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Effect of organic manures on flowering and fruiting of guava

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Abstract: An experiment was carried out at BAU Germplasm Centre (GPC) of Bangladesh Agricultural University, Mymensingh during the period from January to August 2009 to examine the effect of different dose of organic manure on flowering and fruiting of Guava (variety BAU Guava-5). The experiment consisted of seven doses of each paragon compost viz. 0, 4.5, 6.75, 9.0, 11.25, 13.5, 18.05 kg/tree, mustard oil cake viz. 0, 1, 1.5, 2.0, 2.5, 3.0, 3.5 kg/tree, and cowdung viz. 0, 9.0, 13.5, 18.0, 22.0, 27.0, 36.0 kg/tree. The experiment was laid out in RCBD with three replications. Results revealed that in case of paragon compost the dose 11.25 kg/tree gave the highest yield (19.79 t/ha); in case of mustard oil cake the dose 2.5 kg/tree gave the highest yield (13.63 t/ha) and in case of cowdung the dose 36.0 kg/tree gave the highest yield (16.79 t/ha). Among the organic manures the best result was found by the application of paragon compost at 11.25kg/tree and the lowest was in mustard oil cake.
Key words: Organic manure, Flowering, Fruiting, Guava

Introduction

The BAU-5 a high yielding guava variety was developed by BAU Germplasm Center and released in 2007. It bears fruit throughout the year under well managed condition. Average weight of fruit is 300-350g and may attain up to 800g. The variation in size and weight of fruits is directly related to the number of fruits. Fruit is palatable, crispy and moderately sweet in taste. Ripe fruit is light green to whitish in colour. This is a promising variety which can be used for increasing total production of guava. It responds greatly to major essential nutrient elements like nitrogen, phosphorus and potassium in respect of its growth and yield (Schneider and Scarborough, 1960). On the other hand, organic manures like cowdung, mustard oil cake and paragon when applied help in maintaining good soil structure besides being a continuous source of nutrients including micronutrients. These are considered to be the most lasting form of nutrients and are conducive to fruit-fulness (Macmillan, 1962). Deficient and imbalance of these nutrients result in poor growth and reduction in yield. Ram *et al.* (2007) reported that integrated application of different fertilizers, organic manures and biofertilizers on seven years old trees of cv. Sardar improved the vegetative growth parameters. Replacing chemical fertilizers by application of organic manure reduced the factors responsible for environmental pollution and also minimizes organic waste. It is well known that organic manuring highly improves then soil properties through improved physiochemical and biological condition of the soil. No research about organic manuring has yet been reported on guava in Bangladesh. The present experiment was, therefore, undertaken to study the effect of organic manuring (paragon, mustard oil cake, cowdung) on the growth and yield of guava. The core objectives of the study are to increase and assess the yield and quality of fruit per unit area of land, to select the balance dose of organic manure and to reduce the cost of production of Guava.

Materials and Methods

The experiment was conducted at Germplasm Centre of Bangladesh Agricultural University, Mymensingh during the period from January 2009 to August 2009. The experiment was laid out in Randomized Complete Block Design with three replication. Each block contains 21 plants. Total no. of plants 63. The distance between plant to plant and row to row 4 m and 3.47 m respectively. The treatment was randomly assigned in the plants of each block. The experiment was done in two years old guava plants. The plants were established by layers and planted in 2007 and all the plants were uniform in size. The experiment was conducted to study the effect of organic manure on flowering and fruiting of guava. Different types and doses of manures were applied in 3 February 2009 which were Paragon Compost T_1=0, T_2=4.5, T_3=6.75, T_4=9.0, T_5=11.25, T_6=13.5, T_7=18.05 kg/tree, Mustard oil cake T_8=0, T_9=1, T_{10}=1.5, T_{11}=2.0, T_{12} =2.5, T_{13}=3.0, T_{14}=3.6 kg/tree, and Cowdung T_{15}=0, T_{16}=9, T_{17}=13.5, T_{18}=18.0, T_{19}=22.5, T_{20}=27 and T_{21}= 36 kg/tree respectively. Intercultural operation such as weeding, irrigation, thinning and disease control were done as and when necessary. Fruits harvesting were started from June 13, 2009 and harvesting continued to 22 August. Harvesting was done at different time depending on maturity. Data to be collected on plant height (cm), canopy volume (cm^3), number of flowers per plant, fruit set per plant, number of fruits per plant, total number of fresh fruits, number of drop fruit, number of diseased fruit, individual fruit weight (g), fruit size (length and breadth, cm), pulp (endocarp and mesocarp, g), number and weight (g) of seeds per fruits, total fruit weight (g)/plant and yield (t/ha). The significance of difference between pair of means was tested by the Least Significant Difference (LSD) tested at 5% and 1% level of probability.

