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Influence of organic, inorganic and bio fertilizers on flowering, yield and yield attributes of cucumber (cv. Hassan Local) in open field condition*

M. ANJANAPPA, J. VENKATESH AND B. SURESH KUMARA

Department of Horticulture
University of Agricultural Sciences, GKVK, Bangalore- 560 065, India
Email:m_anjanappa@rediffmail.com

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Abstract : An experiment was carried out on influence of organic, inorganic and biofertilizers on yield and economics of cucumber (Cv. Hassan Local) grown under protected condition at Department of Horticulture, University of Agricultural Sciences, Bangalore during the year 2005 and 2006. The results revealed that the plants treated with 75% RDF + 75% FYM + AZT + PSB + TD (T_2) registered lowest number of days for male (30.00 ; 30.40) and female (30.36 ; 36.00) flower appearance, lowest node of first male female(3.30 ; 3.16) flower appearance, lowest sex ratio (4.60 ; 4.88 %), highest fruit length (18.16 ; 20.81 cm), fruit volume (295.61 ; 330.00 ml), fruit diameter (22.23 ; 22.40 mm), fruit weight (309.01 ; 324.94 g), fruit yield vine^{-1} (2.47 ; 2.55 kg) and total fruit yield hectare^{-1} (17.60 ; 18.22 t ha^{-1}) during summer 2005 and *rabi* 2006 respectively. Whereas, the same treatment also recorded least number of nodes of first female (2.46) flower appearance and highest number of male flower (93.00) per vine during summer 2005, highest fruit cavity (4.55 cm) during rabi 2006. With this the treatment T_2, 75% RDF + 75% FYM + Azotobacter + Phospobacteria + Trichoderma is identified as best for earliness and higher productivity.

Key words: Azotobacter, Hassan Local, Phosphobacteria, Trichoderma

Introduction:

Cucumber (*Cucumis sativus* L.) is one of the most popular vegetable. It belongs to the family cucurbitaceae. It is preferably grown for its edible tender fruits in almost all parts of the world. In India, cucumber is cultivated in an area of 18,000 hectares with a production of 1, 20,000 tonnes. In Karnataka, cucumber is grown in an area of 6,021 hectares with annual production of 87,858 tonnes (Anon, 2005). Modern nutrient management strategy has shifted its focus towards the concept of sustainability and eco friendlyness. Intensive use of only chemical fertilizers to achieve high production has created a various problems. Continuous application of heavy doses of chemical fertilizers without organic manures or bio-fertilizers has lead to a deterioration of soil health in terms of physical and chemical, properties of soil, declining of soil microbial activities, reduction in soil humus, increased pollution of soil, water and air. Hence, integrated supply of nutrients through organic, inorganic and bio-fertilizers is the need of the hour for sustainable productivity and to maintain better soil health. Hence, there is a need to standardize the integrated nutrient management practices for cucumber growing under open condition to get early yield and higher productivity and quality of produce under Indian conditions. *Trichoderma* which is a naturally occurring saprophytic soil fungi which is used as cellulose decomposer, phosphate solubilizer bio-pesticide, among which *T. viridae* and *T. harzianum* are most important. The phosphate solubilizing microorganism phosphobacteria which can solubilize insoluble forms of phosphorous by secreting organic acids. These microbes help in solubilizing the phosphorous from rock phosphate and other sparingly soluble forms of soil phosphorous by decreasing their particle size.

Material and methods

The experiment was carried out at the Division of Horticulture, Gandhi Krishi Vigyana Kendra, University of Agricultural Sciences, Bangalore, during summer 2005 and *rabi* 2006 The soil of the experimental field was sandy loam having 6.5 to 7.0 PH. The experiment was laid out in Randomized Completely Block Design with three replications involving 12 treatments. The plot size was 3.5 x 2.0 m. A spacing of 150 x 90 cm was followed. The recommended dose of NPK (60:50:80 kg/ha), farm yard manure (25 t/ha), vermicompost (1.5 t/ha) and bio-fertilizers like Azotobacter

