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Mohit Rathor
School of Agriculture, ITM University Gwalior, Madhya Pradesh, India

Manjunath Rathod
University of Horticultural Sciences, Bagalkote, Karnataka, India

Anuusha KN
University of Horticultural Sciences, Bagalkote, Karnataka, India

Ankur Sharma
Rajmata Vijayaraje Scindia Krishi Vishwavidyalaya, Gwalior Madhya Pradesh, India

Corresponding Author:
Ankur Sharma
Rajmata Vijayaraje Scindia Krishi Vishwavidyalaya, Gwalior Madhya Pradesh, India

Effect of integrated nutrient management on growth and yield of cucumber (*Cucumis sativus* L.) cv. Pusa Sanyog

Mohit Rathor, Manjunath Rathod, Anuusha KN and Ankur Sharma

Abstract
A field experiment was conducted to investigate the response of FYM and biofertilizers on growth and yield of cucumber (*Cucumis sativus* L.) cv. Pusa Sanyog at the CRC Farm, ITM University, Gwalior (M.P.). The experiment was laid out in the randomized block design with three replications and ten treatments *viz*. 100% RDF, 75% RDF + *Azotobacter*, 75% RDF + PSB, 75% RDF + *Azotobacter* + PSB, 75% RDF + Vermicompost + *Azotobacter*, 75% RDF + Vermicompost + PSB, 75% RDF + Vermicompost + *Azotobacter* + PSB, 75% RDF + FYM + *Azotobacter*, 75% RDF + FYM + PSB and 75% RDF + FYM + *Azotobacter* + PSB) The application of bio-fertilizers (*Azotobactor* and PSB) @ 30g sqm^{-1} were inoculated and applied in soil at the time of sowing. FYM was thoroughly mixed in the soil one week prior to sowing and basal dose of vermicompost was also incorporated in soil one week before sowing. The results indicated that application of different organic manures (*viz.*, Vermicompost and FYM) and biofertilizers (*viz.*, *Azotobacter* and PSB) treatments significantly influenced the different growth and yield parameters of cucumber. Application of 75% RDF + Vermicompost + *Azotobacter* + PSB) recorded significantly higher vine length, number of branches per vine, fruit length (14.11 cm), fruit girth (11.12 cm), fruit weight (170.18 gm) and was found to the best treatment among all the treatments. Thus, integrated nutrient management is the suitable option to increase the production and manage the resources efficiently.

Keywords: Biofertilizers, FYM, growth, yield, integrated nutrient management

Introduction
Cucumber (*Cucumis sativus* L.) is one of the early maturing most popular vine vegetable of Cucurbitaceae family. Cucurbits are extremely cross pollinated group of vegetable crops which is cultivated in tropics, subtropics and milder temperate zones of India. Cucumber responds well to manuring and fertilization. The use of expensive commercial fertilizers as per the requirement of the crop is not much affordable to the average farmers. The application of high input technologies such as chemical fertilizers, pesticides, herbicides improved the production but there is growing concern over the adverse effects of the use of chemicals on soil productivity and environment quality. So there is need of shifting towards INM approach. Integrated Nutrient Management (INM) is a sustainable approach, which aims at maintaining the soil fertility and plant nutrient supply, by incorporating all the possible sources of nutrients like organic manures, inorganic fertilizer and the biological components in an integrated and judicious manner to get higher crop yield without hampering the soil health and the environment. Organic manures like FYM which is bulky in nature is a good source of nutrients and build up organic matter in soil as it has been formed by decomposing cattle dung, farm waste, cattle urine and plant waste. Further, biological fertilizers like Biofertilizers are the substances made up of the living cells of beneficial microorganisms which have capability to convert unavailable form of nutrient into the available form in the soil.Amongst bio-fertilizers, *Azotobacter*, PSB, Rhizobium strains play an important role in harvesting the atmospheric nitrogen through its fixation in the roots. It is given a primary importance in non-symbiotic and associative nitrogen fixation and was recognized to play a unique role in nitrogen economy of many crops. Considering all these aspects, a research study was carried out to study the effect of integrated application of FYM and biofertilizer on growth and yield of cucurbits.

