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Effect of nutrient management on growth parameters of okra

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Abstract
A field experiment was conducted at the Instructional Farm of Sardar Patel University, Balaghat (M.P.), during *kharif* season of 2020-21, to evaluate the influence of "Impact of nutrient management on green pod yield and cost ratio of okra." Totally 08 different treatments consisting of different organic and inorganic and fertilizers, alone and in both combination have been tried. Among the different nutrient management practices, The application of nutrient management significantly enhanced significantly enhanced growth parameters *viz*. like plant height, Days to 50% flowering, number of leaves, number of nodes, and length of internode were significantly superior in the T_1 (100% NPK + PSB + Azotobactor) followed by treatment T_3 (75% NPK + Vermicompost + Azotobactor) and proved significantly superior over all other remaining treatments. There for it may be concluded that treatment T_1 (100% NPK + PSB + Azotobactor) may be prefer for higher growth, green pod yield and cost ratio of Okra.

Keywords: okra, nutrient management

Introduction
Okra (*Abelmoschus esculentus* (L.) Moench) commonly known as lady's finger or bhindi, belongs to the family Malvaceae and is a fast growing annual vegetable crop grown in tropical and sub-tropical regions of the world. It is said to have originated from Africa (Markosa and Peter, 1990) [6] but according to Zeven and Zhukovsky (1975) [7] it originated from Hindustan centre of origin. It is one of the most important vegetable crops grown for its tender green fruits in almost all parts of the world. Okra is widely cultivated in plans of the India. Total area covered in India by vegetable crops is 10106 thousand hectares and total production 169064 thousand metric tonnes with okra crop occupying nearly 511 thousand hectares area, production 5848.6 thousand metric tonnes and productivity of 11.40 metric tonnes/ ha (Anonymous 2019b) [2]. Okra crop covered 5.05% of total area and 3.46% of total vegetable production. In Madhya Pradesh total area under vegetable crops is 757.67 thousand hectares with production of about 15568.26 thousand metric tonnes and okra crop occupies area 27.11 thousand hectares with production 342.05 thousand metric tonnes and productivity 12.62 metric tones/ha (Anonymous 2019c) [3]. Chhindwara, Jabalpur, Sagar, Hoshangabad, Tikamgarh, Ratlam, Dewas, Katni, Barwani, Balaghat, Gwalior, Datia, Alirajpur, Bhind, Dhar, Shivpuri and Chhatarpur are major okra producing districts in Madhya Pradesh (Anonymous 2019d) [4]. Among the bulky organic manures, the farm yard manure, goat manure, vermicompost and compost are the most commonly used for crop production. FYM is easily available and extensively used organic source of plant nutrient. Vermicompost is also seems to be very dynamic manure for quality and production of the crop. The combination of manures in addition with chemical fertilizers may be helpful to maintain the soil richness and health by increase content of organic carbon in soil for sustaining the productivity.

Neither inorganic nor organic amendments alone can maintain organic matter status of soil and sustain the productivity in a particular area and crop. Okra being a nutrient livening crop responds well to added nutrient, in soil. Thus the integrated nutrient supply system involving the combined use of chemical, organic sources and bio-fertilizers has been thought to be best option for meeting out the nutrient requirement of the crop and ultimately increasing the seed yield and quality.

Materials and Methods

A field experiment was conducted at the Instructional Farm of Sardar Patel University, Balaghat (M.P.). Balaghat District is located in the southern part of Jabalpur Division. It occupies the south eastern portion of the Satpura Range and the upper valley of the Wainganga River. The district extends from 21°19' to 22°24' north latitude and 79°31' to 81°3' east longitude. The total area of the district is 9,245 km2. Climatologically Balaghat is characterized as slightly moist hot and humid subtropical climate zone. An average annual rainfall of 1100.6 mm is generally appeared and mostly concentrated during the period from June to September. The major portion of the rainfall is received by South-Western monsoon. The May and December is the hottest and coolest month of the year respectively. In general, weekly maximum temperature goes upto 47 °C during the summer season and minimum temperature falls upto 10 °C during the winter season.

