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Effect of rhizome treatment on growth and yield of turmeric

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ABSTRACT

The experiment was conducted at teaching farm, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, W.B. during 2009 and 2010, to assess the efficacy of different chemicals on growth and yield of turmeric (*Curcuma longa* L.) *cv. Suguna. Five chemicals namely GA_3 (50, 100 and 200 ppm), Ethrel (25, 50 and 100 ppm), KH_2PO_4 (0.25, 0.50 and 1.0%), KNO_3 (0.25, 0.50 and 1.0%) and Thiourea (0.25, 0.50 and 1.0%) were included in this investigation. The experiment was laid out in RBD with three replications. Rhizomes (30-35 g) were soaked in different chemicals for two hours and water soaked rhizomes for same duration was treated as control. The plot size was 3 x 1 m and treated rhizomes were planted at 25 x 25 cm spacing. The FYM @ 20 tonnes per ha along with NPK @ 150:60:150 kg/ha^{-1} was applied uniformly to all the treatments. Crop was mulched immediately after planting with paddy straw @ 10 t ha^{-1}. Maximum plant height (184.16 cm), leaf number (22.78) and tiller number (3.28) were noticed in plants raised from thiourea 0.5%, KNO_3 0.25% and thiourea 0.25% at 180 days after planting. Rhizomes treated with KH_2PO_4 0.5% produced significantly higher maximum clump weight (346.28 g), yield per plot (14.97 kg/ 3 sq. m) and projected yield (34.37 t ha^{-1}) as compared to control 258.34g, 10.62 kg/3m^2 and 26.55 t ha^{-1} respectively. The other promising treatments with respect to yield were GA_3 200 ppm (14.35 kg/ 3 sq. m) and KNO_3 0.25% (13.75 kg/ 3 sq. m).*

Key words: GA_3, KH_2PO_4, KNO_3, rhizome, turmeric and thiourea.

Turmeric (*Curcuma longa* L.) is one of the ancient and sacred spices of India. It is widely used in food, beverage, confectionary, medicine, several ceremonies and religious functions. India enjoys monopoly in the production of turmeric. The demand for turmeric is increasing due to its wide utility as a spice, dye in textile industry and cosmetics (Shah, 1997). It is also being used in the drug industry particularly for the preparation of anti-cancer medicine. India being the world's largest producer of turmeric, gains importance for oleoresin and curcumin having medicinal value and ample export opportunity has been created in World Trade Centre (Tamil Selvan *et al.,* 1999). Though a lot of trials on varietal, fertilizer, spacing, date of planting, size of planting material, mulching material and irrigation schedule etc. have been conducted to increase the production but very little work has so far been undertaken to increase the production through rhizome treatment with growth regulating chemicals. Keeping this in view the present investigation was undertaken to study the effect of some chemicals on growth and yield of turmeric *cv.* Suguna.

MATERIALS AND METHODS

The present experiment was carried out at teaching farm, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, West. Bengal in two consecutive seasons during 2009-10 and 2010-11 on turmeric *cv.* Suguna, in randomized block design with three replications. Five chemicals namely GA_3 (50,100 and 200 ppm), Ethrel (25, 50 and 100 ppm), KH_2PO_4 (0.25,0.5 and 1.0%), KNO_3 (0.25,0.5 and 1.0%), and thiourea (0.25, 0.5 and 1.0%) were included in this investigation. The experiment was laid out in randomized block design with three replications. Uniform healthy rhizome bits of 30-35 g with at least two buds were soaked in different chemicals for two hours and then dried under shade. Water soaked rhizomes for same duration was treated as control. In the next day the treated rhizomes were soaked in Indofil M-45 (0.3%) solution for 30 minutes and dried under shade.

The FYM @ 20 tonnes per hectare was applied during land preparation. A fertilizer dose of NPK @ 150:60:150 kg ha^{-1} (Medda, 2000) was applied uniformly to all the treatments. Full amount of phosphorus was applied at the time of planting. Half of both nitrogen and potassium was applied at 45 days after planting (DAP), followed by remaining nitrogen and potassium at 90 DAP. Urea, single super phosphate and muriate of potash was used as inorganic sources of N, P and K respectively. Rhizomes were planted to a depth of 3-4 cm at 25 × 25 cm spacing in the first fortnight at May during both the years. Crop was mulched immediately after planting with paddy straw @ l0t ha^{-1}. Weeding for 3-4 times was done. Earthing up and mulching @ 5t ha^{-1} were done after

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each split application of fertilizer. The crop was harvested 8 months (approx.) after planting *i.e*., during middle of January.