Materials and Methods

A field experiment was conducted at the CRC Farm, of the Division of Horticulture, ITM University, Gwalior (M.P.). The experimental site is located situated at 26°23 N latitude and 74°11′ E longitude at an elevation of 211.52 m above mean sea level falling in the sub-tropical region of India. The climate of this place is bestowed with hot and dry early summers followed by hot and humid monsoon season and cold and dry winters. The soil of the experimental field was sandy clay loam in texture, slightly alkaline (pH 7.73) in reaction, low in organic carbon (4.3 g/kg) and available nitrogen (196.6 kg/ha) but medium in available phosphorus (15.85 kg/ha) and potassium (229.6 kg/ha) with electrical conductivity in the safer range. The experiment was laid out in the Randomized Block Design with three replications. Each replication was comprised of ten treatments (*viz*., T_1 – 100% RDF, T_2 – 75% RDF + *Azotobacter*, T_3 – 75% RDF + PSB, T_4 – 75% RDF + *Azotobacter* + PSB, T_5 – 75% RDF + Vermicompost + *Azotobacter*, T_6 – 75% RDF + Vermicompost + PSB, T_7 – 75% RDF + Vermicompost + *Azotobacter* + PSB, T_8 – 75% RDF + FYM + *Azotobacter*, T_9 – 75% RDF + FYM + PSB and T_{10} – 75% RDF + FYM + *Azotobacter* + PSB) were applied in cucumber cv. Pusa Sanyog. Bio-fertilizers (*Azotobactor* and PSB) @ 30g sqm^{-1} were inoculated and applied in soil at the time of sowing. FYM was thoroughly mixed in the soil one week prior to sowing and basal dose of vermicompost was incorporated in soil one week before sowing. The observation on growth parameters like vine length, number of branches per vine were recorded at 45 and 90 DAS by tagging 5 plants. The data collected from 5 plants were averaged. Further with respect to yield attributes, the data were collected at flowering and fruiting stages and length of fruit, girth was recorded with vernier calliper. Analysis of variance was performed to determine the effect of FYM and biofertilizers on growth and yield of cucumber using Opstat. The interpretation of treatments effects was made on the basis of critical difference at 5% probability level.

Results and Discussion

Growth parameters

The results with respect to growth parameters (Table 1) revealed that the different organic manures (*viz.*, Vermicompost and FYM) and biofertilizers (*viz.*, *Azotobacter* and PSB) treatments significantly influenced the different growth parameters of cucumber. The maximum vine length at 45 and 90 DAS was recorded with the application of 75% RDF + Vermicompost + *Azotobacter* + PSB). It may be due to increased availability of nitrogen and other nutrients through inorganic fertilizers which promote the plant growth by ensuring higher number of green leaves with increased photosynthesis and forming longer and stronger roots to absorb sufficient water and nutrients. Bio-fertilizers also produce the growth promoting substances *viz*., auxin, gibberellin and cytokinin which contributes towards vigorous growth of the plant growth characters. Use of vermicompost would have facilitated better aeration, adequate drainage and created a favourable soil environment for deeper penetration of roots and higher nutrient extraction from soils and it increase the vine length in cucumber. These results are supported by the conformity with Kumar *et al.* (2017) [6], Singh *et al.* (2017) [11], Rathod *et al.* (2018) [8], Kharga *et al.* (2019) [5] and Sahu *et al.* (2020) [9].

The data related to the maximum number of branches and leaves per vine at 45 and 90 DAS was observed with the application of 75% RDF + Vermicompost + *Azotobacter* + PSB) and it was found the best treatment combination of different organic manures and biofertilizers as compared to other treatments. However, the minimum number of branches and leaves per vine at 45 and 90 DAS was observed with the application of 75% RDF + PSB. This may be due to increased availability of organic manures, bio-fertilizers like *Azotobacter* and PSB that produce phytohormone which stimulate root growth and changes in root morphology which in turn affect the assimilation of nutrients and PSB would help in the conversion of unavailable form of phosphorus to available form, especially in early crop growth phase and promoted the growth of leaves and branches in cucumber vine. Similar results were also reported by Kumar *et al.* (2017) [6], Geethu *et al.* (2018) [3], Rathod *et al.* (2018) [8], Dawer *et al*. (2019) [2] and Kharga *et al*. (2019) [5].

Data related to the days to flowering and 50% flowering in cucumber revealed that the minimum days to flowering and 50% flowering were observed with the application of 75% RDF + Vermicompost + *Azotobacter* + PSB) and it was found the best treatment combination among all the treatments. This may be due to reason that application of organic manure and biofertilizers provide better soil physico-chemical properties, growth and productivity of plants because of its higher nutrient content, as it contains more number of N_2 fixing, phosphate solubilising bacteria and other beneficial microbes, antibiotics, vitamins, hormones, enzymes, which have better effect on early flowering in cucumber. The results were in confirmation with the results of Hassan (2017) [4], Singh *et al.* (2018) [10], Tripathi *et al.* (2018) [16] and Rajawat *et al.* (2019) [7].

