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Influence of planting material and plant growth regulators on plant growth and rhizome size of turmeric

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Abstract

An investigation were undertaken on influence of planting material and plant growth regulators on growth and rhizome size of turmeric at Department of Horticulture, Dr. PDKV. Akola, Maharashtra. During 2017-18 and 2018-19. There were 18 treatments laid in FRBD with 2 replications viz., M₁-Mother rhizome M₂-Primary finger and P₁- GA₃ – 100 ppm, P₂- GA₃ – 200 ppm, P₃- Ethrel – 50 ppm, P₄- Ethrel - 100 ppm, P₅- Kinetin - 50 ppm, P₆- Kinetin - 100 ppm, P₇ - Cycocel – 250 ppm, P₈- Cycocel - 500 ppm, P₉- Control – Water. The results revealed that the growth and rhizome size were significantly influenced by the planting material and plant growth regulators. Among the planting material, M₁ i.e. Mother rhizome was found significantly superior in respect of days for emergence, emergence count (%), plant height, leaf area (Cm²) and plant survival (%) and M₂ i.e. Primary finger was found significantly superior in terms of no. of tillers/plant, no. of leaves/plant, length of mother rhizome, girth of mother rhizome, length of primary finger, girth of primary finger, weight of mother rhizome, weight of primary finger. Regarding the PGR's P₅-Kinetin 50 ppm was found significantly superior for days for emergence and emergence count(%).The treatment P₂-GA₃-200 ppm was found significantly superior in plant height at 180 DAP and leaf area. The treatment P₈-CCC 500 ppm was found maximum no.of tillers and maximum no. of leaves/plant, length and girth of mother rhizome, length and girth of primary finger and weight of mother rhizome and primary finger. An interaction effect of planting material and PGR's in respect of growth parameters i.e. days for emergence and emergence count (%) was found significant with treatment combination M₁P₅-Mother rhizome + Kinetin 50 ppm. Plant height and leaf area was found superior in treatment combination M₁P₂-Mother rhizome + GA₃ 200 ppm. No. of tillers/plant, no. of leaves /plant, length of mother rhizome, girth of mother rhizome, length of primary finger, girth of primary finger, weight of mother rhizome/plant, weight of primary finger/plant was found significantly superior in treatment combination of M₂P₈-Primary finger + CCC 500 ppm.

Keywords: Planting material, emergence, plant height, plant growth regulators, rhizome size

Introduction

Turmeric (*Curcuma longa* L.) commonly known as Haldi is an annual herbaceous plant and belongs to ginger family (Zingiberaceae).The plant is one of the most important cash crop and ancient spice of the world. It is appears to be native of southern Asia and is cultivated in India since very ancient times. It is grown on large scale in India, Indochina and Sri Lanka. (Vaidya *et al.* 1972) [15]. India is the leading producer and exporter of the turmeric in the world. Turmeric play an important role in earning foreign exchange for the country. It is grown in different states of India and thus improves the economic status of farmers. It is the most widely and commonly used material in daily cooking and hence is commercially important spice. This is a rhizomiferous seasonal crop. The cost of planting material amounts to 50% of crop production in turmeric. Turmeric takes long time for germination and has slow initial growth. The application of growth regulators like GA₃, NAA or Kinetin may enhance the growth and rhizome size of turmeric raised from primary and secondary rhizomes. Studies on the use of planting material in combination with different plant growth regulators are scanty. Hence there is a need to study the effect of different growth regulators to know the best suited growth regulator for getting higher yields under field conditions.

Material and Methods

A field trial was conducted at Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the year 2017-18 and 2018-19 in factorial randomized block design (FRBD) with 2 replication and 18 treatment combinations with different planting materials In

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factor A i.e. Mother rhizome (M_1), Primary finger (M_2) and factor B different plant growth regulators viz. P_1 - GA₃ - 100 ppm, P_2 - GA₃ - 200 ppm, P_3 - Ethrel - 50 ppm, P_4 - Ethrel - 100 ppm, P_5 - Kinetin - 50 ppm, P_6 - Kinetin - 100 ppm, P_7 - Cycocel - 250 ppm, P_8 - Cycocel - 500 ppm, P_9 - Control - Water. (Soaking and foliar application at 60 and 90 DAP).

