

Effect of inorganic, organic fertilizers and biofertilizers on growth, flowering, yield and quality attributes of bitter gourd, *Momordica charantia* L

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ABSTRACT

The experiment was conducted on bitter gourd at College of Agriculture, Orissa University of Agriculture and Technology, Bhubaneswar during Kharif 2013 to find out the effect of inorganic and organic fertilizers and biofertilizers on growth, flowering, yield and yield attributes of bitter gourd (*Momordica charantia*). Experimental factors included N:P:K three levels (50, 75, 100% RDF) alone or in integration with vermicompost or vermicompost + biofertilizers. The results illustrated that the plants treated with 100 per cent N:P:K + vermicompost + biofertilizers (*Azotobacter*, *Azospirillum* and phosphate solubilizing bacteria) had a beneficial effect on bitter gourd viz maximum vine length (534 cm), number of branches per vine (18.0), minimum days taken to appearance of first male (39.6 days) as well as female flower anthesis (44.0 days) that appeared at earliest node (24.6th node). The same treatment recorded maximum number of fruits/plant (40.0), fruit weight (86.4 g), fruit girth, fruit yield (4036 kg/ha), ascorbic acid (111.1 mg/100 g), TSS (2.10°Brix) and protein content (1.76%). Application of 100 per cent N:P:K integrated with vermicompost and biofertilizers turned to be the best treatment for increasing growth, early flowering, yield and quality attributes of bitter gourd.

Keywords: N:P:K; vermicompost; biofertilizers; growth; flowering; yield; quality

INTRODUCTION

Bitter gourd is a popular and demanded vegetable among cucurbits grown in India. Fruits are considered as a rich source of vitamins and minerals and are rich in vitamin C (88 mg/100 g) (Akter and Rahman 2010). It contains 0.61 mg iron, 20 mg calcium, 70 mg phosphorous, 126

µg carotene, 25 kcal energy, 92.4 per cent moisture, 1.6 g protein, 0.2 g fat, 4.2 g fiber and carbohydrates per 100 g of edible portion. Fruits have medicinal value and are used for curing diabetes, asthma, blood diseases and rheumatism. In India it is cultivated in an area of 87 thousand million ha with a production of 917 thousand MT. Leading states growing the crop are

Andhra Pradesh followed by Odisha, Bihar, Chhattisgarh and Madhya Pradesh. Bitter gourd is cultivated in 11407 ha area with 111762 MT production having 9.71 ton/ha productivity in Odisha (Anon 2014). The information on importance of integrated nutrient management (INM) on growth, flowering, yield and quality attributes of bitter gourd crop is inadequate. Present experiment was carried out on the effect of inorganic and organic fertilizers and biofertilizers on growth, flowering, yield and quality attributes of bitter gourd.

MATERIAL and METHODS

The experiment was conducted at Department of Soil Science, College of Agriculture, Bhubaneswar to study the effect of inorganic and organic fertilizers and biofertilizers on growth, flowering, yield and quality attributes of bitter gourd (*Momordica charantia* L). The soil of the experimental site was sandy loam with pH 6.2 to 6.8. The experiment was laid out in randomized block design with three replications involving ten treatments viz T₁ (absolute control), T₂ (50 per cent recommended dose of fertilizers), T₃ (50% N:P:K + vermicompost 2.5 tons/ha), T₄ (50% N:P:K + vermicompost + biofertilizers *Azotobacter*, *Azospirillum* and PSB @ 4 kg/ha), T₅ (75% N:P:K), T₆ (75% N:P:K + vermicompost), T₇ (75% N:P:K + vermicompost + biofertilizers), T₈ (100% N:P:K), T₉ (100 per cent N:P:K + vermicompost), T₁₀ (100 per cent N:P:K

+ vermicompost + biofertilizers). The recommended dose of N:P:K (150:50:100 kg/ha), vermicompost (2.6 tons/ha) and biofertilizers (*Azotobacter*, *Azospirillum* and phosphate solubilizing bacteria) each @ 4 kg/ha were applied as per the treatments. One fourth part of nitrogen, full dose of P and half of K were applied in basins as per the treatments and were thoroughly mixed in soil followed by irrigation. Half (out of remaining ¾ part) of N and second half of K₂O were top dressed at 15 days after sowing and nitrogen was applied as second top dressing 30 days after sowing. The study was conducted on private company cultivar named hybrid Prachi. Quality attributes such as TSS were measured by hand refractometer, ascorbic acid by volumetric method and protein by nitrogen estimation through Kjeldhal method of digestion and Distillation. The data were analysed by the method of Gomez and Gomez (1976).

