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Effect of bioregulants on growth and yield of turmeric (*Curcuma longa* L.) cv.BSR 2

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Abstract

The effects of bioregulants *viz.*, Panchakavya, Vermiwash, Humic acid and Effective microorganisms, on the growth and yield parameters of turmeric (*Curcuma longa* L.) were studied and compared with the recommended dose of fertilizer. The growth and yield of turmeric was highest in response to the foliar application of 0.05% humic acid and it significantly increased the plant height, leaf area and the yield when compared to the control.

Keywords: Turmeric, *Curcuma longa,* bioregulants, growth, yield

INTRODUCTION

Turmeric (*Curcuma longa* L.) is an important spice as well as a medicinal plant belonging to the family Zingiberaceae. It has a wide range of medicinal values such as stomachic, blood purifier and antiseptic. Furthermore, it is useful in treating dropsy, purulent ophthalmia, wounds and inflammation (Khanna, 1999). Turmeric being an exhaustive crop requires heavy manuring (Subramanian *et al.,* 2001). But the use of chemical fertilizer escalates the production cost and causes health and environmental hazards also. To overcome these problems, of late, organic farming has been used as an important and eco-friendly method of cultivation, with promising effect on growth and yield of various crops (Sugito and Mattuchah, 1995; Khandkar and Nigam, 1996; Gill *et al.,* 1999; Maheswarappa, 2001). The present paper deals with the results of the experiments on the effects of bioregulants on the growth and yield of turmeric that were carried out at the Department of Spices and Plantation Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, India.

MATERIALS AND METHODS

A field experiment was conducted with turmeric var. BSR 2 during 2005-2006. The experimented field soil was sandy loam with the following characteristics: EC 0.42 d s m^{-1}, pH 7.0, available nitrogen 101 kg/ha, available phosphorus 5.6 kg/ha and available potassium 380 kg/ha. The experimental design consisted of thirteen treatments *viz.*, foliar spray with Panchakavya 2% (T_1), Panchakavya 3% (T_2), Panchakavya 4% (T_3), Vermiwash 10 % (T_4), Vermiwash 20% (T_5), Humic acid 0.05 % (T_6), Humic acid 0.1% (T_7) Humic acid 0.15% (T_8), extended Effective microorganism 1% (T_9), extended Effective microorganism 2% (T_{10}), extended Effective microorganism 3% (T_{11}), 100 % recommended dose of NPK fertilizers (T_{12}) and control (T_{13}). The treatments were replicated thrice in a randomized block design. The treatments were imposed from 30 days after planting. Observations on plant height (cm), number of leaves per plant, length of leaf (cm), Leaf area index (LAI), total dry matter production (TDMP), weight of mother rhizomes per plant, rhizome yield, curing percentage and cured rhizome yield were recorded from five randomly selected plants under each treatment, 225 days after planting.

RESULTS

The treatment T_6 (humic acid 0.05% foliar sprays) produced taller plants (92.80 cm of mean height) than the other treatments (Table 1). It was followed by T_2 (panchakavya 3% foliar spray), in which the plants recorded a mean height of 89.19 cm at 225 days after planting. The lowest mean plant height (68.23 cm) was recorded in the control (T_{13}) at 225 days after planting (Table 1).

The foliar application of 0.05% humic acid (T_6) produced lengthier (mean value was 58.86cm) leaves as well when compared to control (mean value was 46.54 cm) (Table 1). The plants, which received 0.05% per cent humic acid (T_6), had also recorded the highest leaf number per plant (22.2) at 225 days after planting, whereas for the control, the leaf number per plant at 225 days of crop growth was only 15.08 (Table 1). Treatment T6 resulted in the highest leaf area Index (LAI) value as well (Table 1).

Further, the treatment T_6 (Humic acid 0.05% foliar sprays) recorded the highest dry matter production with a mean value of 251.73 g $plant^{-1}$ at harvest. It was closely followed by T_2 (panchakavya 3% foliar spray) with the mean value of 246.45 g $plant^{-1}$ at harvest. The lowest dry

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Table 1. Effects of bioregulants on growth and yield of turmeric *Curcuma longa* L. as measured at 225 Days After Planting (DAP). Values are mean of 5 random samples

Treatments*	Plant height (cm) n =5	Leaf length (cm) n = 5	Number of leaves/ plant n = 5	Leaf area index (LAI) n = 5	Total dry matter production (g plant^{-1}) (n = 5)	Curing percentage (n = 5)	Cured rhizome yield per hectare (tonnes)	Weight of mother rhizome plants^{-1} (n = 5)	Fresh rhizome yield (q/ ha)
T_1	84.38	51.47	18.58	8.91	220.10	18.85	6.20	0.179	310.0
T_2	89.19	57.04	21.25	12.65	246.45	19.11	6.70	0.190	335.0
T_3	82.88	56.09	20.90	9.91	231.62	18.72	6.04	0.170	302.0
T_4	87.53	47.85	19.77	11.13	240.81	19.02	6.40	0.182	320.0
T_5	79.25	55.25	17.15	7.92	221.04	18.96	6.12	0.180	306.0
T_6	92.80	58.86	22.20	14.88	251.73	21.02	7.04	0.196	352.0
T_7	81.84	50.37	18.30	7.43	235.22	18.15	6.28	0.172	314.0
T_8	85.84	53.76	16.85	10.45	224.15	18.40	6.06	0.168	303.0
T_9	81.03	51.01	19.60	10.35	236.12	17.30	6.30	0.185	315.0
T_{10}	85.28	56.40	20.80	9.25	221.29	18.47	6.24	0.174	312.0
T_{11}	80.40	52.46	18.80	9.05	229.87	16.42	6.16	0.163	308.0
T_{12}	70.43	48.75	16.20	5.39	218.71	17.96	5.56	0.153	278.0
T_{13}	68.23	46.54	15.08	4.38	187.68	16.21	3.04	0.131	152.0
Overall Mean	82.24	52.76	18.88	9.36	228.06	18.39	6.02	0.17	300.87
SE	0.772	0.431	0.240	0.314	1.804	0.131	0.100	0.003	5.003
CD (at 5%)	1.5935	51.47	0.4959	0.6479	3.7233	0.2713	0.2063	0.0053	10.32