Result and Discussion

Planting materials and plant growth regulators showed significant influence on growth parameters of turmeric. Data regarding growth parameters is presented in table 1. As regards planting materials M_1 -Mother rhizome recorded significantly maximum emergence count (92.97%), Maximum emergence count in mother rhizome might be due to the fact that mother rhizome have more stored food material, which might have resulted in quick emergence and maximum emergence count. As regards minimum days for emergence (21.19), significantly maximum plant height (86.18cm) at 180 DAP, in planting material M_1 -Mother rhizomes showed significantly more plant height over primary finger, This might be due to the mother rhizomes have more stored food material, which might have resulted in quick emergence and more vigorous plants, thus the plants from mother rhizomes had attend more height. Mother rhizome as planting material had produced taller plant has been reported by different workers (Naramnaidu and Yuvraj 2006, Deshmukh *et al.* 2005, Padmadevi *et al.* 2012, Meenakshi *et al.* 2001a, Singh *et al.* 1988, Singh *et al.* 2013, Singh *et al.* 2000 and Dhatt *et al.* 2008) [5, 1, 7, 4, 10, 12, 13, 2]. In respect of leaf area mother rhizomes (300.20cm²) gave significantly better leaf area at 180 DAP than primary finger. This might be due

to the early emergence and more plant height, when mother rhizomes were used as planting material than primary finger. As regards planting material M_2 -primary finger recorded significantly maximum number of tillers/plant (3.22) than the mother rhizome. M_2 -Primary finger as a planting material recorded significantly higher length of mother rhizome (5.70cm). This might be due to horizontal growth of primary finger and more number of buds was observed in the primary finger and maximum number of leaves/plant (21.96 at 180 DAP) recorded significant results when primary finger used as a planting material. The treatment M_2 - Primary finger (4.47cm) recorded significantly maximum girth of mother rhizome. Treatment M_2 -Primary finger showed significantly greater length of primary finger (7.78cm). The treatment M_2 -Primary finger recorded significantly maximum girth of primary finger (3.66cm). M_2 -Primary finger exhibited significantly maximum weight of mother rhizome per plant (74.62g respectively). Maximum weight of mother rhizome/plant might be due to higher number of leaves, which remained photosynthetically active for longer period and dry matter accumulation, more number of shoots as well as rhizomes per plant and all these parameters ultimately led to higher accumulation of photosynthates in the economic part of the plant i.e. rhizomes, whereas the value of all these growth parameters decreased with each decrease in size and weight of planting material. Balashanmugan and Vanangamudi (1988) also reported more weight of mother rhizomes/plant when mother rhizome or primary finger were used as planting material as compared to secondary rhizomes. Similar results has been reported by Kumar (2005) and Tayde and Deshmukh (1986).

Table 1: Effect of planting material and Plant growth regulators on growth of turmeric

