International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(6): 1498-1501

Received: 19-09-2019
Accepted: 21-10-2019

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Effect of different planting materials and rooting media on growth and yield of turmeric (*Curcuma longa* L.)

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Abstract
An experiment was conduct to know the effect of turmeric planting material and rooting media on the growth and yield of transplanted turmeric. Among the various planting materials used with different rooting media T_8 found to be significantly superior treatment which had influenced on growth parameters like percent establishment (99.17), plant height (85.37 cm), number of leaves (17.93) and number of tillers (3.27) was higher in T_9. It also significantly influenced in getting maximum fresh rhizome yield per clump (384.47 g), plot (12.75 kg) and hectare (23.60 t). The purpose of use of disc was to minimize the use of planting material which had come true through T_{10}. Use of mother rhizome direct planting was the control. Use of mother rhizomes had resulted in comparatively higher yields but getting the required quantity of mother rhizome difficult. Use of primary rhizomes in the mixture of cocopeat and vermicompost has resulted in higher yield compared to mother rhizomes.

Keywords: Planting materials, rooting media, growth, yield, turmeric, *Curcuma longa* L.

Introduction
Turmeric (*Curcuma longa* L.) is an ancient and sacred spice of India. It is known as 'Indian saffron' because of its incomparable flavour and it is broadly utilized as an expensive substitute of saffron. Turmeric is an important commercial spice crop grown in India. The Hindus, both tribal and civilized, consider turmeric as sacred and auspicious. It is associated with several rituals from ancient period and the tradition still goes on.
In turmeric, planting material requirement (2000 kg ha^{-1}) is high and it shares 40 percent of the total cost of cultivation. Turmeric seed rhizomes are infrequently accessible and hard to obtain. As cost of planting material is very high in turmeric, there is a need to reduce the cost of seed material by selection of rhizome of optimum size. This can be done by resorting to single bud cuttings, from secondary and primary rhizomes. With this background, the present investigation is designed to determine the optimum planting material and suitable rooting media for better growth and yield of turmeric. Hence the production of healthy seed material and reduction of size of seed material is the need of the hour.

Materials and Methods
The study was carried out using mother, primary, secondary and rhizome discs with 10 treatments. The experiment was laid out in a randomized block design (RBD) replicated thrice. Involving different types of rhizome planting material and rooting media i.e whole mother rhizome direct planting (control) (T_1), whole primary rhizome in cocopeat (T_2), whole Secondary rhizome in cocopeat (T_3), disc with single bud in cocopeat (T_4), whole primary rhizome in vermicompost (T_5), whole secondary rhizome in vermicompost (T_6), disc with single bud in vermicopost (T_7), whole primary rhizome in mixture of cocopeat and vermicopost (1:1) (T_8), whole secondary rhizome in mixture of cocopeat and vermicopost (1:1) (T_9), disc with single bud in mixture of cocopeat and vermicopost (1:1) (T_9) were the different treatment combinations. Plots of 5.4 m^2 size were prepared after which ridges and furrows were prepared at 45 cm and 30 cm plant to plant distance.
The growth parameters were observed at various stages of crop growth (50, 100 and 150 DAT). The crop was harvested after observing the maturity symptoms. The observations on yield parameters were recorded immediately after harvest.

Results and Discussion

Growth characters

There was a significant variation in percentage of establishment, plant height, number of leaves per plant, number of tillers, stem girth among ten treatments used for the study depicted in table 1. Rooting media and planting materials influenced significantly in the per cent field establishment. Highest field establishment of 99.17, 99.17 and 98.33 per cent at 45 days after transplanting in T_1, T_8 and T_2 respectively which was significantly differ. Disc with single bud in cocopeat (T_4) and (T_5) were found to be significantly poor in per cent field establishment. Maximum per cent field establishment indicated maximum population in the field, the expression of maximum yield by T_8 might also be under the influence of maximum population. Balwinder and Gill (2010) [2] opined similarly.