The experiment consisted of 8 treatments *viz*. T_1: 100% NPK, T_2: 75% NPK + Vermicompost + PSB, T_3: 75% NPK + Vermicompost + Azotobactor, T_4: 50% NPK + Vermicompost + Azotobactor + PSB, T_5: 75% NPK + FYM + PSB, T_6: 75% NPK + FYM + Azotobactor, T_7: 50% NPK + FYM + Azotobactor + PSB and T_7: Control Plot which was arranged in Randomized Block Design with three replications. The recommended fertilizer dose of 100:50:50 kg NPK ha^{-1} was applied to the okra crop. The full dose of FYM, Vermicompost, P, K and half dose of N at the time of Sowing and the remaining half dose of N according to the treatments. Nitrogen was supplied through urea containing 46 percent nitrogen, while phosphorus and potash were supplied through single super phosphate and murate of potash containing 16 percent P2O5 and 60 percent K2O, respectively. First weeding and hoeing was done after 25 days of sowing and subsequent two weeding and hoeing were done after 35 and 45 days of sowing. To protect the crop from the attack of insect pests mainly Jassids, borers and whitefly, spray of pesticides as per recommendation were done as and when needed. The fruits were picked manually when they were green, tender and at marketable size. The picked fruits were weighed and subjected to other observations immediately, after each picking.

Results and Discussion growth parameters

Plant height (cm) and number of leaves/plant

The data on various growth parameters *viz*. plant height and number of leaves/plant as influenced by the nutrient management practices were recorded and presented in table 1, 2 and figure 1 and 2. At 30 days after sowing, significantly higher plant height (cm) was observed in treatment T_1 100% NPK + PSB + Azotobactor (22.00 cm) followed by treatment T_3 75% NPK + Vermicompost + Azotobactor (21.50 cm), T_2 75% NPK + Vermicompost + PSB (21.00 cm), T_4 75% NPK + FYM + Azotobactor (20.50 cm), T_5 75% NPK + FYM + PSB (20.00 cm), T_7 50% NPK + FYM + PSB + Azotobactor (19.50 cm), T_6 50% NPK + Vermicompost + PSB + Azotobactor (19.00 cm). And significantly less height was recorded in treatment T8 (Control Plot) (16.20 cm).

At 60 days after sowing, significantly higher plant height (cm) was observed in treatment T_1 100% NPK + PSB + Azotobactor (80.00 cm) followed by treatment T_3 75% NPK + Vermicompost + Azotobactor (78.00 cm), T_2 75% NPK + Vermicompost + PSB (75.00 cm), T_4 75% NPK + FYM + Azotobactor (72.00 cm), T_5 75% NPK + FYM + PSB (70.00 cm), T_6 50% NPK + Vermicompost + PSB + Azotobactor (65.00 cm), T_7 50% NPK + FYM + PSB + Azotobactor (64.00 cm). And significantly less height was recorded in treatment T8 (Control Plot) (55.00 cm).

At 90 days after sowing, significantly higher plant height (cm) was observed in treatment T_1 100% NPK + PSB + Azotobactor (115.00 cm) followed by treatment T_3 75% NPK + Vermicompost + Azotobactor (110.00 cm), T_2 75% NPK + Vermicompost + PSB (107.00 cm), T_4 75% NPK + FYM + Azotobactor (102.00 cm), T_5 75% NPK + FYM + PSB (100.00 cm), T_6 50% NPK + Vermicompost + PSB + Azotobactor (97.33 cm), T_7 50% NPK + FYM + PSB + Azotobactor (96.00 cm). And significantly less height was recorded in treatment T8 (Control Plot) (84.83 cm).

Number of leaves/plant

At 30 days after sowing, significantly higher leaves/plant was observed in treatment T_1 100% NPK + PSB + Azotobactor (7.06) followed by treatment T_3 75% NPK + Vermicompost + Azotobactor (6.80), T_2 75% NPK + Vermicompost + PSB (6.50), T_4 75% NPK + FYM + Azotobactor (6.20), T_5 75% NPK + FYM + PSB (6.00), T_6 50% NPK + Vermicompost + PSB + Azotobactor (5.80), T_7 50% NPK + FYM + PSB + Azotobactor (5.50). And significantly less leaves/plant was recorded in treatment T8 (Control Plot) (3.10).

