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Studies on the effect of organic and integrated sources of nutrients on yield and economics of Bottle Gourd

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ABSTRACT

A field experiment was conducted during the summer in 2009 and 2010 to study the effects of integrated nutrient management on bottle gourd growth, yield, and economics. During both the years, the benefit: cost ratio was found highest for recommended NPK only (T_1) followed by FYM @ 10 t /ha + half of recommended FYM (T_3) and T_5 i.e. for vermicompost @ 0.25 t /ha + half of recommended NPK. In both years, average individual fruit weight was highest in the recommended N-P-K only. In 2009, highest fruit yield was highest for all the treatments except FYM at 20 t/ha, neem cake at 0.50 t/ha and poultry manure at 5.0 t/ha. In 2010, all treatments were similar except for vermicompost at 5 t/ha which had reduced fruit yield.

Key words: Bottle gourd, nutrients, yield, economics, B: C ratio

INTRODUCTION

Bottle gourd (*Lagenaria siceraria*) is an important cucurbitaceous vegetable crop cultivated in several tropical and subtropical countries for its edible fruit. Immature, tender bottle gourd fruits are used as a fresh vegetable and in preparation of pickles and other products. Bottle gourd can provide multiple medicinal benefits (Harika *et al*., 2012). Soil fertility and nutrient management is one of the important factors that have a direct impact on vegetable and fruit yield and quality. Managing optimum soil nutrient levels is the key in maintaining a sustainable and productive vegetable production enterprise. Sharath *et al.* (2016) conducted an experiment on integrated nutrient management in beal and obtained highest fruit yield from the plant received with combined application of FYM and mustard cake while the yield was lowest from the control plants. Vegetable production using organic methods has beneficial effects on the environment, soil health and sustainability of crop production (Panda *et al*., 2012). Integrated nutrient management is a concept easily applied in production of bottle gourd. Research has been done by several researchers on integrated nutrient management in bottle gourd. Till date information on integrated nutrient management in bottle gourd is meager in our country. A study was therefore conducted to determine the influence of inorganic fertilizer alone or in combination with organic fertilizers on bottle gourd for yield and economics.

MATERIALS AND METHODS

The experiment on "Studies on the response of organic and integrated sources of nutrients on yield and economics of bottle gourd" was conducted in the field under the Department of Botany, Utkal University, Bhubaneswar, during the summer seasons of 2009 and 2010. It comes under East and South Eastern Coastal Plain Agro climatic Zone of the state. The place is characterized by warm and moist climate with hot and humid summer and mild winter. The mean annual rainfall of Bhubaneswar is 1660 mm, out of which about 90 per cent is received during June to October. The soil of the experimental plot was low in organic carbon, low in total nitrogen, medium in phosphorus and low in potassium status. The soil was acidic in reaction with pH 6.0. The experiment was laid out in the randomized block design with 3 replications and conducted for 2 consecutive summer seasons (January to May) of 2009 and 2010.

The treatments consisted of nine levels of nutrient management.

Sl.No.	Treatment	Symbol used
1	Recommended dose of fertilizer (RDF) @50-30-50 kg N-P_2O_5- K_2O / ha.	T_1
2	FYM@20 t/ha.	T_2
3	FYM@10t/ha + half recommended N-P-K.	T_3
4	Neem cake @ 0.50t/ha	T_4
5	Neem cake @ 0.25 t/ha + half recommended N-P-K.	T_5
6	Vermicompost @ 5 t/ha	T_6
7	Vermicompost @ 2.5 t/ha + half recommended N-P-K.	T_7
8	Poultry manure @ 5t/ha	T_8
9	Poultry manure @ 2.5 t/ha + half recommended N-P-K.	T_9