Table 1: Effect of different planting material and rooting media on vegetative growth of turmeric

Treatments	Percentage of establishment	Plant height (cm)	Number of leaves	Number of tillers per plant	Girth of the stem (cm)
T_1	99.17	81.47	17.60	2.57	3.38
T_2	98.33	78.90	16.63	1.67	3.30
T_3	96.67	69.23	13.13	2.17	2.63
T_4	94.17	64.27	11.50	1.17	2.77
T_5	94.17	77.23	15.90	2.13	3.13
T_6	95.83	72.67	15.73	2.90	2.80
T_7	95.83	65.83	14.07	2.10	2.60
T_8	99.17	85.37	17.93	2.67	3.40
T_9	95.67	71.40	15.43	3.27	2.93
T_{10}	95.83	70.70	14.90	2.50	2.77
Mean	96.48	73.71	15.28	2.31	2.97
S.Em ±	0.29	3.56	1.03	0.31	0.15
C.D. at 5%	0.87	10.57	3.07	0.92	0.45

All parameters recorded at 150 days of transplanting except percentage of establishment at 45 DAT, cm= centimetre, S.Em±=Standard error of mean, C.D.=Critical difference

The plant height at various stages of growth was under the significant influence due to types of rhizome planting materials and media. The use of T_8 influenced significantly higher plant height (85.37 cm). T_4, T_3 were found to be significantly inferior for plant height throughout the growth stages. The vigorous nature of T_8 might have influenced the higher rhizome yield per hectare. Hanamashetti *et al*. (2002) [3] and Manhas and Gill (2012) [4].

Types of rhizome planting materials and rooting media had significant effect on number of leaves per plant at all the stages of growth. T_8 recorded maximum number of leaves per plant (17.93) followed by T_1 (17.60). T_4 and T_7 treatments were found to be significantly inferior for the number of leaves per plant at all the stages of the growth. Among the vegetative parameters number of leaves per plant being the important parameter towards effective photosynthesis and production of photosynthetes, the expression of maximum number of leaves by T_8 might also had influenced on the rhizome yield and yield attributes. Deshmukh *et al.* (2005) [2].

Effect of types of rhizome planting materials and media on the number of tillers per plant had significant variation. T_9 (3.27) and T_8 (2.67) expressed the on par to each other. Least was observed in T_4 (1.17). More number of tillers per plant will influence the rhizome yield normally. The higher rhizome yield of T_8 might be influenced by higher values of yield attributing character. Singh *et al*. (2013) [7].

Treatment T_8 at all the stages of crop growth exhibited significant and highest stem girth i.e. 3.40 cm followed by mother rhizome direct planting 3.38 cm. Least was observed in T_3 2.63 cm. The extent of stem thickness would influence the strength of the pseudo stem. The opinion of earlier worker Neeraja *et al.* (2017) [6] were also in accordance with the present findings.

Yield parameters

Data on different rhizome characters *viz*., Number of primary rhizomes, number of secondary rhizomes, weight of primary rhizomes, weight of secondary rhizomes, rhizome yield per clump and rhizome yield per hectare are presented in Table 2 and 3.

Table 2: Effect of different planting material and rooting media on yield of turmeric

Treatment	Number of mother rhizome	Number of primary rhizome	Number of secondary rhizome	Weight of mother rhizomes (g)	Weight of primary rhizomes (g)	Weight of secondary rhizomes (g)
T_1	3.17	10.97	7.00	95.20	165.00	38.13
T_2	2.43	6.73	3.73	83.67	125.50	29.20
T_3	2.60	7.03	3.27	87.07	111.10	17.33
T_4	2.80	5.83	1.77	53.53	92.70	26.30
T_5	3.03	8.37	5.53	93.17	164.20	28.06
T_6	2.93	7.73	5.83	77.00	112.30	38.03
T_7	3.60	6.63	7.23	109.13	121.20	44.07
T_8	4.50	11.40	8.90	111.80	166.87	55.93
T_9	3.67	9.17	6.57	90.87	154.23	53.87
T_{10}	4.40	8.63	5.23	95.40	130.13	32.33
Mean	3.31	7.95	5.34	89.07	130.91	36.33
S.Em ±	0.27	0.76	0.62	7.58	12.26	3.78
C.D. at 5%	0.81	2.26	1.85	22.53	36.42	11.22