Results and Discussion

Plant height (cm): The plant height was recorded at different stages of day after manuring (DAM) i.e 30, 60 and 90 days. During the period of plant growth the highest plant height was observed in paragon compost at 11.25kg/tree followed by cowdung with dose 36kg/tree and mustard oil cake with dose 2.50kg/tree. Among the paragon compost treatments, highest plant height was obtained 242.87cm at the dose 11.25kg/tree at 90 DAM. Among the mustard oil cake, the highest plant height was obtained 220.67 cm with the dose 2. 50kg/tree at 90 DAM. On the other hand among cowdung treatments with dose 36kg/tree showed the best result which was 232.50cm (Table 1). The lowest plant height was found with the dose 0 kg/tree MOC at 30 DAM.

Canopy volume (cm^3): Among the Paragon compost treatments, the dose 11.25 kg/tree gave the maximum canopy volume of 898.90cm^3 at 90 DAM while minimum canopy volume 780.83cm^3 was found at the dose 0kg/tree.

Among the mustard oil cake treatments, the dose 2.50kg/tree gave maximum canopy volume of 852.21cm^3 while at 0kg/tree gave minimum value of 780.67cm^3. In case of cowdung maximum canopy volume was found 875.69cm^3 at the dose 36kg/tree. From the experiment, it was observed that for paragon compost and mustard oil cake increasing the doses of manure upto certain level (11.25kg/tree for Paragon, 2.50kg/tree for mustard oil cake) canopy volume increase and then decrease. On the other hand for cowdung as much doses increase, canopy volume increases (Table 1).

Table 1. Effect of organic manuring on plant height, canopy volume and flowering of guava (cv. BAU Guava-5)