At 60 days after sowing, significantly higher leaves/plant was observed in treatment T_1 100% NPK + PSB + Azotobactor (14.50) followed by treatment T_3 75% NPK + Vermicompost + Azotobactor (14.00), T_2 75% NPK + Vermicompost + PSB (13.80), T_4 75% NPK + FYM + Azotobactor (12.80), T_5 75% NPK + FYM + PSB (12.40), T_6 50% NPK + Vermicompost + PSB + Azotobactor (11.40), T_7 50% NPK + FYM + PSB + Azotobactor (11.00). And significantly less leaves/plant was recorded in treatment T8 (Control Plot) (9.30).

At 90 days after sowing, significantly higher leaves/plant was observed in treatment T_1 100% NPK + PSB + Azotobactor (17.50) followed by treatment T_3 75% NPK + Vermicompost + Azotobactor (16.80), T_2 75% NPK + Vermicompost + PSB (16.50), T_4 75% NPK + FYM + Azotobactor (15.50), T_5 75% NPK + FYM + PSB (15.20), T_6 50% NPK + Vermicompost + PSB + Azotobactor (14.30), T_7 50% NPK + FYM + PSB + Azotobactor (14.10). And significantly less leaves/plant was recorded in treatment T_8 (Control Plot) (12.00).

Days to 50% flowering, number of nodes per plant and length of internode (cm)

The data on various growth parameters *viz*. days to 50% flowering, number of nodes per plant and length of internode (cm) as influenced by the nutrient management practices were recorded and presented in Table 3 and figure 3, 4. Significantly less 50% flowering days was observed in treatment T_1 100% NPK + PSB + Azotobactor (36.00%) followed by treatment T_3 75% NPK + Vermicompost + Azotobactor (37.00%), T_2 75% NPK + Vermicompost + PSB (37.50%), T_4 75% NPK + FYM + Azotobactor (39.00%), T_5 75% NPK + FYM + PSB (39.50%), T_6 50% NPK + Vermicompost + PSB + Azotobactor (40.50%), T_7 50% NPK + FYM + PSB + Azotobactor (41.00%). And significantly more leaves/plant was recorded in treatment T8 (Control Plot) (45.00%) The present findings are similar

with the results of Kadlag *et al*. (2010) [5] who reported that the application of bio-fertilizer Azotobacter @ 3 kg/ha recorded significantly highest germination percentage (87.07%), plant height (161.63 cm) and number of leaves per plant (32.36) whereas the minimum days (43.67) to 50% flowering were recorded in the treatment without application of Azotobacter.

Number of nodes per plant

Significantly higher number of nodes was observed in treatment T_1 100% NPK + PSB + Azotobactor (18.46) followed by treatment T_3 75% NPK + Vermicompost + Azotobactor (18.00), T_2 75% NPK + Vermicompost + PSB (17.60), T_4 75% NPK + FYM + Azotobactor (17.00), T_5 75% NPK + FYM + PSB (16.50), T_6 50% NPK + Vermicompost + PSB + Azotobactor (16.00), T_7 50% NPK + FYM + PSB + Azotobactor (15.90). And significantly less number of nodes was recorded in treatment T8 (Control Plot) (14.00).

Length of internode (cm)

Significantly higher internode length was observed in treatment T_1 100% NPK + PSB + Azotobactor (6.12 cm) followed by treatment T_3 75% NPK + Vermicompost + Azotobactor (6.10 cm), T_2 75% NPK + Vermicompost + PSB (5.80 cm), T_4 75% NPK + FYM + Azotobactor (5.40 cm), T_5 75% NPK + FYM + PSB (5.10 cm), T_6 50% NPK + Vermicompost + PSB + Azotobactor (4.90 cm), T_7 50% NPK + FYM + PSB + Azotobactor (4.80 cm).