Treatment	Days for Emergence	Emergence count (%)	No. of tillers/plant	Plant Height (180 DAP)	No. of leaves (180 DAP)	Leaf area (cm ²)
M_1 - Mother rhizome	21.19	92.97 (9.69)	2.94	92.56	20.58	300.20
M_2 - Primary Finger	26.83	88.24 (9.44)	3.22	86.18	21.96	284.30
F Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE(m)±	0.20	0.008	0.05	0.20	0.15	0.89
CD@5%	0.60	0.024	0.15	0.61	0.44	2.66
P_1 - GA ₃ 100ppm	21.87	90.18 (9.54)	2.11	100.57	16.32	342.23
P_2 GA ₃ 200ppm	22.63	89.81 (9.52)	2.23	101.00	16.96	337.00
P_3 - Ethrel 100 ppm	23.75	91.56 (9.61)	3.77	85.99	24.28	278.50
P_4 - Ethrel 200 ppm	24.37	93.50 (9.72)	3.98	84.62	25.30	264.11
P_5 - Kinetin 50 ppm	20.13	94.56 (9.77)	2.60	97.23	19.55	350.00
P_6 - Kinetin 100 ppm	20.75	94.31 (9.76)	2.70	95.45	20.00	368.30
P_7 - CCC 250 ppm	23.75	90.00 (9.53)	4.20	82.56	26.64	254.90
P_8 - CCC 500 ppm	25.75	89.13 (9.49)	4.40	75.95	28.64	242.20
P_9 - Water	31.13	82.38 (9.13)	1.75	80.01	13.74	193.10
F Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m)±	0.42	0.017	0.10	0.43	0.31	1.89
CD @ 5%	1.27	0.051	0.31	1.29	0.95	5.64
M_1P_1	18.75	91.37 (9.61)	2.22	103.57	16.85	383.67
M_1P_2	19.75	91.00 (9.59)	2.37	106.46	17.60	370.12
M_1P_3	20.75	97.00 (9.89)	3.27	89.35	22.22	254.73
M_1P_4	21.75	96.12 (9.85)	3.52	87.05	22.97	249.80
M_1P_5	17.00	99.37 (10.01)	2.77	101.20	20.60	373.52
M_1P_6	17.50	97.87 (9.94)	2.87	99.27	21.10	410.77
M_1P_7	22.25	90.75 (9.57)	3.75	84.97	23.77	237.87
M_1P_8	22.50	90.25 (9.55)	3.90	77.30	25.72	225.15
M_1P_9	30.50	83.00 (9.16)	1.82	83.85	14.37	196.48
M_2P_1	25.00	89.00 (9.48)	2.00	97.57	15.80	300.80
M_2P_2	25.50	88.62 (9.46)	2.10	95.60	16.32	303.90
M_2P_3	26.75	86.12 (9.33)	4.27	82.62	26.32	302.22
M_2P_4	27.00	90.87 (9.58)	4.45	82.20	27.62	278.42
M_2P_5	23.25	89.75 (9.52)	2.42	93.25	18.50	326.42

M ₂ P ₆	24.00	90.75 (9.57)	2.52	91.62	18.90	325.75
M ₂ P ₇	29.25	89.25 (9.50)	4.65	80.15	29.50	271.92
M ₂ P ₈	29.00	88.00 (9.43)	4.90	74.60	31.55	259.30
M ₂ P ₉	31.75	81.75 (9.09)	1.67	77.97	13.10	189.75
F Test	Sig.	Sig.	Sig.	Sig.	Sig.	M x P
SE (m)±	0.60	0.024	0.15	1.83	0.45	Sig.
CD @ 5%	1.80	0.073	0.45	0.61	1.34	2.67

Table 2: Effect of planting material and plant growth regulators on rhizome size of turmeric