Treatment		Dose (kg/tree)	Plant height (cm)			Canopy volume (cm^3)			Number of flowers per plant			Fruit set per plant	Number of fresh fruit per plant	Number of diseased fruit per plant	Number of dropped fruit per plant	Total harvested fruit per plant
			30 DAM	60 DAM	90 DAM	30 DAM	60 DAM	90 DAM	30 DAM	60 DAM	90 DAM					
Paragon compost	T1	0	142.33	170.67	181.17	747.35	769.97	780.83	7.67	38.67	2.00	23.00	14.00	3.00	6.00	17.00
	T2	4.5	174.48	203.52	210.37	784.34	814.17	823.02	10.33	44.33	3.66	40.67	35.33	2.00	3.30	37.33
	T3	6.75	185.39	217.49	228.52	823.17	849.59	861.57	12.67	56.67	5.00	42.33	38.67	1.00	2.66	39.67
	T4	9.0	196.67	225.15	236.49	838.39	867.91	875.72	14.33	71.33	6.67	57.67	50.00	3.33	4.67	53.33
	T5	11.25	201.32	233.87	242.87	847.13	888.96	898.90	44.67	115.67	11.67	99.33	80.00	2.00	17.33	82.00
	T6	13.5	200.67	230.33	240.33	840.13	880.72	891.97	40.00	110.33	13.00	94.00	77.33	0.01	17.67	77.33
	T7	18.05	199.15	229.73	239.67	841.91	906.68	887.33	41.33	102.00	10.33	95.67	71.67	1.00	23.00	72.67
Mustard oil cake	T8	0	101.13	130.64	139.42	700.63	723.67	731.33	4.00	15.00	0.00	10.00	6.00	2.00	5.33	8.00
	T9	1	135.67	164.33	173.67	740.33	771.60	780.67	4.67	19.33	0.00	14.33	7.33	2.00	5.00	9.33
	T10	1.5	149.45	179.67	190.33	751.67	780.42	792.97	6.33	30.67	1.33	23.00	16.00	1.67	6.33	17.67
	T11	2.0	161.33	190.50	201.45	770.57	801.16	812.96	7.00	46.00	2.67	32.67	25.00	1.33	6.34	26.33
	T12	2.5	178.67	209.33	220.67	810.19	842.45	852.21	17.00	81.33	6.00	73.00	58.33	2.00	13.67	60.33
	T13	3.0	178.33	209.34	218.33	809.38	835.63	847.22	16.33	77.67	6.33	60.33	50.00	1.00	9.67	51.00
	T14	3.6	170.43	201.52	210.15	800.53	832.17	844.27	10.00	69.33	6.33	52.67	40.67	3.00	9.00	43.67
Cowdung	T15	0	116.33	146.52	153.64	721.97	749.82	760.33	5.67	18.00	0.00	13.00	8.33	2.00	3.67	10.33
	T16	9.0	150.67	179.39	190.33	750.43	782.97	791.17	9.00	29.67	1.67	21.33	12.67	2.00	7.34	16.67
	T17	13.5	161.33	191.89	200.67	760.88	789.67	800.83	13.33	40.00	1.00	30.67	19.33	0.01	8.67	23.33
	T18	18.0	172.33	200.67	209.15	771.53	799.68	811.57	13.00	54.33	3.33	49.67	22.00	1.33	16.34	40.33
	T19	22.5	185.60	217.33	229.67	825.68	856.41	863.09	19.00	87.33	5.67	77.00	62.33	1.00	14.67	63.67
	T20	27.0	188.33	218.45	228.33	832.41	860.93	871.67	23.67	90.67	7.00	80.33	63.69	2.00	15.34	65.67
	T21	36.0	190.67	221.67	232.50	836.37	899.99	875.69	28.00	94.00	9.33	82.00	69.00	0.01	13.00	69.00
Level of significance			**	**	**	**	**	**	**	**	**	**	**	**	**	**

** Significant at 1% level of probability, DAM = Days after manuring, T_1 = 0 kg/tree, T_2 = 4.5 kg/tree, T_3 = 6.75 kg/tree, T_4 = 9.0 kg/tree, T_5 = 11.25 kg/tree, T_6 = 13.5 kg/tree, T_7 = 18.05 kg/tree, T_8 = 0 kg/tree, T_9 = 1 kg/tree, T_{10} = 1.5 kg/tree, T_{11} = 2.0 kg/tree, T_{12} = 2.5 kg/tree, T_{13} = 3.0 kg/tree, T_{14} = 3.5 kg/tree, T_{15} = 0 kg/tree, T_{16} = 9 kg/tree, T_{17} = 13.5 kg/tree, T_{18} = 18.0 kg/tree, T_{19} = 22.5 kg/tree, T_{20} = 27 kg/tree, T_{21} = 32 kg/tree;

Number of flowers per plant: Though plant height and canopy volume were found maximum at 90 DAM but in case of Number of flowers per plant it was found at 60 DAM. Among the paragon compost treatment, maximum number of flowers per plant was found 115.67 at the dose 11.25kg/tree at 60 DAM. Among the mustard oil cake treatments, the dose 2.50kg/tree gave the highest flowers per plant which was 81.33 while highest flowers was found 94.00 at the dose 36kg/tree among the cowdung treatments (Table 1). The minimum number of flowers per plant was found at the dose 0 kg/tree MOC at 30 DAM.

Fruit set per plant: In case of paragon treatments maximum number of fruit set per plant (99.33) found at the dose 11.25 kg/tree while minimum was (23.00) in 0 kg/tree. Among the mustard oil cake treatments, maximum (73.00) was at 2.50 kg/tree and minimum was (10.00) at 0kg/tree. Among the cowdung treatments, maximum fruit set per plant was 82.00 at the dose 36 kg/tree and minimum was 13.00 at 0 kg/tree. From the experiment it was observed that number of fruits set per plant was highest in the paragon compost (11.25 kg/ tree) (Table 1).