Treatment details mentioned in the material and methods

T_1 – 100% RDF (60:50:80 kg NPK/ha) + 100%FYM (25 t/ha)
T_2 – 75% RDF + 75% FYM + Azotobacter + Phosphobacteria + Trichoderma
T_3 – 50% RDF + 50% FYM + Azotobacter + Phosphobacteria + Trichoderma
T_4 – 75% RDF + VC (1.5t/ha) + Azotobacter + Phosphobacteria + Trichoderma
T_5 – 50% RDF + VC (1.5t/ha) + Azotobacter + Phosphobacteria + Trichoderma
T_6 – 75% RDF + 50% FYM + VC (1.5 t/ha) + Azotobacter + Phosphobacteria + Trichoderma
T_7 – 50% RDF + 50% FYM + VC (1.5 t/ha) + Azotobacter + Phosphobacteria + Trichoderma
T_8 – 75% RDF + 50% FYM + Azotobacter
T_9 – 50% RDF + 50% FYM + Azotobacter
T_{10} – 75% RDF + 50% FYM + Phosphobacteria
T_{11} – 50% RDF + 50% FYM + Phosphobacteria
T_{12} – 100% FYM + Azotobacter + Phosphobacteria + Trichoderma

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(5 kg/ha), Phosphobacteria (5 kg/ha) and Trichoderma (5 kg/ha) were applied as per the treatments, but the biofertilizers were mixed with farm yard manure and were applied to the soil before sowing the seeds. Fifty per cent of N and full dose of P and K were applied in the furrows as per treatments and were thoroughly mixed in soil. The remaining half of the nitrogen was top dressed at 30 days after planting. The cultivar used in this study was 'Hassan Local', it is an indigenous and most popular local variety grown mainly in Hassan district of Karnataka. The observations on flowering characters like days to first male and female flower appearance, node at first male and female flower appearance, number of male and female flowers per plant and sex ratio, and growth parameters like fruit length (cm), fruit volume (cc), fruit diameter (cm), fruit cavity (mm), number of fruits per vine, fruit weight (g), fruit yield (kg $vine^{-1}$) and fruit yield (t ha^{-1}) was recorded and analysed.

Results and discussion

For days taken to first male and female flower appearance, plants fertilized with 75% RDF + 75% FYM + AZT + PSB + TD (T_2) recorded least number of days (30.00 ; 30.40 and 30.36 ; 36.00 days) taken for first male and flower appearance which was *on par* with T_6 (30.50 ; 30.50 and 31.13 ; 37.33 days) during the year summer 2005 and *rabi* 2006 respectively. This could be attributed to vigorous growth of the plants due to balanced nutrient levels with bio-fertilizers. Phosphorus is an important element and essential for initiation of flowering, PSB along with NPK known to increase the availability of phosphorus resulted in early flowering. This finding is in line with Sharma *et al.* (1997), Patil *et al.* (1998) reported that application of 150 kg N plus 50 kg each of P and K per hectare produced significantly highest vine length (180 cm), number of branches per vine (5.50) and earlier male flower (35.25 days) initiation in cucumber cv. Himangi, Nirmala *et al.* (1999) in cucumber (Table 1).

For node of first male flower appearance during summer 2005, plants provided with 75% RDF + 75% FYM + AZT + PSB + TD (T_2) recorded minimum number of nodes (2.46) for first male which was *on par* with T_6 (2.63) and the same treatment also recorded lowest number of nodes for female (3.30 ; 3.16) appearance, while maximum (4.13 ; 4.93) number of nodes for first female flower appearance was recorded with 100% FYM + AZT + PSB + TD (T_{12}) during summer 2005 and *rabi* 2006 respectively (Table 1).

For number of male, female flowers and sex ratio data are presented in table 2. During summer 2005, plants provided with 75% RDF + 75% FYM + AZT + PSB + TD (T_2) registered the maximum number of male flowers (93.00) per vine which was on par with T_6 (92.00), T_4 (87.43), T_1 (87.41), T_7 (86.83), T_8 (84.66), T_{10} (84.16) and T_3 (81.83). While the minimum number of male flowers (75.00) was registered in treatment provided with 100% FYM + AZT + PSB + TD (T_{12}). The increased number of male flowers due to higher uptake of nitrogen favouring vigorous vine growth which helped in synthesis of hormones like GA which induced production of more number of male and female flowers. Combination of organic, inorganic and bio-fertilizers helped in enhanced uptake of nutrients which promotes faster plant growth leading to increase production of higher number of male and female flowers. These results are in conformity with the findings of Sharma *et al.* (1997), Patil *et al.* (1998), Nirmala *et al.* (1999) in cucumber, Das *et al.* (1987) in pointed gourd, Arora *et al.* (1994) in ridge gourd and Singh *et al.* (1995) in muskmelon.