Treatment	Length of mother rhizome (cm)	Girth of mother rhizome (cm)	Length of primary finger (cm)	Girth of primary finger (cm)	Weight of mother rhizomes/plant (g)	Weight of primary fingers /plant (g)
M ₁ - Mother rhizome	5.06	4.05	7.37	3.50	65.24	172.10
M ₂ - Primary Finger	5.70	4.47	7.78	3.66	74.62	188.00
F Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m)±	0.07	0.08	0.07	0.03	1.88	4.48
CD @ 5%	0.22	0.23	0.21	0.10	5.43	12.94
P ₁ - GA ₃ 100ppm	4.15	3.47	6.82	3.16	56.27	142.62
P ₂ GA ₃ 200ppm	4.40	3.55	6.92	3.22	57.21	146.00
P ₃ - Ethrel 100 ppm	6.25	4.72	8.09	3.87	75.40	198.70
P ₄ - Ethrel 200 ppm	6.47	4.98	8.26	3.98	79.50	210.83
P ₅ - Kinetin 50 ppm	5.00	3.90	7.18	3.40	63.19	166.40
P ₆ - Kinetin 100 ppm	5.16	3.97	7.31	3.45	64.90	171.00
P ₇ - CCC 250 ppm	6.65	5.22	8.45	4.05	86.49	221.70
P ₈ - CCC 500 ppm	6.85	5.46	8.68	4.17	96.58	233.30
P ₉ - Water	3.52	3.07	6.48	2.92	49.81	129.90
F Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m)±	0.16	0.17	0.16	0.07	3.99	9.50
CD @ 5%	0.47	0.49	0.46	0.22	11.54	27.45
M ₁ P ₁	4.40	3.57	6.92	3.12	57.75	145.50
M ₁ P ₂	4.60	3.67	7.00	3.22	58.75	148.75
M ₁ P ₃	5.45	4.27	7.58	3.65	68.80	179.92
M ₁ P ₄	5.55	4.37	7.67	3.76	70.70	188.05
M ₁ P ₅	5.15	3.97	7.27	3.50	65.25	172.60
M ₁ P ₆	5.30	4.07	7.42	3.52	67.00	177.40
M ₁ P ₇	5.70	4.57	7.82	3.82	72.27	196.42
M ₁ P ₈	5.85	4.77	8.07	3.95	75.35	207.40
M ₁ P ₉	3.60	3.17	6.57	2.95	51.25	132.45
M ₂ P ₁	3.90	3.37	6.72	3.19	54.79	139.75
M ₂ P ₂	4.20	3.42	6.83	3.22	55.67	143.20
M ₂ P ₃	7.05	5.17	8.60	4.09	82.00	217.55
M ₂ P ₄	7.40	5.60	8.86	4.20	88.30	233.60
M ₂ P ₅	4.85	3.82	7.10	3.30	61.12	160.25
M ₂ P ₆	5.02	3.87	7.20	3.37	62.80	164.60
M ₂ P ₇	7.60	5.87	9.07	4.28	100.70	246.90
M ₂ P ₈	7.85	6.15	9.30	4.39	117.80	259.10
M ₂ P ₉	3.45	2.97	6.40	2.90	48.37	127.35
F Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m)±	0.23	0.24	0.22	0.11	5.65	13.44
CD @ 5%	0.67	0.70	0.66	0.32	16.33	38.85

Amongst different plant growth regulators, treatment P₅ (Kinetin 50 ppm) was found superior in recording minimum number of days (20.13) for emergence. This might be due to kinetin has ability to induce cell division resulting in early emergence. As regards emergence count P₅-Kinetin 50 ppm recorded significantly better emergence count (94.56%). Among different growth regulator treatments P₈-CCC 500 ppm produced maximum number of tillers per plant (4.40) than all of the treatment. This might be due to CCC has decisive role in the suppression of apical dominance and diverting the polar transport of auxin towards the basal buds leading to increased tiller production. This is an accordance with the findings of Maruthi *et al.*, (2003a); Sengupta *et al.*, (2008); and Velayutham *et al.*, (2013), Ravishankar (1983) [3, 14, 16, 9] in ginger. Vijayakumar and Abdhul Khader (1986) [17] in cassava, Phogat and Singh (1987) [18] in ginger. In plant

growth regulator, treatments P₂ - GA₃ 200 ppm recorded maximum plant height (101.00cm at 180 DAP). Increased plant height due to GA₃ 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) [11, 6].