No. of dropped fruits per plant: In paragon compost, the dose 0kg/tree was found the lowest (6.00) and at 18.05kg/tree obtained the highest (23.00) fruit drop per plant. In mustard oil cake, the dose 1kg/tree was the lowest (5.00) and at the dose 2.5kg/tree was the highest (13.67) fruit drop per plant. Among the cowdung treatments, the dose 0kg/tree had lowest (3.67) and at 27kg/tree (15.34) had highest fruit drop per plant (Table 1). Percentage of fruit drop was nil with sheep, goat and leaf litter application but was higher with vermicompost and poultry manures (Naik and Babu, 2007).

Total harvested fruits per plant: Total harvested fruit per plant was inversely proportional with the number of dropped fruit per plant. The maximum (82.00) at the dose 11.25 kg/tree among the paragon compost treatments while minimum was at 0 kg/tree (17.00). Among the mustard oil cake treatments, the highest was found (60.33) at 2.50 kg/tree and the lowest was in (8.00) at 0 kg/tree. Among the cowdung treatments, the maximum (69.00) was at 36 kg/tree and the minimum (10.33) was in the dose 0kg/tree (Table 1).

Number of fresh fruits per plant: In Paragon compost treatments, the dose 11.25kg/tree out of 82 harvested fruit per plant while 80 were fresh fruits per plant which was maximum among all the treatments. Among the mustard oil cake treatments, only 2 fresh fruits per plant was found at the dose 0kg/tree while highest (58.33) was at 2.50kg/tree. Among the cowdung treatments, the highest (69.00) was at 36kg/tree and the lowest (8.33) at the dose 0kg/tree (Table 1).

Number of diseased fruit per plant: It was found that, at the dose 13.5kg/tree (Paragon compost), 13.5kg/tree and 36kg/tree (Cowdung) there was no disease fruit per plant at all where as disease fruit per plant reached the maximum (3.00) under the doses 0kg/tree and 9.0kg/tree (Paragon compost), mustard oil cake at 3.6kg/tree. In general, beside effect of organic manuring, there are some other environmental factors that increase the disease fruit per plant (Table 1).

Table 2. Effect of organic manuring on different fruit characteristics of guava (cv. BAU Guava-5)

	Treatment	Dose (kg/tree)	Fruit size (cm)		Pulp weight (g)		Seed		Individual fruit weight (g)	Fruit weight per plant (kg)	yield (t/ha)
			Length	Breadth	Mesocarp	Endocarp	Number of seed	Weight of seed (g)			
Paragon compost	T1	0	7.00	8.17	270.29	38.21	382.15	5.010	302.11	5.62	4.01
	T2	4.5	9.01	15.00	299.91	44.33	567.02	6.590	320.12	12.11	9.55
	T3	6.75	9.00	14.01	302.00	52.33	532.67	6.00	360.41	13.42	11.89
	T4	9.0	9.01	15.02	301.20	54.29	549.30	6.42	362.32	15.26	12.36
	T5	11.25	10.03	16.00	329.59	52.63	556.02	6.47	387.39	27.53	19.79
	T6	13.5	8.89	12.53	299.20	35.29	371.02	4.34	308.11	25.46	18.70
	T7	18.05	8.80	12.05	292.23	27.62	369.92	4.52	287.42	21.23	16.36
Mustard oil cake	T8	0	6.37	7.26	206.23	24.43	390.22	5.43	156.23	2.34	2.56
	T9	1	5.39	7.10	196.40	33.57	368.31	3.99	167.46	3.98	4.56
	T10	1.5	7.35	9.23	282.32	31.27	351.32	4.01	280.11	5.36	6.78
	T11	2.0	7.97	9.47	285.07	33.99	370.31	4.02	290.52	10.39	9.89
	T12	2.5	8.60	10.63	297.20	36.05	375.02	4.92	335.93	18.95	16.63
	T13	3.0	6.95	8.00	251.32	43.33	443.30	6.01	149.34	15.72	12.46
	T14	3.6	8.00	9.98	292.53	35.09	373.21	4.93	321.42	13.65	11.36
Cowdung	T15	0	5.59	7.23	187.92	23.10	217.21	1.99	140.33	4.26	3.56
	T16	9.0	8.09	10.17	280.70	20.05	212.92	1.96	234.11	6.12	4.86
	T17	13.5	8.08	11.03	282.01	25.23	290.23	3.01	259.34	8.34	7.39
	T18	18.0	8.00	10.23	283.20	24.62	250.19	2.43	258.33	11.56	10.85
	T19	22.5	8.15	10.10	295.23	33.59	370.13	4.23	330.49	20.19	16.28
	T20	27.0	7.11	8.72	280.62	24.02	242.30	2.33	302.11	18.39	15.58
	T21	36.0	8.50	10.00	301.21	36.20	377.11	4.92	338.91	23.35	16.67
Level of significance			**	**	**	**	**	**	**	**	**