And significantly less internode length was recorded in treatment T_8 (Control Plot) (4.00 cm). The present results are agreement with the Bharadiya *et al*., (2007) who studied the effect of inorganic and organic fertilizers on growth and yield of okra. The results revealed that treatment with 50% RDF+50% N through neem cake recorded the highest plant height, number of leaves per plant, days required for initiation of flowering, days to 50% flowering, number of fruits per plant, total yield, weight of individual fruit, fruit length and diameter.

Table 1: Plant height (cm) at 30, 60 and 90 DAS

Plant height (cm)				
Tr. No.	**Treatment Details**	**30 DAS**	**60 DAS**	**90 DAS**
T_1	100% NPK + PSB + Azotobactor	22.00	80.00	115.00
T_2	75% NPK + Vermicompost + PSB	21.00	75.00	107.00
T_3	75% NPK + Vermicompost + Azotobactor	21.50	78.00	110.00
T_4	75% NPK + FYM + Azotobactor	20.50	72.00	102.00
T_5	75% NPK + FYM + PSB	20.00	70.00	100.00
T_6	50% NPK + Vermicompost + PSB + Azotobactor	19.00	65.00	97.33
T_7	50% NPK + FYM + PSB + Azotobactor	19.50	64.00	96.00
T_8	Control Plot	16.20	55.00	84.83
	S.Em (±)	1.02	3.32	5.61
	CD (5%) =	3.10	10.07	17.04
	CV =	8.87	8.23	9.58

Table 2: Number of leaves per plant at 30, 60, 90 DAS

Number of leaves per plant				
Tr. No.	**Treatment Details**	**30 DAS**	**60 DAS**	**90 DAS**
T_1	100% NPK + PSB + Azotobactor	7.06	14.50	17.50
T_2	75% NPK + Vermicompost + PSB	6.50	13.80	16.50
T_3	75% NPK + Vermicompost + Azotobactor	6.80	14.00	16.80
T_4	75% NPK + FYM + Azotobactor	6.20	12.80	15.50
T_5	75% NPK + FYM + PSB	6.00	12.40	15.20
T_6	50% NPK + Vermicompost + PSB + Azotobactor	5.80	11.40	14.30
T_7	50% NPK + FYM + PSB + Azotobactor	5.50	11.00	14.10
T8	Control Plot	3.10	9.30	12.00
	S.Em (±)	0.37	0.64	0.84
	CD (5%) =	1.13	1.95	2.55
	CV =	10.99	9.00	9.56

Table 3: Growth parameters

Growth parameters				
Tr. No.	**Treatment Details**	**Days to 50% flowering.**	**Number of nodes per plant.**	**Length of internode (cm)**
T_1	100% NPK + PSB + Azotobactor	36.00	18.46	6.12
T_2	75% NPK + Vermicompost + PSB	37.50	17.60	5.80
T_3	75% NPK + Vermicompost + Azotobactor	37.00	18.00	6.10
T_4	75% NPK + FYM + Azotobactor	39.00	17.00	5.40
T_5	75% NPK + FYM + PSB	39.50	16.50	5.10
T_6	50% NPK + Vermicompost + PSB + Azotobactor	40.50	16.00	4.90
T_7	50% NPK + FYM + PSB + Azotobactor	41.00	15.90	4.80
T8	Control Plot	45.00	14.00	4.00
	S.Em (±)	1.51	0.69	0.25
	CD (5%) =	4.51	2.07	0.76
	CV =	8.34	9.04	8.22