Table 1. Effect of integrated nutrient management on days taken for first male and female flowers and node at first male and female flower appearance grown under open condition

Treat-ments	Days to first				Node at first			
	Male flower appearance		Female flower appearance		Male flower appearance		Female flower appearance	
	Summer 2005	*Rabi* 2006	Summer 2005	*Rabi* 2006	Summer 2005	*Rabi* 2006	Summer 2005	*Rabi* 2006
T_1	33.36	33.16	34.03	39.83	3.26	3.56	3.90	3.80
T_2	30.00	30.40	30.36	36.00	2.46	3.13	3.30	3.16
T_3	31.36	31.20	32.50	38.13	2.83	3.50	3.60	3.40
T_4	33.46	33.40	34.20	40.33	3.36	3.60	3.93	4.00
T_5	32.10	31.26	32.83	38.93	3.06	3.53	3.60	3.56
T_6	30.50	30.50	31.13	37.33	2.63	3.26	3.43	3.26
T_7	33.20	32.93	33.66	39.83	3.20	3.56	3.90	3.73
T_8	32.50	32.46	33.46	39.56	3.16	3.56	3.73	3.60
T_9	30.83	30.86	32.20	38.06	2.76	3.40	3.43	3.40
T_{10}	32.33	32.16	33.13	37.43	3.13	3.53	3.63	3.56
T_{11}	32.83	34.06	34.26	40.33	3.50	3.63	4.10	4.23
T_{12}	34.33	34.50	34.50	40.50	3.73	3.66	4.13	4.93
S.Em. ±	0.93	0.91	0.84	1.33	0.17	0.18	0.23	0.21
C.D. at 5%	2.75	2.69	2.47	3.91	0.50	NS	0.69	0.63
C.V. (%)	5.03	4.93	4.42	5.92	9.70	8.92	11.04	10.02

NS: Non significant

RDF - Recommended dose of fertilizer
FYM – Farm Yard Manure
VC - Vermicompost
Azotobacter (AZT)
Phosphobacteria (PSB)
Trichoderma (TD)

Plants provided with 75% RDF + 75% FYM + AZT + PSB + TD (T_2) recorded lowest (4.60 ; 4.88 %) sex ratio which was *on par* with plants provided with 75% RDF + 50% FYM + VC (1.5 t/ha) + Azotobacter + Phosphobacteria + Trichoderma (T_6) (5.20 ; 4.90) during summer 2005 and *rabi* 2006 respectively (Table 2). The lower sex ratio may be due to the production of almost same number of female flowers as that of male flowers. The results are in conformity with the findings of Nirmala *et al.* (1999) in cucumber (Table 2).

The highest fruit length (18.16 ; 20.81 cm) was recorded in plants provided with 75% RDF + 75% FYM + AZT + PSB + TD (T_2) which was *on par* with T_6 (18.00 ; 19.68 cm) during summer and *rabi* respectively. During summer 2005 and *rabi* 2006, plants fertilized with 75% RDF + 75% FYM + AZT + PSB + TD (T_2) recorded highest fruit volume (295.61 ; 330.00 ml), whereas minimum fruit volume (189.00 ; 195.33 cc) recorded in 100% FYM + AZT + PSB + TD (T_{12}) respectively. Plants fertilized with 75% RDF + 75% FYM + AZT + PSB + TD (T_2) recorded the highest fruit diameter (22.23 ; 22.40 cm) which was on par with T_6 (22.20 ; 22.33cm) 75% RDF + 50% FYM + VC + AZT+ PSB + TD. While lowest fruit diameter (21.41 ; 21.86 cc) was noticed with 100% FYM + AZT + PSB + TD (T_{12}) during summer 2005 and *rabi* 2006 respectively (Table 3).

The increased fruit length, fruit cavity, fruit volume and diameter could be attributed to balanced nutrition, better nutrient uptake and synthesis of more carbohydrates by plants when provided with combinations of inorganic, organic and biofertilizers which influence the increased vine length, number of leaves and branches per vine and increased chlorophyll content in leaf resulting in higher photosynthesis leading to increased fruit length fruit diameter intern increased the fruit volume and fruit cavity. The results are in conformity with the findings of Patil *et al.* (1998) cucumber and Umamaheshwarappa *et al.* (2005) in cucumber, Yadav and Luthra (2004) in water melon, Orowski *et al.* (1991) in cucumber, Naidu *et al.* (1999) in okra, Upadhyaya and Sharma (2002) in cucumber.

