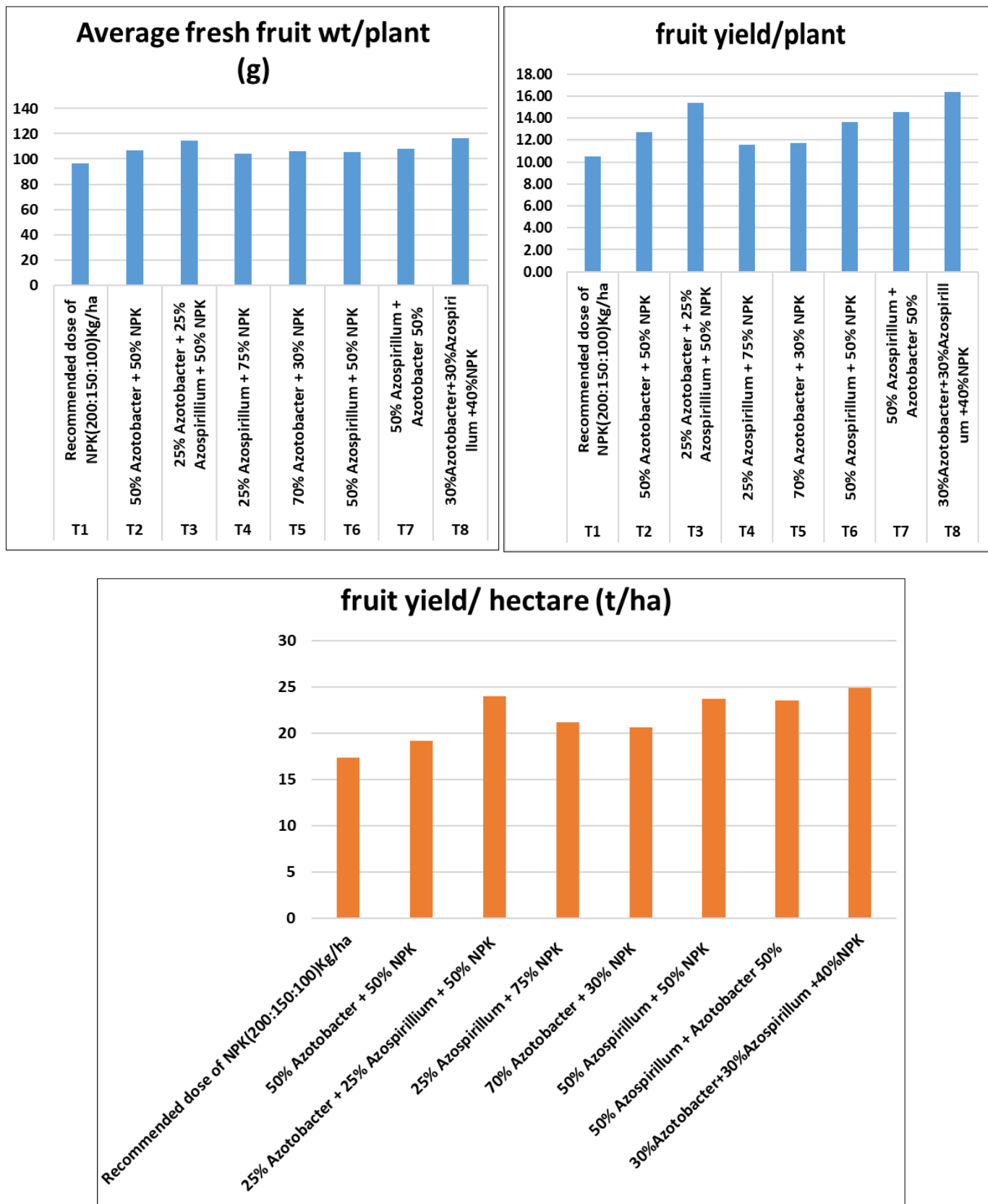


Fig 3: Efficacy of bio-fertilizers and the combinations of macronutrients on average fresh fruit weight, fruit yield/plant and total yield (t/ha)

Conclusion

From above finding and results the best combinations of bio-fertilizers with chemical fertilizers for higher yield of brinjal was significant in the combination of 30 % Azotobacter+30%Azospirillum +40%NPK. This combination of bio-fertilizers and chemical macronutrients was recommended to the farmers of Kanpur.

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