In respect of plant growth regulators the treatment P₈-CCC 500 ppm observed maximum number of leaves per plant 28.64cm at 180 DAP. This might be due to CCC has decisive role in inducing the apical growth of plant and accelerating the formation of highest number of leaves per plant and also due to maximum tiller production in the treatment P₈ due to suppression of apical dominance and diverting the polar transport of auxin towards basal buds that increased leaves per plant. (Ravishankar, 1983 and Maruthi *et al.* 2003a) [9, 31]. When growth regulators treatments were evaluated, leaf area per plant at 180 DAP was recorded maximum in the

treatment P₆-Kinetin 100 ppm (368.30cm²). The treatment P₈-CCC 500 ppm was found significantly superior (6.85cm). The length of mother rhizome is due to CCC might have enhanced the translocation of carbohydrates to the developing sink and contributed for better enlargement of rhizomes. Another reason could be the reduced vegetative growth there by increased the production of sizable rhizomes. The present results are in similarity with the findings of Nambiar *et al.* (1976) and Abdhul Vahab and Mohana Kumaran (1980) in sweet potato and Phogat and Singh (1987) [8] in ginger.

The treatment P₈-CCC 500 ppm showed significantly maximum girth of fresh mother rhizome (5.46cm). The CCC might have enhanced the translocation of carbohydrates to the developing sink and contributed for better enlargement of rhizomes. Another reason could be the reduced vegetative growth there by increased the production of sizable rhizomes. The present results are in similarity with the findings of Nambiar *et al.* (1976) and Abdhul Vahab and Mohana Kumaran (1980) in sweet potato and Phogat and Singh (1987) [8] in ginger. The treatment P₈-CCC 500 ppm showed maximum length of primary finger (8.68cm). This might be due to the fact that CCC might have enhanced the translocation of carbohydrates to the developing sink and contributed for better enlargement of rhizomes. Another reason could be the reduced vegetative growth there by increased the production of sizable rhizomes. The present results are in similarity with the findings of Nambiar *et al.* (1976) and Abdhul Vahab and Mohana Kumaran (1980) in sweet potato and Phogat and Singh (1987) [8] in ginger.

The maximum girth of rhizomes when treated with P₈-CCC 500 ppm (4.17cm). Maximum girth of primary fingers might be due to CCC might have enhanced the translocation of carbohydrates to the developing sink and contributed for better enlargement of rhizomes. Another reason could be the reduced vegetative growth there by increased the production of sizable rhizomes. The present results are in similarity with the findings of Nambiar *et al.* (1976) and Abdhul Vahab and Mohana Kumaran (1980) in sweet potato and Phogat and Singh (1987) [8] in ginger. P₈-CCC 500 ppm (9.58g respectively) showed greater weight of fresh mother rhizome. This might be due to the fact that CCC might have enhanced the translocation of carbohydrates to the developing sink and contributed for better enlargement of rhizomes. Another reason could be the reduced vegetative growth there by increased the production of sizable rhizomes that directly increased the weight of rhizomes. The present results are in similarity with the findings of Nambiar *et al.* (1976) and Abdhul Vahab and Mohana Kumaran (1980) in sweet potato and Phogat and Singh (1987) [8] in ginger.

The interaction effect of planting material and plant growth regulators was found significant. M₁P₅ i.e. M₁- mother rhizome and P₅-kinetin 50 ppm was found significant for producing maximum emergence count (99.37%). As regards number of tillers/plant (4.90) and number of leaves/plant (28.20) was found significant results in treatment combination M₂P₈ i.e. Primary finger and CCC 500 PPM. In respect of plant height M₁P₂ i.e. Mother rhizome and GA₃ 200 ppm (106.46 cm at 180 DAP) was found significant results. As regards leaf area M₁P₆ i.e. mother rhizome and Kinetin 100 ppm (410.77cm²) was found significant results.

The treatment combination of M₂P₈ i.e. Primary finger and CCC 500 ppm was found significantly superior (7.85cm). M₂P₈ i.e. Primary finger and CCC 500 ppm was significantly superior over other treatment combinations in recording

maximum girth of mother rhizome (6.15cm). M₂P₈ Primary finger and CCC 500 ppm was found to be significantly superior in recording higher length of primary finger (9.30cm). The treatment combination M₂P₈ (4.25cm, 4.54cm and 4.39cm respectively) was found significantly superior. M₂P₈ i.e. Primary finger and CCC 500 ppm recorded significantly higher weight of fresh mother rhizome per plant (117.80g).

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