RESULTS and DISCUSSION

The results of the mean data in respect of growth (vine length), flowering, yield and quality attributes as influenced by various treatment combinations are presented in Tables 1 and 2.

Growth parameters

Significantly highest vine length (533 cm) and highest number of branches per vine (18.00) were recorded in treatment T₁₀ as against lowest vine length (306 cm)

and number of branches per vine (8.00) recorded in control. The inorganic nutrients alone increased the vine length by 32.1 per cent, 38.5 per cent when integrated with vermicompost and 47.5 per cent in combination with vermicompost and biofertilizers over control. The increase in vine length might be due to better nutrient supply by specific combination of INM treatment. Use of vermicompost not only improves the soil aeration and nutrient status but also biological properties. The results are supported by the findings of Sureshkumar and Kruppaaiah (2008) in Kerala and Prasad et al (2009) in West Bengal. Anjanappa et al (2012), Mulani et al (2007) and Prabhu et al (2006) also reported similar results in cucumber.

Flowering

Significantly minimum days taken for first male flower (39.6 days), female flower anthesis (44 days) and first female flower recorded at earliest node (24.6th node) were recorded by treatment T_{10} which was significantly superior to all the other treatments but was on par with T_7 . Significantly maximum days taken for first male and female flowering were with unfertilized treatment (T_1) while in control treatment the first female flower appeared at 34th internode. The female flowers appeared 10 days after the appearance of male flowers. The treatments having integration with vermicompost and biofertilizers exhibited the appearance of male flowers and female flower 3 to 9 days

earlier as compared to biofertilizers omitted treatments. Female flowers appeared almost at 10 internodes lower than the absolute control treatment indicating the necessity of optimum dose of inorganic nutrients preferably integrated with vermicompost and biofertilizers. Mulani et al (2007), Sureshkumar and Karuppaiah (2008) and Prasad et al (2009) also made similar observations in bitter gourd. Prabhu et al (2006) and Anjanappa et al (2012) also reported similar results in cucumber.

Fruit characters

The fruit parameters like number of fruits per vine, fruit length, girth and their unit weight have been presented in Table 2. Even though the crop was affected by 'Philin' the average number of fruits per plant varied significantly between 17.3 in absolute control to 40 in T_{10} . Similarly length of fruit varied between 12 to 17 cm, girth between 11.9 to 13.6 cm and unit fruit between 42.4 and 86.4 g. All these parameters positively increased with incremental uses of inorganic nutrients and further with integrated uses of vermicompost either alone or with biofertilizers. Similar observations were also made by Mulani et al (2007) and Prasad et al (2009) in bitter gourd and Anjanappa et al (2012) in cucumber.

Fruit yield per hectare

The fruit yield of bitter gourd due to various treatments varied between 1303 and 4036 kg/ha highest being due to

Table1. Effect of Inorganic, organic and biofertilizers on growth and flowering attributes of bitter gourd

Treatment	Vine length (cm)	# branches /vine	Days to first male flower appearance	Days to first female flower appearance	Average node number of first female flower anthesis
T ₁	306.4	8.00	49.3	59.0	34.0
T ₂	357.0	12.20	44.0	48.0	29.0
T ₃	373.0	13.00	42.0	46.0	28.2
T ₄	387.5	13.50	40.0	45.7	28.0
T ₅	393.5	13.00	42.0	45.0	28.4
T ₆	416.5	14.00	40.4	44.7	27.8
T ₇	436.0	15.00	39.7	44.3	27.0
T ₈	464.0	16.00	42.0	45.6	28.0
T ₉	483.4	16.30	40.0	45.0	27.4
T ₁₀	534.0	18.00	39.6	44.0	24.6
CD _{0.05}	13.67	1.29	4.73	7.01	5.30
CV (%)	9.12	5.49	6.56	8.64	10.89