** Significant at 1% level of probability, DAM = Days after manuring, T_1 = 0 kg/tree, T_2 = 4.5 kg/tree, T_3 = 6.75 kg/tree, T_4 = 9.0 kg/tree, T_5 = 11.25 kg/tree, T_6 = 13.5 kg/tree, T_7 = 18.05 kg/tree, T_8 = 0 kg/tree, T_9 = 1 kg/tree, T_{10} = 1.5 kg/tree, T_{11} = 2.0 kg/tree, T_{12} = 2.5 kg/tree, T_{13} = 3.0 kg/tree, T_{14} = 3.5 kg/tree, T_{15} = 0 kg/tree, T_{16} = 9 kg/tree, T_{17} = 13.5 kg/tree, T_{18} = 18.0 kg/tree, T_{19} = 22.5 kg/tree, T_{20} = 27 kg/tree, T_{21} = 32 kg/tree

Individual fruit weight (g): The weight of individual fruit increased with the increase of organic manure of cowdung. But incase of paragon compost and mustard oil cake, fruit weight decrease after certain levels. Individual fruit weight was the maximum (387.39g) in paragon at the dose 11.25kg/tree. In mustard oil cake, maximum weight was 335.93g. (2.5kg/tree), and in cowdung the highest weight was 338.91g (36kg/tree). In case of paragon at 13.5kg/tree and 18.05kg/tree showed decreased trend in fruit weight. Same as paragon compost, mustard oil cake at 3.0kg/tree and 3.6kg/tree showed decrease trend. Weight of individual fruit was maximum for fruit thinning practices. In was possible that due to fruit thinning optimum number of fruits retained in the plants for the cause inter fruit competition was less for nutrient moisture, light and space. Moreover, optimum quantity of photosynthates might have deposited in the fruit which possibly increased weight of individual fruit (Table. 2). Faqir *et al.* (2000) observed that combined application of FYM and NPK proved best to increase the fruit size, weight and total yield. Alone application of manures was found better than alone application of NPK.

Fruit size: The largest fruit (in case of length and breath respectively 10.3 and 16.00cm) was obtained at the dose of 11.25 kg/tree of paragon compost. It was observed during the experimental period, there was no sequential increase in fruit size along with the treatment of different organic manure (Table 2). Ram and Rajput (2000), reported that the highest number of fruits per plant, reducing sugars and yield per plant was observed upon treatment with neem cake and treatment with FYM recorded the highest acidity, while treatment with *Sesbania aculeata* recorded the highest ascorbic acid content

Pulp weight: Normally weight for mesocarp increased with the increase of dozes of organic manure, but there was no sequential positive co-relation between endocarp weight and dozes of organic manure. Among the paragon

compost treatments, heavier mesocarp was obtained the highest (329.59 g) at 11.25kg/tree. But endocarp not found in this treatment. In endocarp, it was found (54.29g) at 9.0kg/tree. In mustard oil cake treatments, heavier mesocarp and endocarp were found at the dose 2.5kg/tree and the weight were 297.20 g and 56.05g respectively. Finally in cowdung treatments, the dose of 36kg/tree which gave the highest mesocarp and endocarp weight 301.21 g and 36.20 g respectively (Table 2). Bashir *et al.* (2009) reported that maximum pulp weight and fruit size were obtained from guava plants applied with 40 kg FYM and 1 kg each of N, P_2O_5 and K_2O per plant. Comparison among the three organic manure used in the experiment showed paragon gave the highest mesocarp, mustard oil cake gave the highest endocarp and the ratio of mesocarp and endocarp was the highest in cowdung.

