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Integrated nutrient management studies in bottle gourd

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Abstract
The present investigation entitled on "Integrated nutrient management studies in bottle gourd (*Lagenaria ciceraria* L.)" at Main Garden, Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The experiment conducted in Randomized Block Design with three replications using cv. Samrat, with thirteen treatments, two kinds of organic manures (FYM and vermicompost) alone and in combination with two kinds of bio-fertilizers (*Azotobacter* and PSB) and reduced doses of chemical fertilizers were tested in comparison with control i.e. without any nutrient application.
On the basis of results, the application of 50% RDCF (50:25:25 NPK kg ha^{-1}) + 2.5 t ha^{-1} FYM + 1.65 t ha^{-1} vermicompost and *Azotobacter*, *PSB* each 5 kg ha^{-1} to the crop found to be sound integrated practice, where it recorded maximum vine length (551.56 cm), length of internode (15.88 cm), number of female flowers (17.44), fruit set percent (75.11%), yield per vine (7.61 kg), yield per hectare (380.61q). According to the B: C ratio, the treatment T_{12} was found to be profitable and remunerative.

Keywords: Bottle gourd, vermicompost, FYM, biofertilizers, yield

Introduction
Cucurbitaceous family is a large group of vegetable crops, cultivated extensively in tropical and subtropical parts of the world. This group consists of a wide range of vegetables viz. cucumbers, melons, pumpkins, squashes and gourds. Among gourds, bottle-gourd (*Lagenaria siceraria* L) commonly known as lauki, kaddu or dudhi is grown extensively in India. Bottle gourd is cultivated as a field crop in *kharif* and summer seasons throughout the country. However, it is grown throughout the year, where the winters are mild. Fertilizer application plays a major role in harnessing optimum and good quality fruits in bottle-gourd. Although chemical fertilizers particularly nitrogenous and phosphatic fertilizers contribute a lot in fulfilling the nutrient requirement but their excessive, regular and unbalanced use may lead to health and ecological hazards and deteriorate physicochemical properties of soil. Substances like urea which are either absorbed by the plant roots or converted to nitrates which are absorbed or lost in leaching or converted to gases in N cycle. Hence, there is a need to find an alternate or complementary source of nutrients that may enhance the yield without having adverse effects on soil properties and fruit quality.
Organic manures and bio-inoculants produce organic acids which have the capacity of holding cation and anions so integration of nitrogenous fertilizers with organic manures and bio-inoculants is more beneficial in releasing cations slowly to the plants. Addition of organic manures and bio-inoculants can buffer soil pH making more availability of nutrients to the plants. Since no work has been done on the integration of chemical fertilizers with organic manures and bio-inoculants in bottle-gourd, so the trial was laid out to find out the integrated effect of chemical fertilizers in combination with organic manures and bio-inoculants to achieve the maximum economic return on growth yield and quality of bottle-gourd.

Material Methods
The study was carried out at the Horticulture farm and analytical work was carried out at Analytical Laboratory, Department of Horticulture, Dr. P.D.K.V., Akola during the year 2012-2013. A soil of the experimental plots was loamy in texture, low in available nitrogen (161.4 kg/ ha) and medium in phosphorus (19.2 kg/ha) and potassium (332.4 kg/ha).

Treatment No.	Treatment details
T_1	100:50:50 N:P:K kg/ha.(Recommended Dose of Chemical and fertilizers)
T_2	10 t/ha FYM.
T_3	6.6 t/ha Vermicompost
T_4	10 t/ha FYM + 5 kg/ha *Azotobacter* + 5 kg/ha PSB
T_5	6.6 t/ha Vermicompost + 5 kg/ha *Azotobacter* + 5 kg/ha PSB.
T_6	75% RDCF + 2.5 t/ha FYM + 5 kg/ha *Azotobacter* + 5 kg/ha PSB
T_7	75% RDCF + 1.65 t/ha Vermicompost + 5 kg/ha *Azotobacter* + 5 kg/ha PSB.
T_8	50% RDCF +5 t/ha FYM + 5kg/ha *Azotobacter* + 5kg/ha PSB
T_9	50% RDCF + 3.3 t/ha Vermicompost + 5 kg/ha *Azotobactre* + 5 kg/ha PSB
T_{10}	25% RDCF + 4.95 t/ha Vermicompost + 5kg/ha *Azotobacter* + 5 kg/ha PSB.
T_{11}	25% RDCF + 7.5 t/ha FYM + 5 kg/ha *Azotobacter* + 5 kg/ha PSB.
T_{12}	50% RDCF + 2.5 t/ha FYM + 1.65 t/ha Vermicompost + 5 kg/ha *Azotobacter* + 5 kg/ha PSB.
T_{13}	Control.