Table 1: Effect of integrated nutrient management on growth parameters of cucumber

Treatment symbols	Treatment detail	Vine length (cm)		Number of branches/vine		Number of leaves/vine		Days to flowering	Days to 50% flowering
		45 DAS	90 DAS	45 DAS	90 DAS	45 DAS	90 DAS		
T_1	100% RDF	167.77	208.40	8.30	11.02	82.80	143.04	29.73	34.86
T_2	75% RDF + *Azotobacter*	143.60	191.66	6.85	8.71	72.99	132.21	31.32	37.19
T_3	75% RDF + PSB	138.12	189.06	6.40	8.49	70.07	130.41	31.40	37.40
T_4	75% RDF + *Azotobacter* + PSB	147.62	192.93	6.99	9.10	74.69	133.57	31.21	36.93
T_5	75% RDF + Vermicompost + *Azotobacter*	158.66	203.43	8.04	10.74	80.23	141.35	30.25	35.36
T_6	75% RDF + Vermicompost + PSB	151.64	195.62	7.45	10.15	78.23	138.62	30.72	36.09
T_7	75% RDF + Vermicompost + *Azotobacter* + PSB	170.11	210.13	8.42	11.10	84.11	144.16	29.43	34.41
T_8	75% RDF + FYM + *Azotobacter*	155.37	199.59	7.76	10.46	79.41	140.35	30.56	35.77
T_9	75% RDF + FYM + PSB	149.64	194.35	7.12	9.85	77.08	136.18	30.98	36.56
T_{10}	75% RDF + FYM + *Azotobacter* + PSB	164.68	206.52	8.21	10.91	81.20	142.48	29.95	35.00
S.Em (±)		0.747	0.327	0.047	0.315	0.356	0.437	0.105	0.059
CD 5%		2.218	0.972	0.139	0.936	1.058	1.299	0.311	0.174

Yield parameters

The Result related to yield attributes (Table 2) revealed that application of 75% RDF + Vermicompost + *Azotobacter* + PSB was found the best treatment combination of different organic manures and biofertilizers for influencing the different yield parameters of cucumber and it recorded the maximum fruit length, girth and weight. The increase in yield parameters of cucumber could be attributed to higher metabolic activities due to optimum nitrogen supplies and also production of phytohormones which were manifested in the form of enhanced growth and higher carbohydrate production which resulted increase in fruit size, weight and length. Similar results for most of the characters were also reported by Sureshkumar *et al.* (2016) [13], Thriveni *et al.* (2017) [15], Dash *et al.* (2018) [1], Geethu *et al.* (2018) [3], Rajawat *et al.* (2019) [7] and Sahu *et al.* (2020) [9].

The data related to maximum number of fruits per vine, maximum yield per vine, per plot and per hectare was recorded with the application of 75% RDF + Vermicompost + *Azotobacter* + PSB) It is due to the effect of different organic manures and bio-fertilizers resulted in increase in number of fruits per vine. The different biofertilizers were found effective in nitrogen fixation, synthesis of plant growth promoting hormones and enzyme activation. Increase in average weight of fruit is due to application of organic manures and biofertilizers which might be due to favourable action of the microorganisms and positive effect of the manures which might have enhanced the micronutrient availability in the soil. Similar results were reported by Thongney *et al.* (2020) [14], Hassan (2017) [4], Dawer *et al.* (2019) [2], Sahu *et al.* (2020) [9] and Suman *et al.* (2020) [12].

Table 2: Effect of integrated nutrient management on yield parameters of cucumber

Treatment symbols	Treatment detail	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	Number of fruits per vine	Yield per vine (kg)	Yield per plot (kg)	Yield per hectare (q)
T_1	100% RDF	13.94	11.02	168.63	17.00	5.74	252.64	255.16
T_2	75% RDF + *Azotobacter*	12.33	9.29	140.35	13.78	4.38	192.90	194.83
T_3	75% RDF + PSB	12.14	9.10	137.14	13.00	4.17	183.34	185.17
T_4	75% RDF + *Azotobacter* + PSB	12.55	9.61	144.04	14.32	4.57	201.22	203.23
T_5	75% RDF + Vermicompost + *Azotobacter*	13.54	10.52	161.47	16.03	5.35	235.30	237.65
T_6	75% RDF + Vermicompost + PSB	12.89	9.99	153.69	15.27	5.00	219.79	221.99
T_7	75% RDF + Vermicompost + *Azotobacter* + PSB	14.11	11.12	170.18	17.41	5.87	258.28	260.87
T_8	75% RDF + FYM + *Azotobacter*	13.10	10.12	157.53	15.85	5.21	229.25	231.54
T_9	75% RDF + FYM + PSB	12.75	9.81	150.53	14.79	4.82	212.22	214.34
T_{10}	75% RDF + FYM + *Azotobacter* + PSB	13.77	10.85	164.47	16.63	5.55	244.30	246.75
S.Em (±)		0.050	0.049	0.698	0.073	0.029	1.259	1.272
CD 5%		0.147	0.146	2.075	0.216	0.085	3.742	3.779

Conclusion

It is concluded that application of the organic manures (*viz.*, Vermicompost and FYM) and biofertilizers (*viz.*, *Azotobacter* and PSB) significantly influenced the different growth and yield parameters in cucumber. The application of 75% RDF + Vermicompost + *Azotobacter* + PSB was found to the best treatment among all the treatments and it gave the maximum growth and yield parameters. Thus, integrated nutrient management is the suitable option to increase the production and manage the resources efficiently.

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