The plot size is 3.00m x 2.70 m and plants were maintained at a spacing of 1.00 m x 0.90 m. The experimental plot was ploughed thrice followed by laddering in order to break the clods and level the field. Organic amendments were applied before sowing of seed and inorganic fertlizers were applied in splits. Inorganic fertilizers like Urea (1/4 rate) + single super phosphate (full rate) + muriate of potash (1/4 rate) were applied at the time of sowing to treatments T_1, T_3, T_5, T_7 and T_9. The first top dressing of urea (1/4 rate) + muriate of potash (1/4 rate) were applied at 15 days after sowing. The second top dressing with the remaining urea and muriate of potash was done at 30 days after sowing. Five seeds of bottle gourd variety BBOG 3-2 were sown in each pit at a depth of 2-3 cm on 21st January, 2009 and 22nd January, 2010 at a spacing of 100 cm x 90 cm. After the emergence, plants were thinned to three per pit, keeping in view the uniformity in growth for the trial. Hoeing, weeding, thinning and 1st top dressing were done after 15 days of sowing. The weeds present in intra row spaces were uprooted manually. A second hoeing, weeding, thinning and second top dressing was also done at 30 DAS. Irrigation was given after sowing of seeds, first top dressing and second top dressing of fertilizers and also as and when needed. The crop was sprayed 2 to 3 times with Triazophos @ 2ml/l and Sulfex @3 g/l in each growing season during both the years for management of red pumpkin beetle and powdery mildew respectively. Harvesting was done 61 days after sowing in both the years. Plot yields were recorded at 4 days interval starting from 61 days of sowing of seed. Just after plucking, the fruit weights were recorded plot wise and date wise. The fruit yields were expressed in quintal per hectare. The date on which the first fruit was harvested in each plot was recorded and the days taken were calculated from the date of sowing. The length of randomly selected five fruits from five sample plants in each plot was measured at harvest and the average was worked out by means of a piece of thread and a graduated scale and expressed in cm. The diameter of five fruits selected randomly from each sub plot was recorded in cm with the help of a measuring tape and the average was worked out. The fruit weight of the above randomly selected five fruits from the five sample plants in each plot was recorded (in g) and the average worked out. The fruits were harvested at an interval of 4 days and were weighed. The cumulative yields of each plot were multiplied by the hectare factor to get the fruit yield per hectare. The return was worked out from the total output of all enterprises before deducting the cost of cultivation.Net return was computed from the total output of the enterprise after deducting the total variable costs, which also included the wages of manual labour. Return per rupee invested was computed by dividing the gross return with total cost. Analysis of variance method as suggested by Panse and Sukhatme (1978) was used for statistical analysis for Randomized Block Design (RBD).

RESULTS AND DISCUSSION

From the data presented in the Table 1, it is obvious that fruit length was affected by year, in 2009 fruits being shorter than in 2010. The highest fruit length was obtained with the application of

recommended NPK only (T_1) (10.61 cm) followed by FYM @10t/ha + half recommended NPK (T_3)(10.06 cm) and vermicompost @ 2.5 t/ha + half recommended NPK (T_7)(10.0cm) which were similar, but greater than the rest of the treatments. Treatment neem cake @ 0.50 t /ha (T_4) produced significantly shortest (6.79 cm) fruit as compared to other treatments in bottle gourd. Similarly, greater fruit diameter was found in 2009 than in 2010 except neem cake @ 0.50 t /ha (T_4). The widest fruits were in recommended NPK (T_1)(15.84cm) followed by FYM@10t/ha + half recommended NPK (T_3)(15.08 cm) which were similar, but higher than rest of the treatments. The minimum fruit diameter was recorded in neem cake @ 0.50 t /ha (T_4) (9.41 cm).The treatment T_4 (neem cake @ 0.50 t /ha) produced significantly the lowest fruit diameter (9.41cm) as compared to other treatments (Table 1).

Table 1. Effect of organics and inorganics on fruit length (cm) of bottle gourd

Treatment	Fruit length (cm)			Fruit diameter (cm)		
	2009	2010	Pooled	2009	2010	Pooled
T_1 Full NPK (50:30:50 kg /ha)	8.910	12.300	10.610	16.660	15.030	15.840
T_2 FYM @ 20 t/ ha	7.210	10.000	8.610	12.930	11.140	12.030
T_3 FYM @ 10 t/ ha + 1/2 NPK	8.210	11.900	10.060	15.850	14.330	15.080
T_4 NC @ 0.5 t/ ha	5.080	8.500	6.790	8.850	9.960	9.410
T_5 NC @0 .25 t/ ha +1/2 NPK	8.170	11.000	9.590	15.280	12.290	13.780
T_6 VC @ 5 t/ ha	7.970	8.700	8.340	14.430	10.410	12.420
T_7 VC @ 2.5 t/ ha +1/2 NPK	8.490	11.500	10.000	15.710	12.830	14.260
T_8 PM @ 5 t/ ha	7.470	9.200	8.340	13.490	10.630	12.050
T_9 PM @ 2.5 t/ ha + 1/2 NPK	7.850	10.400	9.130	14.210	11.680	12.940
S.Em.(+)	**0.379**	**0.507**	**0.317**	**0.775**	**0.629**	**0.499**
C D at 5 %	**1.135**	**1.521**	**0.912**	**2.323**	**1.886**	**1.437**
C D (Y x T)			NS			NS

