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Effect of Organic Manures on Growth, Yield and Quality of Mango Ginger (*Curcuma amada* Roxb.) in the Gangetic Alluvial Plains of West Bengal

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A B S T R A C T

The experiment was carried out at Horticultural Research Farm, Barajaguli, BCKV, Mohanpur, Nadia, West Bengal during the years 2016-17 and 2017-18. The rhizomes were planted during middle of May in 3.0 X 2.0 m plot at 30 X 25 cm spacing with three replications. Four organic manures (Farm yard manure, Poultry manure, Mustard cake and Vermicompost) with single (25t/ha, 1t/ha, 0.75 t/ha and 2.5 t/ha) and double (50 t/ha. 2t/ha, 1.5 t/ha and 5 t/ha) doses along with control which results in 9 treatment combinations were applied. The maximum plant height (94.55 cm), number of tillers/plant (5.73) and number of leaves/plant (12.16) were observed by application of Poultry manure @ 2 t/ha (T_4). Highest yield/ha (32.88 t/ha) was also noticed in Poultry manure @ 2 t/ha (T_4) followed by Mustard cake @ 0.75 t/ha (T_5). The highest curcumin percentage (1.34 %) and oleoresin percentage (6.52 %) were noticed in Vermicompost @ 5 t/ha (T_8) over control (0.48 % and 4.66 %) T_9.

Introduction

The genus *Curcuma*, belonging to the family Zingiberaceae, comprises over 80 species of rhizomatous herbs that are adapted to environments from sea level to elevations as high as 2000 min the Western Ghats and Himalayas The genusis originated in the Indo-Malayan region and widely distributed in the tropics of Asia to Africa and Australia (Sasikumar,2005). Mangoginger (*Curcuma amada* Roxb.) is an important member of this genus, is a unique spice, which morphologically resembles the ginger (*Zingiber officinale*) but, it imparts mango (*Mangifera indica*) flavour. Mango flavor is mainly attributed to car-3-eneand*cis*-ocimene (Achut *et al.*, 1984 and Rao *et al.*, 1989). Mango ginger is used the rapeutically as a carminative and stomachic and topically for contusions and sprains (Kirtikar and Basu, 1984; Nadkarni, 1954; Rao *et al.*, 1989).

Organic manures provide all the nutrients that are required by the plant, maintains the C: N ratio in the soil, thereby improves the yield. Very meagre literature is available on effect of organic manures in mango ginger. Therefore, the present investigation was undertaken to study the efficacy of different organic manures in Mango ginger.

Materials and Methods

The present experiment was undertaken during the middle of May for two consecutive years i.e., 2016-17 and 2017-18 at Horticultural Research Farm, Barajaguli, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal (23.5^{o}N and 89^{o}E longitude, with an altitude of 9.75 m above the mean sea level).

The soil of the experiment field was Entisol with sandy clay loam texture (54.25 % sand, 30.20 % silt and 14.30 % clay), slightly acidic to neutral in reaction (pH 6.7) with good water holding capacity, well drained with moderate soil fertility status. The experiment was conducted in Randomized block design with nine treatments replicated thrice. There were nine treatments including control viz., T_1- Farm yard manure @ 25t/ha, T_2- Farm yard manure @ 50t/ha, T_3- Poultry manure @ 1t/ha, T_4- Poultry manure @ 2t/ha, T_5- Mustard cake @ 0.75t/ha, T_6- Mustard cake @ 1.5t/ha, T_7-Vermicompost@ 2.5t/ha, T_8- Vermicompost@ 5t/ha and T_9- Control.

Rhizomes of Mango ginger var. Nadia (Krishnagar) local were sown with a spacing of 30 X 25 cm in a plot size of 6m^2. The data recorded on various parameters were subjected to statistical analysis as per the procedure suggested by Gomez and Gomez, 1984.

Results and Discussion

The growth, yield and quality parameters of Mango ginger (*Curcuma amada* Roxb) recorded were shown significant differences among the treatments. The effect of organic manures on various growth, yield and quality parameters of Mango ginger are briefly discussed.

Vegetative parameters

A perusal of Table 1 indicated significant variations in plant height due to application of organic manures observed at maturity stage. Maximum plant height (94.55 cm) was recorded by application of Poultry manure @ 2t/ha (T_4) followed by T_3 (87.26 cm) and the lowest recorded in Control (61.38 cm) i.e. T_9.Data presented in Table 1 clearly indicated that there was significant variation with respect to number of tillers per plant during both the years. Maximum number of tillers per plant (5.73) were noticed in the plot applied with Poultry manure @ 2 t/ha (T_4) followed by Poultry manure @ 1t/ha (4.86) T_3.

Minimum number of tillers per plant was noticed from control (1.93) plots. Data presented in Table 1 showed significant variation with respect to number of leaves per plant, leaf length, leaf breadth and leaf area observed at maturity stage. Maximum number of leaves per plant, leaf length, leaf breadth and leaf area was recorded in T_4 (12.16, 64.07 cm, 16.10 cm and 686.99 cm^2 respectively) followed by T_3 (11.43, 60.65 cm, 15.93 cm and 643.45 cm^2 respectively).

Minimum number of leaves per plant, leaf length, leaf breadth and leaf area were noticed in control i.e. T_9 (8.19, 35.18 cm, 11.43 cm and 267.80 cm^2) plots. Adesodun *et al.*, (2005) had found that application of poultry manure to soil increased soil organic matter, N and P and aggregate stability.