g = gram, S.Em± = Standard error of mean, C.D. = Critical differenc

Table 3: Effect of different planting material and rooting media on fresh rhizome yield of turmeric

Treatments	g clump^{-1}	kg plot^{-1}	t ha^{-1}
T_1	383.33	12.44	23.03
T_2	310.93	11.63	21.54
T_3	248.00	9.51	17.61
T_4	183.33	4.83	8.95
T_5	323.40	11.76	21.78
T_6	268.20	9.22	20.77
T_7	253.27	7.89	14.61
T_8	384.47	12.75	23.60
T_9	333.40	11.22	20.77
T_{10}	308.23	10.91	20.20
Mean	299.66	10.22	19.29
S.Em ±	16.48	1.18	0.88
C.D. at 5%	48.97	3.52	2.64

g= gram, kg=kilogram, t/ha= tonne per hectare, S.Em±=Standard error of mean, C.D.= Critical difference

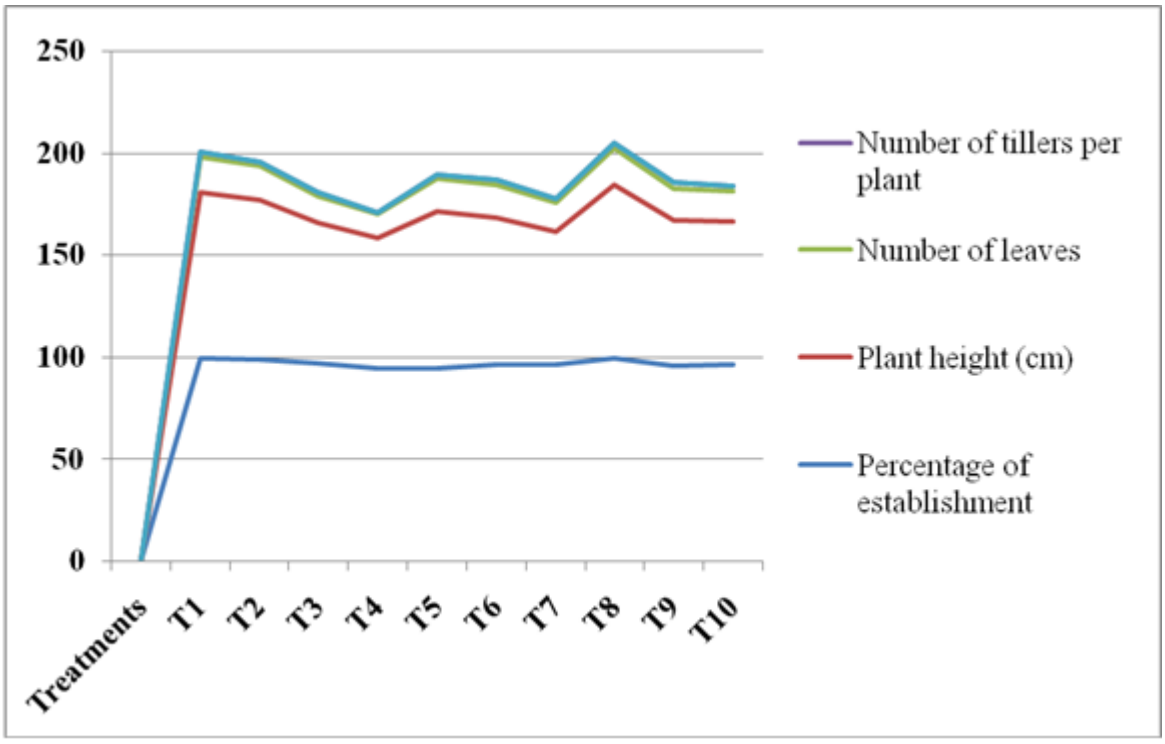

Fig 1: Effect of different planting material and rooting media on vegetative growth of turmeric