NS = Non – significant

From the data presented in Table 2, it was found that the average individual fruit weight was highest in the recommended NPK (T_1) during both years. In the first year, fruit weight was second highest in vermicompost @ 2.5 t/ha + half recommended NPK(T_7)(1.0 kg) followed by FYM@10t/ha + half recommended NPK (T_3) (0.99 kg), which were at par but significantly higher than vermicompost @ 5 t/ha (T_6), NC @ 0.25 t/ha + half recommended NPK (T_5), PM @ 2.5t/ha + half recommended NPK (T_9), FYM @ 20 t/ha (T_2), PM @ 5 t/ha (T_8) and neem cake @ 0.50 t /ha (T_4). The treatment neem cake @ 0.50 t /ha (T_4) recorded significantly lowest fruit weight (0.22 kg per plant) than all other treatments. In the second year, the second highest treatment was obtained from the treatment T_3 *i.e.* FYM@10t/ha + half recommended NPK (1.0 kg) followed by (T_7) i.e. vermicompost @ 2.5 t/ha + half recommended NPK (0.977kg). T_4 *i.e.*, neem cake @ 0.50 t /ha) produced the lowest (0.44 kg) fruit weight. In the present study, high fruit length and diameter were recorded with FYM @ 10 t/ha + half recommended NPK which is in agreement with the findings of Nirmala *et al*. (1999), Subbarao and Ravisankar (2001) and Das *et al*. (2015) who observed similar beneficial effects of integrated nutrient management on cucumber, brinjal and bottle gourd respectively. The treatment FYM @ 10 t/ha + half recommended NPK (T_3) also resulted in high fruit weight of bottle gourd which conforms to the findings of Sreenivas *et al*. (2000).

Perusal of data presented in the Table 2, revealed that during 2009, fruit yield was highest in T_1 (318.28 q/ha) followed by T_3 (314.82 q/ha) which were *at par* with each other and were significantly superior to other treatments. The lowest yield was obtained in T_4 (49.63 q/ha) which was similar to T_2 (61.61). Similarly, during 2010, T_1 was at top (330.62 q/ha) followed by T_3 (319.51 q/ha) which were at par with each other but

significantly higher than other treatments. Again the treatment T_4 obtained lowest (59.14 q/ha) fruit yield which was inferior to all treatments. Integrated nutrient management with FYM can maintain high productivity in bottle gourd and the rate of inorganic fertilizer can be halved without sacrificing productivity. This is in agreement with the findings of Dass *et al.* (2008) and Jahromi and Aboutalebi (2012) using other crops.

Table 2.Effect of organics and inorganics on fruit weight(kg) of bottle gourd

Treatment	Fruit weight (kg)			Fruit yield (q/ha)		
	2009	2010	Pooled	2009	2010	Pooled
T_1 Full NPK (50:30:50 kg /ha)	1.177	1.213	1.200	318.280	330.620	324.450
T_2 FYM @ 20 t/ ha	0.620	0.810	0.720	61.610	175.810	118.710
T_3 FYM @ 10 t/ ha + 1/2 NPK	0.990	1.000	1.000	314.820	319.510	317.170
T_4 NC @ 0.5 t/ ha	0.220	0.440	0.330	49.630	59.140	54.390
T_5 NC @0 .25 t/ ha +1/2 NPK	0.813	0.883	0.850	186.430	233.460	209.950
T_6 VC @ 5 t/ ha	0.843	0.490	0.670	113.090	106.050	109.570
T_7 VC @ 2.5 t/ ha +1/2 NPK	1.000	0.977	0.990	211.120	242.110	226.620
T_8 PM @ 5 t/ ha	0.587	0.610	0.600	95.680	135.070	115.380
T_9 PM @ 2.5 t/ ha + 1/2 NPK	0.710	0.843	0.780	128.150	201.240	164.700
S.Em.(+)	**0.040**	**0.035**	**0.027**	**4.051**	**7.323**	**4.185**
C D at 5 %	**0.121**	**0.105**	**0.077**	**12.145**	**21.952**	**12.052**
C D (Y x T)			0.127			26.718

Table 3. Economics of treatments in bottle gourd (during 1st year i.e. 2009)

Treatment	Yield (q/ha)	Gross income (Rs/ha)	Total cost of cultivation (Rs/ha)	Net income (Rs/ha)	Benefit: Cost ratio
T_1 Full NPK (50:30:50 kg /ha)	318.28	187149.00	23716.00	163433.00	7.89
T_2 FYM @ 20 t/ ha	61.61	36227.00	33810.00	2417.00	1.07
T_3 FYM @ 10 t/ ha + 1/2 NPK	314.82	185114.00	28763.00	156351.00	6.43
T_4 NC @ 0.5 t/ ha	49.63	29182.00	26950.00	2232.00	1.08
T_5 NC @ .25 t/ ha +1/2 NPK	186.43	109621.00	25333.00	84288.00	4.32
T_6 VC @ 5 t/ ha	113.09	66497.00	46550.00	19947.00	1.43
T_7 VC @ 2.5 t/ ha +1/2 NPK	211.12	124139.00	35133.00	89006.00	3.53
T_8 PM @ 5 t/ ha	95.68	56260.00	41650.00	14610.00	1.35
T_9 PM @ 2.5 t/ ha + 1/2 NPK	128.15	75352.00	32683.00	42669.00	2.31