Yield and yield attributing parameters

The data on yield and yield attributing parameters viz. length of clumps (cm), number

of mother rhizome, number of primary finger, number of secondary finger, yield per plant (g) and yield per hectare (t/ha) presented in Table 2. These yield and yield attributing parameters showed significant variations due to application of organic manures. The application of Poultry manure @ 2 t/ha (T_4) effectively increase length of clumps (23.10 cm), number of mother rhizome (2.03), number of primary finger (6.18), number of secondary finger (16.11), yield per plant (411.02 g) and yield per hectare (32.88 t/ha), which was followed by Poultry manure @ 1 t/ha (T_3) treatment (22.63 cm, 1.82, 5.74, 15.87, 397.88 g and 31.83 t/ha respectively).The poultry manure could have supplied micronutrients which is essential for ginger growth and yield. Stirling (1989) and stirling and Nikulin (1998) also recorded the highest yield of ginger with poultry manure.

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Table.1 Effect of organic manures on vegetative parameters of Mango ginger (*Curcuma amada* Roxb.)

Treatments	Plant height (cm)	No. of tillers per plant	No. of leaves per plant	Leaf length (cm)	Leaf breadth (cm)	Leaf area (cm^2)
T_1	78.94	3.91	9.74	46.74	14.81	461.01
T_2	81.73	4.12	9.98	49.03	14.50	473.48
T_3	87.26	4.86	11.43	60.65	15.93	643.45
T_4	94.55	5.73	12.16	64.07	16.10	686.99
T_5	72.74	3.73	9.22	41.54	12.87	356.05
T_6	76.89	3.82	9.67	43.88	14.16	413.81
T_7	82.11	4.55	10.15	51.82	15.09	520.78
T_8	85.03	4.74	10.88	56.23	15.65	586.07
T_9	61.38	1.93	8.19	35.18	11.43	267.80
SEm (±)	0.8660	0.0076	0.0627	0.4194	0.2546	1.3472
CD(5%)	2.5963**	0.0229**	0.1880**	1.2575**	0.7633**	4.0388**

*T_1-FYM @ 25t/ha, T_2- FYM @ 50t/ha, T_3-Poultry manure @ 1t/ha, T_4- Poultry manure @ 2t/ha, T_5-Mustard cake @ 0.75 t/ha, T_6- Mustard cake @ 1.5 t/ha, T_7-Vermicompost @ 2.5 t/ha, T_8- Vermicompost @ 5 t/ha, T_9-Control

Table.2 Effect of organic manures on yield and yield attributing parameters of Mango ginger (*Curcuma amada*Roxb.)

Treatments	Length of clumps (cm)	No. of mother rhizome	No. of primary finger	No. of secondary finger	Yield/ plant (gm)	Yield/ hectare (t/ha)
T_1	20.95	1.58	3.46	14.66	339.21	27.13
T_2	21.27	1.65	3.82	15.18	353.16	28.25
T_3	22.63	1.82	5.74	15.87	397.88	31.83
T_4	23.10	2.03	6.18	16.11	411.02	32.88
T_5	19.55	1.30	2.98	13.81	307.08	24.56
T_6	20.19	1.52	3.10	14.29	326.17	26.09
T_7	21.48	1.71	4.13	15.45	373.69	29.89
T_8	21.72	1.78	4.61	15.74	384.52	30.76
T_9	16.86	0.46	2.36	4.91	144.23	11.53
SEm (+)	0.8389	0.0192	0.0168	0.4082	0.8553	0.5000
CD(5%)	2.5149**	0.0577**	0.0505**	1.2239**	2.5641**	1.4990**

*T_1-FYM @ 25t/ha, T_2- FYM @ 50t/ha, T_3-Poultry manure @ 1t/ha, T_4- Poultry manure @ 2t/ha, T_5-Mustard cake @ 0.75 t/ha, T_6- Mustard cake @ 1.5 t/ha, T_7-Vermicompost @ 2.5 t/ha, T_8- Vermicompost @ 5 t/ha, T_9-Control

Table.3 Effect of organic manures on quality parameters of Mango ginger (*Curcuma amada* Roxb.)

Treatments	Oleoresin (%)	Curcumin (%)
T1	5.94	1.10
T2	6.03	1.22
T3	6.01	1.06
T4	6.28	1.26
T5	5.69	0.61
T6	5.82	0.72
T7	6.23	1.19
T8	6.52	1.34
T9	4.66	0.48
SEm (+)	0.0116	0.0077
CD(5%)	0.0347**	0.0231**

*T_1-FYM @ 25t/ha, T_2- FYM @ 50t/ha, T_3-Poultry manure @ 1t/ha, T_4- Poultry manure @ 2t/ha, T_5-Mustard cake @ 0.75 t/ha, T_6- Mustard cake @ 1.5 t/ha, T_7-Vermicompost @ 2.5 t/ha, T_8- Vermicompost @ 5 t/ha, T_9-Control

Quality parameters

The observations recorded on quality parameters such as oleoresin (%) and curcumin (%) indicated that application of organic manures significantly improved the quality aspects of Mango ginger, with respect to increased oleoresin (%) and curcumin (%) as compared to control (Table 3). Application of vermicompost @ 5t/ha (T_8) recorded highest oleoresin (6.52 %) and curcumin (1.34 %) content. The minimum oleoresin (4.66 %)

and curcumin (0.48 %) content were recorded in Control (T_9).

It is concluded from this work that apart from improving macronutrient availability, poultry manure reduced soil bulk density and enhanced its moisture content. These improvements led to significant increases in growth and yield attributes of mango ginger.

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