For number of fruits per vine, the highest number of fruits per vine (10.25 ; 10.30) was recorded with 75% RDF + 75% FYM + AZT + PSB + TD (T_2) which was on par with T_6 - 75% RDF + 50% FYM + VC + AZT + PSB + TD (10.00 ; 10.25), T_4 - 75% RDF + VC + AZT+ PSB +TD (8.70 ; 9.03) and T_1 - 100% RDF + 100% FYM (8.11 ; 8.58). While, lowest number of fruits (6.26 ; 7.01) was noticed in plants provided with 100% FYM + AZT + PSB + TD (T_{12}) during summer 2005 and *rabi* 2006 respectively. (Table 4).

With regard to fruit weight, maximum fruit weight (309.01 ; 324.94 g) was recorded in plants fertilized with 75% RDF + 75% FYM + AZT + PSB + TD (T_2) which was on par with T_6 (302.14 ; 313.98 g), T_4 (298.14 ; 310.83 g) and T_1 (279.27 ; 289.15 g), while, lowest fruit weight (193.07 ; 191.94 g) was observed in plants fertilized with 100% FYM + AZT + PSB + TD (T_{12}) during summer 2005 and *rabi* 2006 respectively. For the character fruit yield per vine, maximum fruit yield per vine (2.47 ; 2.55 kg vine^{-1}) was recorded in plants fertilized with 75% RDF + 75% FYM + AZT + PSB + TD (T_2) which was *on par* with T_6 (2.45 ; 2.51kg vine^{-1}), T_4 (2.19 ; 2.23 kg vine^{-1}) and T_1 (2.18 ; 2.21 kg vine^{-1}) during summer 2005 and *rabi* 2006 respectively.

Application of 75% RDF + 75% FYM + AZT + PSB + TD (T_2) recorded maximum fruit yield per hectare (17.60 ; 18.22 t ha^{-1}) which was followed by T_6 - 75% RDF + 50% FYM + VC + AZT + PSB + TD (17.41 ; 17.79 t ha^{-1}), T_4 - 75% RDF + VC + AZT+ PSB +TD (15.59 ; 15.85 t ha^{-1}) and T_1 - 100% RDF + 100% FYM (15.52 ; 15.75 t ha^{-1}) in both the seasons (Table 4).

Increased fruit yield in these treatments could be attributed to lowest number of days taken for male and female flower appearance, production of more number of female flowers, number of fruits and fruit weight which were positively contributed

Table 2. Effect of integrated nutrient management on number of male and female flowers per vine and sex ratio in cucumber grown under open condition.

Treatments	Number of male flowers plant^{-1}		Number of female flowers plant^{-1}		Sex ratio	
	Summer, 2005	*Rabi,* 2006	Summer, 2005	*Rabi,* 2006	Summer, 2005	*Rabi*, 2006
T_1	87.41	86.58	15.29	16.85	5.90	5.37
T_2	93.00	90.00	16.32	17.32	4.60	4.88
T_3	81.83	83.33	15.05	15.70	5.33	5.09
T_4	87.43	87.50	15.35	17.04	5.94	5.39
T_5	82.50	83.50	15.07	15.84	5.53	5.15
T_6	92.00	88.16	15.55	17.16	5.20	4.90
T_7	86.83	85.00	15.19	16.25	5.70	5.35
T_8	84.66	84.66	15.14	15.95	5.63	5.34
T_9	80.50	82.33	14.93	15.62	5.22	4.99
T_{10}	84.16	84.00	15.12	15.89	5.59	5.29
T_{11}	79.50	82.58	14.71	15.48	6.15	5.63
T_{12}	75.00	82.16	14.68	16.25	6.14	6.07
S.Em. ±	4.17	3.85	0.57	0.98	0.21	0.20
C.D. at 5%	12.25	NS	NS	NS	0.63	0.59
C.V. (%)	8.55	7.84	6.57	10.56	6.68	6.62

NS: Non significant

RDF - Recommended dose of fertilizer
FYM – Farm Yard Manure
VC - Vermicompost
Azotobacter (AZT)
Phosphobacteria (PSB)
Trichoderma (TD)