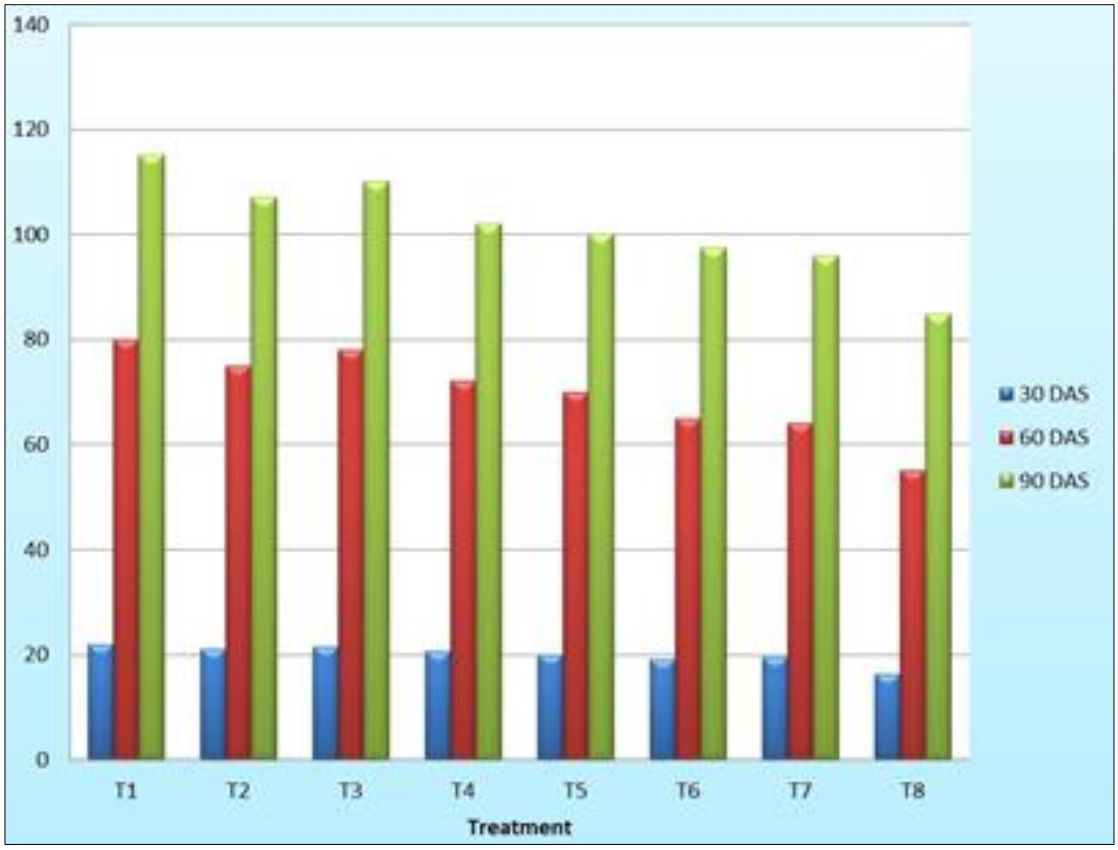

Fig 1: Plant height in cm.