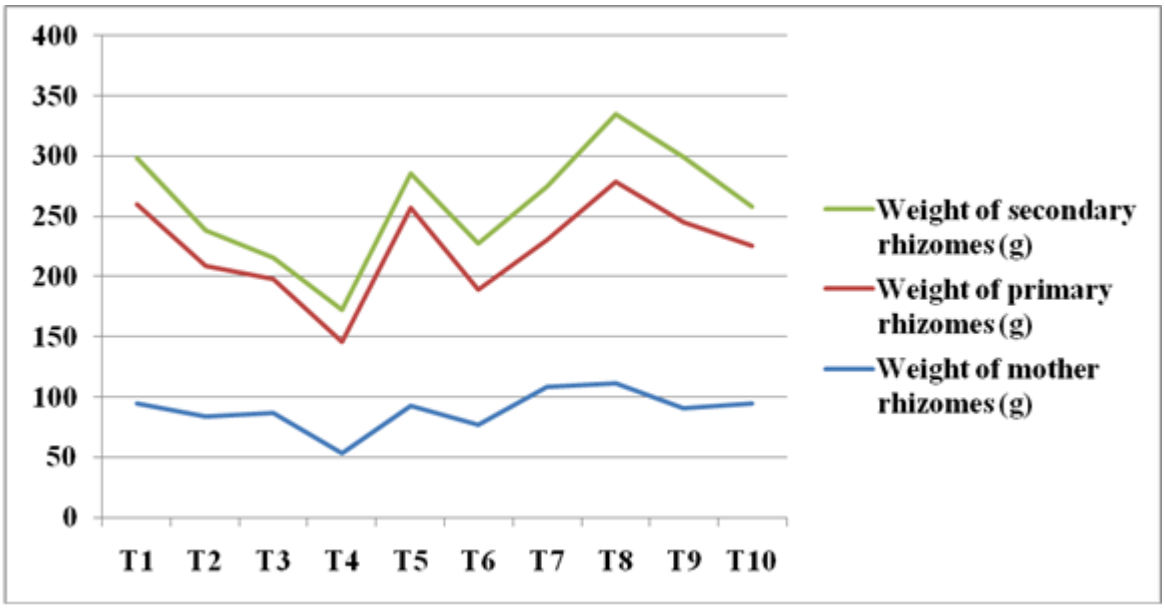

Fig 2: Effect of different planting material and rooting media on yield of turmeric