Table 3. Effect of integrated nutrient management on fruit length, fruit volume and fruit diameter of cucumber at harvest grown under open condition

Treat-ments	Fruit length (cm)		Fruit volume (cc)		Fruit diameter (cm)	
	Summer, 2005	*Rabi,* 2006	Summer, 2005	*Rabi,* 2006	Summer, 2005	*Rabi,* 2006
T_1	16.58	17.65	259.33	288.00	22.03	22.20
T_2	18.16	20.81	295.61	330.00	22.23	22.40
T_3	15.33	15.91	227.66	225.33	21.76	21.93
T_4	17.41	17.91	261.66	316.33	22.06	22.21
T_5	15.75	17.08	246.66	246.66	21.88	21.93
T_6	18.00	19.68	289.00	320.66	22.20	22.33
T_7	16.25	17.58	258.33	275.33	22.00	22.06
T_8	16.00	17.53	253.66	260.66	21.93	22.00
T_9	15.16	15.62	221.33	223.33	21.53	21.93
T_{10}	15.83	17.25	247.00	251.66	21.90	21.93
T_{11}	14.68	15.10	200.33	218.33	21.50	21.86
T_{12}	14.66	15.06	189.00	195.33	21.41	21.86
S.Em. ±	0.81	1.00	12.17	12.36	0.12	0.10
C.D. at 5%	2.37	2.96	35.17	36.27	0.36	0.31
C.V. (%)	8.69	10.12	8.58	8.15	9.66	8.13

NS: Non significant

RDF - Recommended dose of fertilizer
FYM – Farm Yard Manure
VC - Vermicompost
Azotobacter (AZT)
Phosphobacteria (PSB)
Trichoderma (TD)

Table 4. Effect of integrated nutrient management on number of fruits per vine and fruit yield of cucumber grown under open condition

Treatments	Number of fruits vine^{-1}		Fruit weight (g)		Fruit yield (kg vine^{-1})		Fruit yield (t ha^{-1})	
	Summer, 2005	*Rabi*, 2006	Summer, 2005	*Rabi*, 2006	Summer, 2005	*Rabi,* 2006	Summer, 2005	*Rabi,* 2006
T_1	8.11	8.58	279.27	289.15	2.18	2.21	15.52	15.75
T_2	10.25	10.30	309.01	324.94	2.47	2.55	17.60	18.22
T_3	7.66	7.90	243.69	244.72	2.02	2.03	14.36	14.45
T_4	8.70	9.03	298.14	310.83	2.19	2.23	15.59	15.85
T_5	7.66	8.26	246.94	268.25	2.03	2.03	14.45	14.45
T_6	10.00	10.25	302.14	313.98	2.45	2.51	17.41	17.79
T_7	8.00	8.56	286.99	266.66	2.13	2.19	15.16	15.59
T_8	7.83	8.50	278.35	259.50	2.08	2.18	14.81	15.42
T_9	6.75	7.33	240.23	203.66	1.99	2.02	14.17	14.43
T_{10}	7.73	8.33	255.65	269.49	2.08	2.11	14.81	15.04
T_{11}	6.46	7.25	238.35	195.98	1.98	1.98	14.10	14.10
T_{12}	6.26	7.01	193.07	191.94	1.81	1.87	12.91	13.29
S.Em. ±	0.83	0.70	16.46	30.43	0.21	0.27	0.97	1.03
C.D. at 5%	2.46	2.06	48.29	89.25	0.62	NS	2.86	3.04
C.V. (%)	18.27	14.42	10.92	19.90	17.41	21.81	11.20	11.69

NS: Non significant

RDF - Recommended dose of fertilizer
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towards fruit yields. Increased yield was also related to balanced nutrition, better uptake of nutrients by the plants which helped for better fruit set and fruit yield. More yield of cucumber in present study could be due to the influence of bio-fertilizers in combination with NPK and FYM enhanced the synthesis of photosynthates by increasing the synthesis of growth regulators like IAA, GA, amino acids, and vitamins. More number of fruits per plant and fruit weight per plant ultimately resulted in more fruit yield per hectare. Present findings are in conformity with the reports of Hanna and Adams (1991), Muniz *et al.* (1992), Choudhari and More (2002), Yingjajawal and Marukmoon (1993) in cucumber, Resende and Pessoa (1996) in cucumber.

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