* See Materials and Methods section for details about various treatment types. The treatments were imposed 30 days after planting

matter production was recorded in the treatment T_{13} (control) with the mean value of 187.68 g plant^{-1} at harvest (Table 1).

The foliar application of 0.05% humic acid (T_6) showed maximum weight of mother rhizomes (mean value of 0.196 kg plant^{-1}), as well, while in the absence of foliar application of bioregulants, the maximum weight of mother rhizome the mean value recorded was only 0.131 kg plant^{-1} (Table 1).

Among the treatments, the highest fresh rhizome yield, the greatest curing percentage and cured rhizome yield mean values of (with 352.0 q ha^{-}, 21.02%, 7.04 t ha^{-1}, respectively) were obtained with the foliar application of 0.05% humic acid (T_6). The lowest curing percentage and cured rhizome yield (16.21%, 3.04 t ha^{-1}) were recorded when there was no foliar application of bioregulants (T_{13}) (Table 1).

DISCUSSION

The treatment T_6 Humic acid 0.05% foliar spray) produced significantly taller plants (Table 1). Generally FYM with narrow CN ratio may produce more humic acid and the humic subtance contained in it form chelates of divalent cations that are potential to precipitate phosphate ions. The chelated ions make phosphates freely available to crops. This might have led to increased plant height in turmeric. This result was in accordance with that of Prasad (1988) in Paddy and Hussain *et al.* (2001) in ginger. Furthermore, Carbonic acid in soil dissolves the reserve mineral substances and made it more readily available to the plants. This could also be the reason for increase in the plant height in turmeric observed under the treatment T_6. This is in agreement with the previous work of Khandkar and Nigam (1996) in ginger.

The treatment T_6 produced lengthiest leaves among the treatments. This could be due to the higher uptake of nutrients especially iron and magnesium from the soil resulting in greater photosynthetic activity. Similar result was reported by Khandkar and Nigam (1996) also in ginger.

The highest number of leaves per plant in treatment T_6 may be ascribed to the fact that humic acid has the optimum CN ratio, which on decomposition releases nitrogen in the form of usable nutrient ions such as ammonium and nitrate. This favours the increase in the number of leaves, as reported by Maheswarappa *et al.* (2001) in *Galanga*.

Leaf area index (LAI) was also significantly altered due to different bioregulant sprays. The mean values of Leaf area index (LAI) were determined at 225 days after planting. Application of humic acid 0.05 foliar sprays (T_6) resulted in the highest LAI among the treatments with the mean value was 14.88 cm at harvest. It was closely followed by T_2 (panchakavya 3% foliar spray) with the mean value of 12.65 cm. The lowest LAI was recorded in the treatment T_{13} (control) with the value of 4.38 cm at harvest. Bhome *et al.* (2001) reported 105% increase in LAI due to various treatments. Enhanced nutrient and water uptake by plants treated with humic acid might have contributed to the increased leaf area index observed for humic acid treatment (T_6) in the present study as reported earlier by Liu *et al.* (1998).

The apparent increase in dry matter production in response to foliar application of humic acid (0.05%) may be due to orthodihydric phenols of humic acid that inhibit the IAA oxidase (Mato *et al.*, 1972). This will lead to prolonged persistence of IAA in the plant which consequently could have promoted the dry matter production.

This maximum weight of mother rhizomes recorded in response to humic acid (T_6) treatment at 0.05% might be due to mobilization of the reserve food materials through increased activity of hydrolyzing and oxidizing enzymes which helps in the increased availability and efficient utilization of nutrients. This is confirmation with the findings of Mato and Mendez (1970).

The increased rhizome yield due to the humic acid 0.05% application, might be ascribed to increased the movement and availability of phosphorus and micronutrients to the plants as a result of this treatment. This could have led to increase in the uptake of phosphorus in plants and consequent increase in the yield of rhizomes. This result of the present study is in corroboration with earlier findings of Sugito and Mattuchah, (1995) and Gill *et al.* (1999) in turmeric.

Foliar spraying of 0.05 % humic acid might have increased the mineralization of organic matter. This might have resulted in higher uptake of nutrients by plants, which in turn might have increased the curing percentage and cured rhizome yield. Further more, humic acid might have stimulatory effect on nitrogen uptake of plants, which would also have resulted in increased dry weight of rhizomes. Similar results were reported by Reddy and Rao, (1978) and Rao and Rao, (1988) also.

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