A plot size of 4x4 m^2 was maintained and plants were spaced at 1.0 x 1.0 m thereby keeping 16 plants per plot. The cultivar used for the trials was Samrat. All the cultural practices were applied. All the characters studied like length of main vine (cm), Length of internode (cm), Number of days required to bear 1st Female flower, Number of Female flower/vine, Number of male flower/vine, Sex ratio, Number of fruits/vine, Fruit set (%), Yield per vine (kg), Yield per hectare (q), Length of fruit (cm), Diameter of fruit (cm), Average weight of fruit (gm) and B:C ratio was subjected to statistical analysis using variance technique as described by Panse and Sukhatme (1967) [5].

Result and Discussion

The growth parameters like main vine length, intermodal length etc., increased significantly with reduction of inorganic fertilizers in combination with organic manures and bio-fertilizers over the exclusive application of organic manures, chemical fertilizers and combined application of both. The vine length was observed to be maximum (551.56 cm) with application of 50% RDCF at the rate of 50 kg N, 25 kg P_2O_5, 25 kg K_2O ha^{-1} dose of fertilizers in combination with FYM 2.5 t ha^{-1},vermicompost 1.65 t ha^{-1}, azotobacter 5 kg kg^{-1} and PSB 5 kg kg^{-1} i.e. T_{12}. Whereas, minimum vine length was recorded in the T_{13} (290.34 cm). The length of internodal was recorded maximum throughout the growth period (15.88 cm) with an application of 50 kg N, 25 kg P_2O_5, 25 kg K_2O ha^{-1} dose of fertilizers in combination with FYM 2.5 t ha^{-1}, vermicompost 1.65 t ha^{-1}, azotobacter 5 kg ha^{-1} and PSB 5 kg ha^{-1} i.e. T_{12}. Whereas, a minimum length of internodal was recorded in the T_{13}. (11.14 cm). Similar results were also obtained from Patil *et al*., (1993) [6], Kumar *et al*., (2012) [4], and Prasad *et al*., (2009) [9].

The results obtained in respect of the days required to bear the female flower, the treatments found to be the significant. The minimum days (45.83) for female flower were recorded in the treatment 75% RDCF along with vermicompost and biofertilizers i.e. T_7. However, maximum number of days required to bear first female flower was recorded in the treatment T_{13} and T_2. The results obtained in respect of internodes at which first female flower appeared, the treatment found to be the significant. The treatment 75% RDCF along with FYM and biofertilizers i.e. T_6 recorded minimum internodes (10.98) for first female flower appeared. However, the maximum number of internodes required to bear first female flower was recorded in the treatment T_{13} which might be due to the integrated effect of organic, inorganic and biofertilizers. This result was similarly found by Prasad *et al*., (2009) [9], Prabhu *et al*., (2006) [7].

The results obtained in respect to the number of female and male flower per vine, the treatments found to be significant. The treatment T_{12} found a maximum number (17.44) of female flower with the application of 50 kg N, 25 kg P_2O_5, 25 kg K_2O ha^{-1} dose of fertilizers in combination with the application of FYM 2.5 t ha^{-1}, vermicompost 1.65 t ha^{-1}, azotobacter 5 kg ha^{-1} and PSB 5 kg ha^{-1}. However, the minimum number of the female flower (9.45) recorded in the treatment $T_{13.}$ The treatment T_7 i.e application 75% RDCF along with vermicompost and biofertilizers found a minimum number of male flower (46.07) while the maximum number of male flower (89.36) was found in treatment $T_{2.}$ The sex ratio of female to male flower was found the minimum in treatment T_7. However, the sex ratio was found to be maximum in treatment T_{13}. This result was similarly found by Prasad *et al*., (2008) [8] and Bindiya *et al*., (2006) [1].

The results obtained in respect to yield parameters like the number of fruit per vine, fruit set percent per vine, yield per vine (kg) and yield per hectare (q), treatments shown significant differences. The maximum number of fruits per vine (13.10) were found in treatment T_{12} with the application of 50 kg N, 25 kg P_2O_5, 25 kg K_2O ha^{-1} dose of fertilizers in combination with the application of FYM 2.5 t ha^{-1}, vermicompost 1.65 t ha^{-1}, Azotobacter 5 kg ha^{-1} and PSB 5 kg ha^{-1}. However, a minimum number of fruits (4.56) per vine were recored in T_{13} i.e. Control. The fruit set percent was recorded maximum (75.11) in treatment T_{12} while treatments T_7 and T_6 were found at par. The minimum number of fruit set percent (48.25) was recorded in T_{13} i.e. Control. The results of the present investigation are in apparent with the finding by Karuthmani (1995) and Broadbent *et al.*, (1977).