T₁ (absolute control), T₂ (50% recommended dose of fertilizers), T₃ (50% N:P:K + vermicompost 2.5 tons/ha), T₄ (50% N:P:K + vermicompost + biofertilizers *Azotobacter*, *Azospirillum* and PSB @ 4 kg/ha), T₅ (75% N:P:K), T₆ (75% N:P:K + vermicompost), T₇ (75% N:P:K + vermicompost + biofertilizers), T₈ (100% N:P:K), T₉ (100 per cent N:P:K+ vermicompost), T₁₀ (100 per cent N:P:K + vermicompost + biofertilizers).

Table2. Effect of Inorganic, organic and biofertilizers on yield and quality attributes of bitter gourd

Treatment	# fruits/plant	Weight/ fruit (cm)	Fruit yield (kg/ha)	RAE (%)	Ascorbic acid (mg/100 g)	Protein content (%)	TSS (°Brix)
T ₁	17.3	42.2	1303	—	47.14	1.11	1.10
T ₂	26.4	60.0	2760	66	63.9	1.20	1.43
T ₃	28.7	73.1	2937	74	72.8	1.37	1.50
T ₄	29.4	85.4	3430	96	79.7	1.55	1.80
T ₅	32.0	74.4	3230	87	84.0	1.22	1.50
T ₆	33.0	76.1	3396	94	92.9	1.37	1.83
T ₇	36.6	86.0	3773	111	104.0	1.70	2.00
T ₈	34.7	78.4	3523	100	99.7	1.56	1.60
T ₉	35.7	79.1	3683	107	99.7	1.60	1.90
T ₁₀	40.0	86.4	4036	123	111.1	1.76	2.10
CD _{0.05}	2.61	17.1	623.04		16.3	0.23	0.37
CV (%)	4.84	13.4	11.32		11.17	9.25	12.95

T₁ (absolute control), T₂ (50% recommended dose of fertilizers), T₃ (50% N:P:K + vermicompost 2.5 tons/ha), T₄ (50% N:P:K + vermicompost + biofertilizers *Azotobacter*, *Azospirillum* and PSB @ 4 kg/ha), T₅ (75% N:P:K), T₆ (75% N:P:K + vermicompost), T₇ (75% N:P:K + vermicompost + biofertilizers), T₈ (100% N:P:K), T₉ (100 per cent N:P:K+ vermicompost), T₁₀ (100 per cent N:P:K + vermicompost + biofertilizers).

combined use of incremental dose of inorganic fertilizers with vermicompost and biofertilizerd (T_{10}) and lowest due to without fertilizer application (control). Compared to the yield of 3523 kg/ha due to optimum inorganic dose there was 22 per cent and 8 per cent yield loss due to application of half and 75 per cent recommended doses of fertilizers respectively. Integration of vermicompost application @ 2.5 tons/ha increased the fruit yield by 6.4, 5.2 and 4.6 per cent compared to respective yields due to 50, 75 and 100 per cent recommended doses of fertilizers respectively. Again the fruit yield increased 17, 11 and 10 per cent by the integration of biofertilizers application with combined application of inorganic fertilizers 50, 75 and 100 per cent respectively. With the combined use of organic nutrients and biofertilizers the fruit yield increased at a decreasing rate with the incremental doses of inorganic nutrients. Similar results were also obtained by Anjannapa et al (2012) in cucumber.

Quality parameters

Plants supplied with T_{10} recorded maximum ascorbic acid content (111.1 mg/100 g edible portion), TSS (2.10°Brix) and protein content (1.76%) which were on par with T_7 and T_9 respectively. The increase in ascorbic acid, TSS and protein content of fruit in these treatments could be attributed to integrated application of organic and

inorganic fertilizers along with the biofertilizers (diazotrophs and PSB) which might have helped in better uptake of major nutrients including micronutrients. The findings are supported by the work of Anjanappa et al (2012) in cucumber.

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