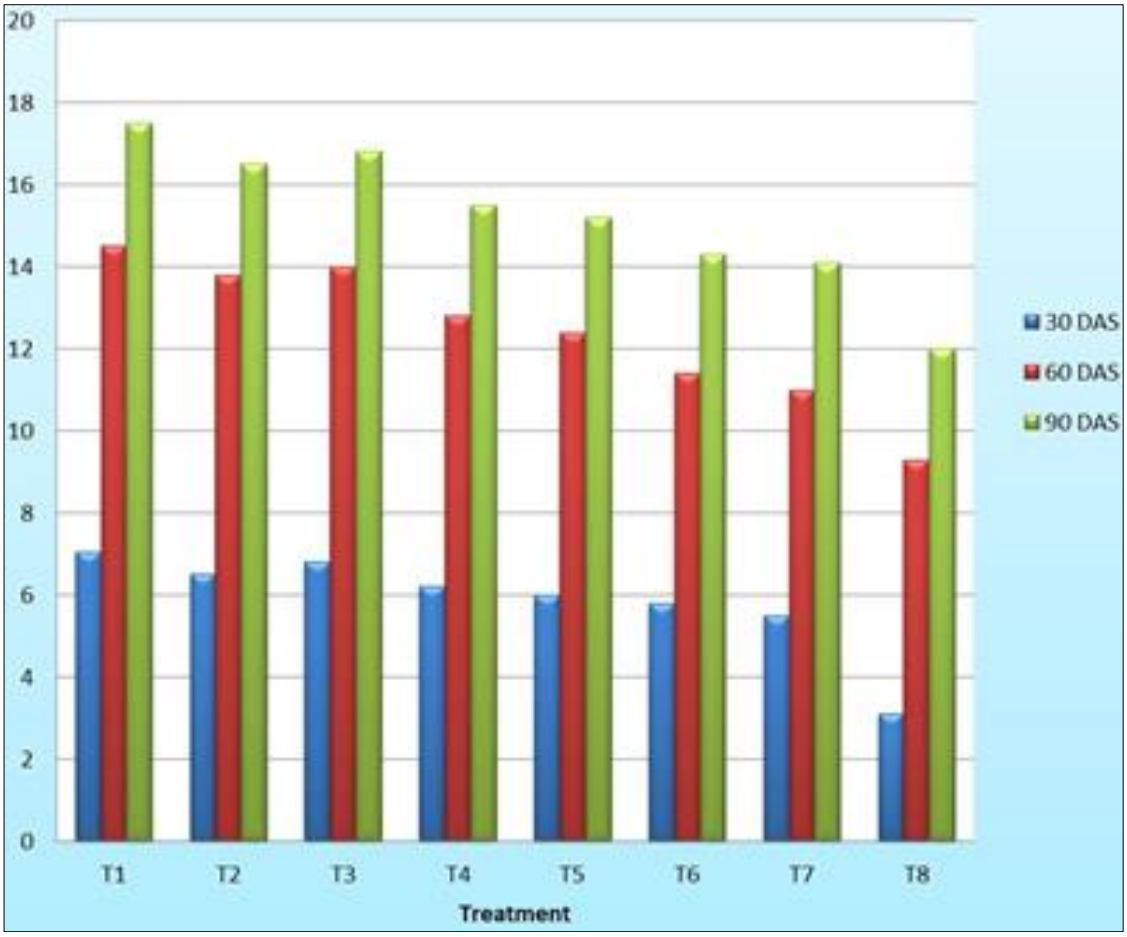

Fig 2: Number of leaves

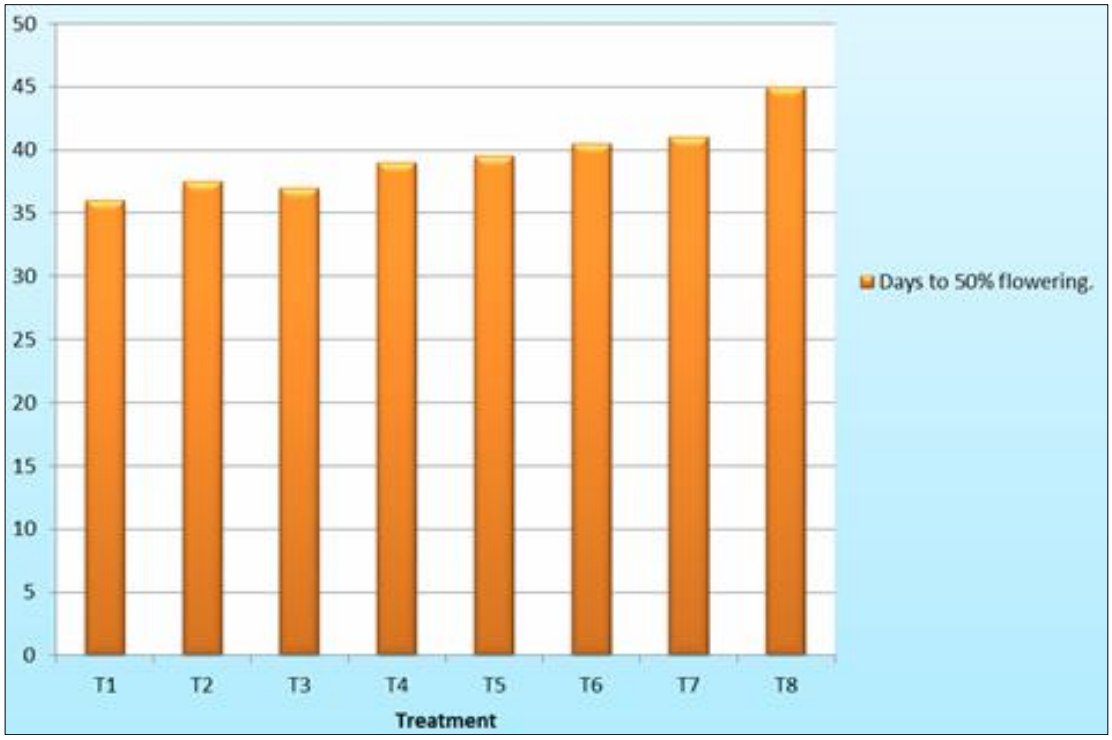

Fig 3: Days to 50% flowering

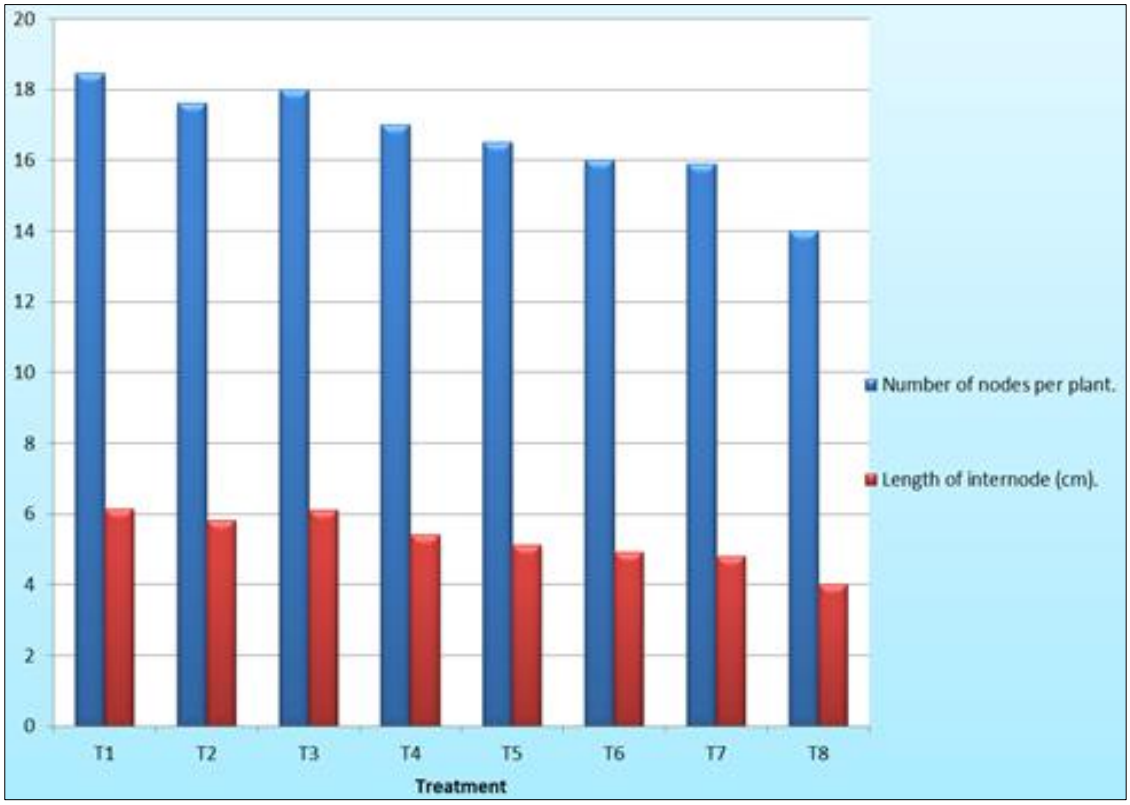

Fig 4: Number of nodes per plant and Length of internode (cm)

Conclusion

On the basis of above findings, treatment T_1 100% NPK + PSB + Azotobactor stand first in position and T_3 75% NPK + Vermicompost + Azotobactor stand in second order of preference. However, treatment T_2 75% NPK + Vermicompost + PSB comes in next in order.

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