The data on vegetative parameters were recorded at 180 days after planting (DAP). Rhizome yield was measured on net plot (2·0 × 1·0m) basis at harvest. The projected yield per ha was calculated on the basis of yield per plot after reduction of 25% area (Anon, 1995). The data were analysed following standard statistical procedure (Panse and Sukhatme, 1985.)

RESULTS AND DISCUSSION

The data presented in table 1 and 2, clearly revealed that both growth and yield parameters were significantly influenced by different chemicals. At 180 DAP, the maximum plant height was associated with thiourea 0.50% (184.16 cm) followed by GA_3 200 ppm (178.32 cm) and thiourea 0.25% and minimum height was observed with ethrel 100 ppm (136.35 cm). Increased plant height due to GA_3 treatment might be because of its effect on stem elongation. Similar findings were also reported by Singh *et al.* (1993) and Nath and Medhi (2003). The promoting effect of thiourea might have been due to its cytokinin activity (Enez, 1978).

Thiourea 0.25% treated rhizomes recorded maximum number of tillers per clump at 180 DAP (3.28) followed by KNO_3 0.50% (3.22), GA_3 200 ppm (3.18) and least number was observed with ethrel 100 ppm (1.92). Beneficial effect of KNO_3 on sprouting and subsequent growth of turmeric was reported by Balashanmugam *et al.,* (1993). This might be due to its effect in breaking dormancy and enhancing sprout growth. Potassium nitrate is also very effective in increasing the germination of seeds and is commonly included in the medium for tests of seed germ inability (Isely, 1965). Hashimoto (1948) has suggested that this salt may serve to enhance the effectiveness of gibberellin in the germinating seed. At 180 DAP, the maximum leaf number was noticed with KNO_3 0.25% (22.78) followed by GA_3 200 ppm (22.16) and KNO_3 0.5% (21.94) and lowest leaf number (17.52) was observed in thiourea 1.00%.

Maximum clump weight of 346.28g was observed in KH_2PO_4 0.5% treatment followed by GA_3 200 ppm (332.84 g), KNO_3 0.25% (327.16 g) and thiourea 0.50% (318.12 g) as compared to lowest clump weight (236.12 g) with ethrel 100 ppm. (Table 2). The clump weight under control plants was 258.34 g. The maximum length (18.26 cm) and breadth of clump was (12.94 cm) were associated with GA_3 200 ppm and K_2HPO_4 0.5% (12.94%) respectively as compared to lowest dimension of clump (15.82 cm × 10.54 cm) under control plants.

Both maximum number (7.94) and weight (172.42g) of primary finger were observed in GA_3 200ppm treatment (Table 1). The KH_2PO_4 0.5%, KNO_3 0.25% and thiourea 0.50% also give good response in this aspect. The maximum length (7.56 cm) and breadth (2.18 cm) of primary finger was observed with KNO_3 0.25% and GA_3 200 ppm. Like primary finger the significant variation were observed with respect to both number and weight of secondary finger among different treatments (Table 2). The maximum number (13.32) and weight of secondary finger (138.94 g) were found in GA_3 100 ppm that was on par with K_2HPO_4 0.50%. Data presented in Table 2, clearly indicated that the different treatments had significant influence on fresh yield per plot (kg/3.0m^2). The plants raised from K_2HPO_4 0.5% (13.75 kg), GA_3 100 ppm (13.74 kg) and thiourea 0.50% (13.62 kg) had more yield as compared to. The projected yield per hectare also followed the similar pattern. The maximum projected yield (37.42 t/ha) was recorded in K_2HPO_4 0.50% as compared to control plants (26.55 t/ha).Under West Bengal condition maximum projected yield of turmeric cv. Suguna was also reported by Roy and Hore (2009) under bio-organic management when turmeric grown as inter crop in arecanut plantation. The results are in good conformity with the findings of Alam *et al.,* (2006) who also reported the beneficial effect of thiourea,GA_3 and KNO_3 on growth and yield of ginger. Thiourea has an unusual effect is that it may cause the growth of several bud primodial *i.e*., as many as eight sprouts growing from an eye (Crocker, 1948). In the present experiment the similar type of effect also observed *i.e* on an average more number of tillers irrespective of the concentration, as compared to other chemicals. In bringing about germination/ sprouting thiourea may cause an increase in gibberellin like substance, but does not cause decrease in the inhibitory substances present in the propagating material (Wareing and Villers, 1961).