Sale price – Rs588/q

Table 4. Economics of treatments in bottle gourd (during 2nd year i.e. 2010)

Treatment	Yield (q/ha)	Gross income (Rs/ha)	Total cost of cultivation (Rs/ha)	Net income (Rs/ha)	Benefit: Cost ratio
T_1 Full NPK (50:30:50 kg /ha)	330.62	210605.00	24941.00	185664.00	8.45
T_2 FYM @ 20 t/ ha	175.81	111991.00	35525.00	76466.00	3.15
T_3 FYM @ 10 t/ ha + 1/2 NPK	319.51	203528.00	30233.00	173295.00	6.74
T_4 NC @ 0.5 t/ ha	59.14	37672.00	28322.00	9350.00	1.33
T_5 NC @ .25 t/ ha +1/2 NPK	233.46	148714.00	26607.00	122107.00	5.59
T_6 VC @ 5 t/ ha	106.05	67554.00	48902.00	18652.00	1.38
T_7 VC @ 2.5 t/ ha +1/2 NPK	242.11	154224.00	36897.00	117327.00	4.18
T_8 PM @ 5 t/ ha	135.07	86040.00	43757.00	42283.00	1.97
T_9 PM @ 2.5 t/ ha + 1/2 NPK	201.24	128190.00	34349.00	93841.00	3.73

Sale price- Rs 637/q

ECONOMICS ANALYSIS

The data presented in the table 3 indicated that the gross income per ha in the first year(during 2009) was highest in T_1 (Rs. 1,87,149.00) followed by T_3 (Rs. 1,85,114.00) and T_7 (Rs. 1,24,139.00). The lowest gross income was obtained in T_4 (Rs. 29,182.00).During second year (2010), also T_1 recorded the highest (Rs. 2,10,605.00) income followed by T_3 (Rs. 2,03,528.00), T_7 (Rs.1,54,224.00) and T_5 (Rs.1,48,714.00), while T_4 was the lowest (Rs. 37,672.00). (Table 4).Thus, in both years the gross income was highest for the recommended NPK only followed by FYM @10t/ ha + half of the recommended NPK and lowest in neem cake @ 0.5 t/ha. During 2009, total cost of cultivation per ha was highest with T_6 (Rs. 46,550.00) followed by T_8 (Rs. 41,650.00) and T2 (Rs. 33,810.00). It was lowest in T_1 (Rs, 23,716.00 per ha) (Table 3). During 2010, also total cost of cultivation per ha was highest with T_6 (Rs. 48,902.00) followed by T_8 (Rs. 43,757.00) and T_7 (Rs.36,897.00) while it was lowest in T_1 (Rs, 24,941.00 per ha) (Table 4). Thus, in both the years the total cost of cultivation was highest for the treatment with vermicompost @ 5 t /ha (T_6) and lowest in treatment with recommended NPK only (T_1).

During 2009, net income per ha obtained from T_1 was highest (Rs.1,63,433.00) followed by T_3 (Rs. 1,56,351.00)and T_4 was lowest (Rs. 2,232.00).(Table 3).During 2010, highest net income per ha was obtained from T_1 (Rs.1,85,664.00) followed by T_3 (Rs. 1,73,295.00) while lowest net income per ha was obtained from T_4 was lowest (Rs. 9,350.00).(Table4). Hence, in both the years the net incomes per ha were highest for T_1 i.e. for the recommended NPK only followed by T_3 i.e. FYM @ 10 t/ha + half of recommended NPK. The lowest net income per ha was obtained from T_4 i.e. for neem cake @ 0.5 t/ha only.In case of Benefit: Cost (B.C.) ratio during 2009, T_1 recorded the highest (7.89) followed by T_3 (6.43) and T_5 (4.32) while T_2 was the lowest (1.07) (Table 3).During 2010, this economic parameter was also found to be highest with T_1 (8.45) followed by T_3 (6.74) and T_5 (5.59) and lowest in T_4 (1.33)(Table 4). During both the years 2009 and 2010, the benefit: cost ratio was found best for recommended NPK only (T_1) followed by FYM @ 10 t /ha + half of recommended FYM (T_3) and T_5 i.e. for vermicompost @ 0.25 t /ha + half of recommended NPK. The results are in conformity with the findings of Kumar *et al*. (2012) indicating that the plant responses can be extrapolated to differing environmental conditions.

CONCLUSION

Integrated nutrient management with FYM can maintain high productivity in bottle gourd and the rate of inorganic fertilizer can be halved without sacrificing productivity.

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