Maximum fruit weight (753.23 g) recorded in treatment T7 was found to be at par with T12 (712.45 g) and T6 (682.10 g). The minimum fruit weight (331.92 g) was recorded in T13. The maximum yield per vine and yield per hectare recorded in the treatment T12 i.e. 50:25:25 Kg NPK ha-1 + FYM 2.5 t ha-1 + Vermicompost 1.65 t ha-1 + treatment with PSB @ 5 kg ha-1 and Azotobacter @ 5 kg ha-1. This may be due to the application of inorganic, organic and biofertilizers, similar result obtained by Kumar *et al*., (2012) [4] and Prabhu *et al*., (2006) [7].

The results obtained in respect to quality parameters like a length of fruit (cm), a diameter of fruit (cm) and average fruit weight (g), the treatments found to be the significant. The maximum length of fruit (33.21) was recorded with the application of 75% RDCF along with vermicompost and

biofertilizers i.e. T_7 was found to be at par with T_{12} (32.85 cm) and T_6 (31.40 cm), While minimum (21.93 cm) was recorded in T_{13} i.e. Control. With regard to fruit diameter, the maximum (8.38 cm) fruit diameter was obtained in the treatment T_7 was found to be at par with T_{12} (7.90 cm) and T_6 (7.83 cm). However, minimum (5.36 cm) was recorded in T_{13} i.e. Control. A significant effect of INM on length, diameter and average fruit weight of bottle gourd fruit was also reported by Kumar *et al*., (2012) [4] and Prasad *et al*., (2009) [9].

Table 1: Impact of different organic, inorganic and biofertilizers on growth characters of Bottle gourd.

Treatment No.	Main vine length (cm)	Length of internode (cm)	No. of days required to bear 1st Female flower	No. of male flower/vine	No. of Female flower/vine	Sex ratio	Fruit set (%)	Average weight of fruit (gm)	No. of fruit/vine	Yield per vine (kg)	Yield per hectare (q)	Length of fruit (cm)	Diameter of fruit (cm)	B:C Ratio
T_1	395.58	15.34	51.42	65.34	15.02	4.35	59.78	476.71	8.98	6.01	300.71	28.61	6.96	2.26
T_2	311.65	12.32	55.57	89.36	12.76	7.00	47.41	359.60	6.12	3.65	182.56	24.38	5.41	1.49
T_3	335.23	12.87	54.45	75.15	13.14	5.71	52.20	372.12	6.86	4.60	230.12	26.84	5.84	1.83
T_4	361.14	13.50	53.36	72.76	13.91	5.23	51.25	389.34	7.13	5.00	250.29	27.17	6.40	2.03
T_5	375.55	14.04	52.11	70.43	14.12	4.98	52.76	409.29	7.45	5.28	267.34	27.89	6.64	2.11
T_6	480.95	15.66	46.77	50.23	16.82	2.98	66.11	682.91	11.12	7.17	358.82	31.40	7.83	2.73
T_7	502.41	15.54	45.83	46.07	17.22	2.67	67.59	753.23	11.64	7.35	365.91	33.21	8.38	2.77
T_8	451.36	15.03	48.63	54.91	16.09	3.41	63.14	592.71	10.16	6.98	349.45	29.63	7.51	2.72
T_9	475.69	15.23	47.97	52.65	16.45	3.20	66.01	621.13	10.86	7.17	353.71	30.11	7.74	2.71
T_{10}	438.25	14.81	49.86	56.78	15.88	3.57	62.27	534.89	9.89	6.70	335.13	29.23	7.41	2.66
T_{11}	413.26	14.68	50.05	60.36	15.41	3.91	60.09	501.61	9.26	6.52	325.89	28.91	7.01	2.54
T_{12}	551.56	15.88	46.12	47.45	17.44	2.72	75.11	712.45	13.10	7.61	380.61	32.85	7.90	2.94
T_{13}	290.34	1 1.14	56.09	85.03	9.45	8.99	48.25	331.92	4.56	3.4	170.16	21.93	5.36	1.46
-	Sig.	Sig	Sig.	Sig.	Sig	-	Sig	Sig	Sig	Sig.	Sig.	Sig.	Sig.	-
-	25.54	0.69	2.29	2.92	0.85	--	3.35	32.20	0.68	0.43	16.36	1.60	0.36	-
-	74.56	2.01	6.68	8.53	2.48	-	9.79	94.01	2.00	1.27	47.75	4.67	1.05	-

Conclusion

On the basis of results, the treatment T_{12} i.e. 50:25:25 kg NPK ha-1 + 2.5 t ha-1 FYM + 1.65 t ha-1 vermicompost + 5 kg ha-1 Azatobacter + 5 kg ha-1 PSB shown maximum result, which was at par with treatment T7 (75:37.5:37.5 kg NPK +1.65 t ha-1 vermicompost +5 kg ha-1 Azatobacter + 5 kg ha-1 PSB) and T6 (75:37.5:37.5 kg NPK +2.5 t ha-1 FYM + 5 kg ha-1 Azatobacter + 5 kg ha-1 PSB). Treatment T12 was found to be profitable and remunerative as per the B:C ratio (2.94).

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