The increased clump weight may be due to the fact that GA_3 cause cell elongation and cell enlargement. The increase in yield of rhizome with GA_3 could be attributed to the increased in plant height and number of leaves per plant which increase the photosynthetic surface which led to more synthesis and translocation of photosynthates to the rhizome. Favourable response of GA_3 in yield was also reported by certain workers

Table 1: Effect of rhizome treatment on vegetative growth and primary finger of turmeric (Pooled data of 2 years)

Treatments	Plant height (cm)	Number of tillers clump^{-1}	Number of leaves clump^{-1}	Primary finger			
				Number	Weight (g)	Length (cm)	Breadth (cm)
GA_3 50 ppm	156.94	2.64	20.53	6.83	143.17	7.18	1.92
GA_3 100 ppm	171.53	2.83	21.82	7.62	136.03	7.36	2.07
GA_3 200 ppm	178.32	3.18	22.16	7.94	172.42	7.42	2.18
Ethrel 25ppm	141.42	2.45	19.62	6.82	132.74	7.26	1.86
Ethrel 50ppm	147.16	2.36	18.94	7.15	128.56	7.04	1.92
Ethrel 100 ppm	136.35	1.92	18.38	5.84	145.02	6.84	2.05
KH_2PO_4 0.25%	145.74	2.12	18.52	6.96	142.73	7.16	2.04
KH_2PO_4 0.50%	162.82	2.86	19.18	7.88	157.32	7.48	2.09
KH_2PO_4 1.00%	156.46	2.63	18.12	7.32	146.20	6.90	1.92
KNO_3 0.25%	148.24	2.02	22.78	7.76	168.91	7.56	2.14
KNO_3 0.50%	163.89	3.12	21.94	7.28	143.52	7.25	2.03
KNO_3 .1.00%	158.36	2.98	21.28	5.92	122.36	6.83	1.96
Thiourea 0.25%	168.84	3.28	18.48	6.83	134.51	7.14	2.04
Thiourea 0.50%	184.16	3.16	18.96	7.73	153.86	7.39	1.96
Thiourea 1.00%	176.39	2.94	17.52	6.14	123.52	6.82	1.82
Control	142.35	2.54	17.83	6.21	132.84	6.42	2.03
S Em (±)	**2.406**	**0.152**	**0.413**	**0.362**	**2.165**	**0.156**	**0.084**
LSD (0.05)	**7.420**	**0.468**	**1.273**	**1.116**	**0.481**	**0.481**	**NS**

Table 2: Effect of rhizome treatment on secondary finger, clump character and yield of turmeric (Pooled data of 2 years)

Treatments	Secondary finger				Clump			Plotyield	Projected
	Number	Weight (g)	Length (cm)	Breadth(cm)	Weight (g)	Length (cm)	Breadth (cm)	(kg $3m^{-2}$)	yield (t ha^{-1})
GA_3 50 ppm	12.65	103.48	4.62	1.57	296.50	17.96	11.83	12.93	32.32
GA_3 100 ppm	13.32	136.18	5.19	1.83	315.27	17.52	12.34	13.74	34.35
GA_3 150 ppm	12.86	124.03	4.86	1.98	332.84	18.26	12.78	14.35	35.87
Ethrel 25ppm	9.16	108.94	4.60	2.07	276.15	16.93	12.06	11.64	29.10
Ethrel 50ppm	9.30	97.38	4.36	1.78	259.40	17.24	11.92	11.05	27.62
Ethrel 100 ppm	8.64	64.25	4.28	1.56	236.12	16.51	10.76	9.86	24.65
KH_2PO_4 0.25%	10.84	104.62	4.75	1.75	274.82	17.60	11.85	11.75	29.37
KH_2PO_4 0.50%	13.72	138.94	5.36	2.05	346.28	17.92	12.94	14.97	37.42
KH_2PO_4 1.00%	12.14	116.32	4.69	1.88	296.45	16.84	12.72	12.73	31.82
KNO_3 0.25%	10.75	127.80	4.92	1.93	327.16	18.14	12.62	13.75	34.37
KNO_3 0.50%	12.82	132.43	5.03	2.12	308.24	17.92	12.67	12.94	32.35
KNO_3 .1.00%	11.96	121.05	4.73	1.78	282.04	16.74	10.95	12.07	30.17
Thiourea 0.25%	10.75	117.34	5.02	1.69	291.53	17.30	11.56	12.19	30.47
Thiourea 0.50%	13.45	132.81	5.29	2.02	318.72	17.64	12.83	13.62	34.05
Thiourea 1.00%	9.32	93.45	4.62	1.84	252.46	16.82	10.63	10.51	26.27
Control	10.28	96.80	4.98	1.74	258.34	15.82	10.54	10.62	26.55
SEm (±)	**0.196**	**1.240**	**0.422**	**0.560**	**5.294**	**0.624**	**0.234**	**0.986**	**1.620**
LSD (0.05)	**0.604**	**3.824**	**NS**	**NS**	**16.324**	**1.924**	**0.721**	**3.040**	**4.996**

(Pandita *et al.,* 1981 and Singh *et al*., 1993) in closely related tube crop like potato.

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