Seed (Number and weight): In the experiment two seed character were taken in consideration and they were number of seeds and weight of seeds (g). Like all other parameter different doses of organic manure had significant effect on the number of seed per fruit and weight of individual seed. Among the paragon treatments, the dose 11.25kg/tree was found the highest number of seed per fruit (556.02) and the maximum weight was 6.47 g. In mustard oil cake treatments, the dose 3.0kg/tree gave the highest seed per fruit (443.30) and the maximum seed weight was 6.01 g. Among the cowdung treatments, the dose 36kg/tree gave the highest number of seed (377.11) and the maximum seed weight was 4.92 g. Comparison among the three organic manure used in the experiment paragon compost, the dose of 11.25-kg/tree was the peak one to give highest number of seeds per fruit and weight of individual seed (Table 2).

Fruit weight per plant (kg): There was a significant effect of application in different organic manures on fruit weight per plant. Fruit weight per plant was the maximum (27.53 kg) in paragon compost treatment at the dose of 11.25 kg/tree among all the treatments. In mustard oil cake treatments, the highest fruit weight per plant was found 18.95 kg at the dose of 2.5 kg/tree where as in cowdung, maximum was found 23.35 kg at the dose 36 kg/tree. From the experiment it was revealed that among the three organic manure (Paragon compost, mustard oil cake, cowdung), paragon compost gave the highest fruit weight per plant (Table 2).

Yield (t ha^{-1}): The most desirable important parameter of a tree is yield. Application of different doses of three organic manure (Paragon compost, mustard oil cake, cowdung) was found statistically significant on the yield (t ha^{-1}) of guava tree. Maity *et al.* (2006) reported that application of nutrients irrespective of their sources and doses markedly enhanced yield and quality of guava fruits over untreated control. From the figure 3, it was observed that there was a positive correlation between doses and yield in cowdung. But in case of paragon and mustard oil cake the correlation turn negative after the dose 11.25kg/tree and 2.5kg/tree respectively. Highest yield (19.79 t ha^{-1}) was obtained for paragon compost treatment, the dose of 11.25 kg/tree. Among the mustard oil cake treatments, it was 13.63 t/ ha^{-1} and among the cowdung treatments it was 16.79 t /ha. So from the comparison, it was revealed that paragon compost treatment at 11.25kg/tree gave the best yield.

In case of paragon compost growth, no. of flowers, no. of fruits and fruit characters like size, pulp weight was increased by increasing the doses of organic manures at the rate of 0, 4.5, 6.75, 9.0, 11.25 kg $plant^{-1}$ respectively. Then decreased from the doses of 13.5, 18.05 kg $plant^{-1}$ where the maximum yield was observed at the dose of 11.25kg/tree (19.79 t ha^{-1}) and the minimum (3.81 t/ha) at 0kg/tree. In case of mustard oil cake, all the selected parameters were increased by the increasing the dose of manure considered doses at 0, 1, 1.5, 2.0, 2.50 kg per plant then decreased at 3.0kg/tree and 3.6kg/tree, the maximum yield was observed at 2.5kg/tree (13.63 t ha^{-1}) and the minimum (0.719 t/ ha)at 0kg/tree. In case of cowdung, growth, yield and fruit characters were increased with the increasing of the dose of cowdung from the doses of 0, 9, 13.5, 18.0, 22.5, 27.00, 36 kg per plant respectively. Maximum yield was observed at 3.6kg/tree (16.79 t ha^{-1}) and the minimum (1.58 t/ ha) yield at 0kg/tree. Among the observation the best result was found considering all character by the application of paragon compost and the lowest was in mustard oil cake. The results obtained from this investigation exhibited a great influence of organic manures on flowering and fruiting of guava an indication to apply paragon compost at the dose of 11.25 kg/plant to get higher yield (19.79 t/ha) of guava in Bangladesh. However, further studies may be carried out to investigate the bearing habit in different seasons.

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