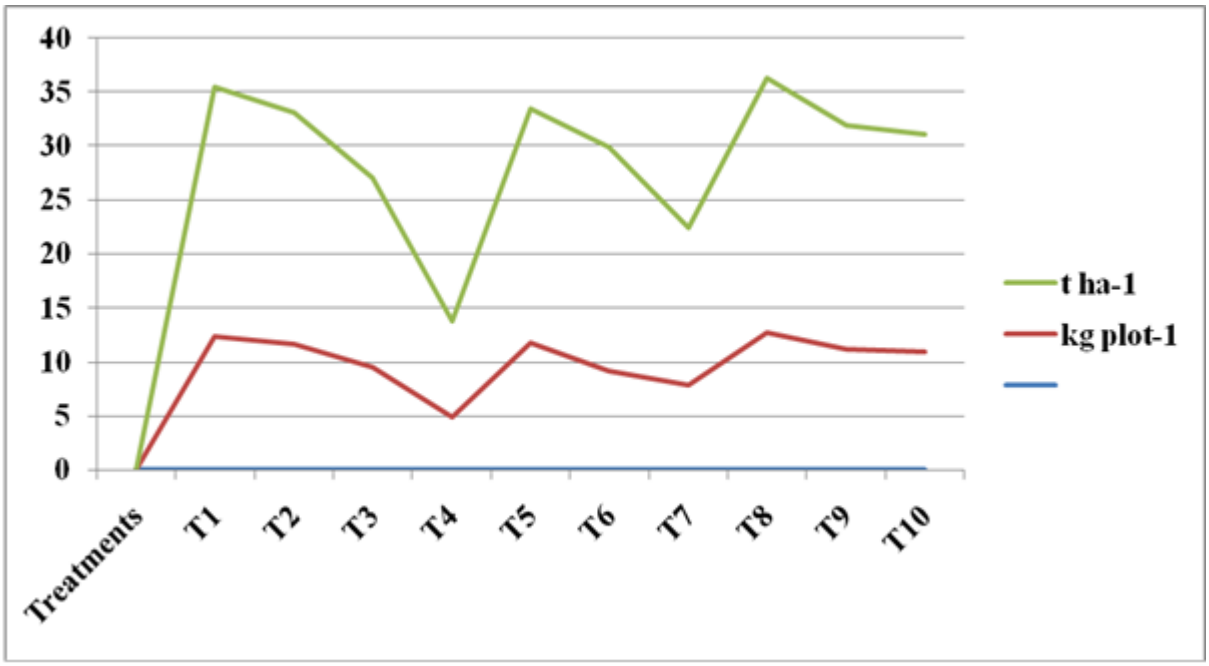

Fig 3: Effect of different planting material and rooting media on fresh rhizome yield of turmeric

The effect of types of rhizome planting material and rooting media on the number of mother, primary and secondary rhizomes per clump exhibited significantly superior performance through T_8 was significantly superior with respect to more number of mother rhizome (4.50), primary rhizome (11.40) and secondary rhizome (8.90) per clump. Least number of mother, primary and secondary rhizome was observed in T_4. As the number of mother, primary and secondary rhizomes per clump are influencing yield and yield parameters, either significantly or statistically higher numbers of these characters shall influence the fresh rhizome yield. Hence the T_8 had the higher rhizome yield per hectare. Similar results were obtained by earlier researchers Balwinder and Gill (2010) [1].

T_8 was found to be significantly superior for average fresh weight of mother rhizome (111.8 g), primary rhizome (166.87 g) and secondary rhizome (55.93 g). Mother rhizome direct planting was on par with T_8. Least fresh weight was observed in T_4. The superior performance of T_8 might to be attributed to the mixture of rooting media comprised of cocopeat and vermicompost in 1:1 ratio and primary rhizome as a planting material which helped in getting high root mass per seedling. (Deshmukh *et al*. (2005) [2].

The yield per clump, per plot and per hectare showed wide range of variation for fresh rhizome yield. The treatment T_8 exhibited significantly higher fresh rhizome yield of 384.47 g per clump, 12.75 kg per plot and 23.60 t per hectare followed by T_1. T_4 was emerged as significantly least treatment for fresh weight of rhizome. Higher rhizome weight per clump and per plot shall result in higher rhizome yield per hectare as they directly influence the yield. Transplanting of turmeric plants raised in mixture (1:1) cocopeat and vermicompost using primary rhizome would yield significantly higher fresh rhizome yield per hectare and as primary rhizome with more reserved food and more number of buds might have contributed towards bigger clumps and higher yield. Manhas *et al*. (2011) [5].

Conclusion

Hence the use of primary rhizome as planting material in mixture of cocopeat and vermicompost resulted in significantly higher fresh rhizome yield compared to other planting material and growing media. Though the use of mother rhizome for direct planting resulted in higher yield but getting the required quantity of mother rhizome for commercial cultivation found to be difficult.

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