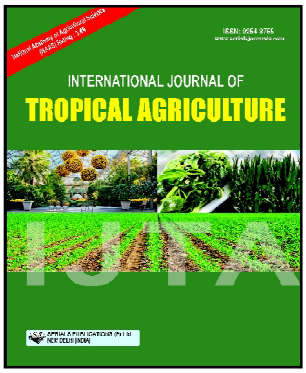

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Effect of Rhizome Size on Growth and Yield of Turmeric CV. GNT-1

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Abstract: Turmeric (*Curcuma longa* L.) plant species produces different size of mother rhizomes and finger rhizomes. Rhizomes as well as fingers are used as propagating material in turmeric cultivation. Hence, the field investigation entitled "Effect of rhizome size on growth and yield of turmeric cv. GNT-1" was carried out during *Kharif* season of 2013-14 to 2016-17 at College Farm as well as Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari (Gujarat). The experiment was carried out with 9 treatments in a Randomized Block Design (RBD) and replicated thrice comprising different rhizome sizes with pro-trays raised seedlings as planting material for better growth and yield of turmeric. Among the different size of planting materials, the plants grown from mother rhizomes (35-40 g) when directly planted into field, reported the maximum plant height (128.49 cm), tillers per plant (3.18), number of leaves per plant (20.48), length of leaves (44.94 cm), leaf breath (11.67 cm) and germination percentage (99.67%) as well as weight of rhizome per plant (369.11 g) with minimum mortality percentage (0.33%) and yield of rhizome (27.14 t/ha). Looking to the economics point of view, maximum benefit:cost ratio (3.34) were calculated in treatment T_6 i.e. planting of mother rhizome pieces @ 10-15 g in pro tray and transplanting after 1 month with required minimum rate of seed rhizomes (1358 kg/ha) for planting in turmeric cv. GNT-1.

Keywords: Mother rhizome, pro tray, turmeric, GNT-1, growth and yield.

INTRODUCTION

Turmeric (*Curcuma longa* L.) commonly known as *Haldi* is an annual herbaceous plant and belongs *Zingiberaceae* family. India is leading producer and exporter of turmeric in the world. It is cultivated throughout India covering an area of 2.08 lakh hectares with an annual production of 1029 million tonnes and productivity of 5.1 metric tonnes per hectare (Anon., 1). The world production of turmeric stands around 8,00,000 tonnes, of which the

contribution of India has approximately 75-80 per cent. In India, Andhra Pradesh, Maharashtra, Orissa, Tamil Nadu, Karnataka, Gujarat and Kerala are the important states which cultivate turmeric. Gujarat occupies an area of 1400 ha with the production of 16510 tones. Out of that, South Gujarat is about 14500 tones covering an area of about 1000 hectares. Turmeric is propagated by mother rhizome (shoot base) and finger rhizomes. The finger rhizomes of the species are considered to be different in size, because primary finger rhizomes developed from the shoot base have secondary and tertiary finger rhizomes which are different in size due to the differences in developing time. In addition, all the primary finger rhizomes are not developed at a time from a shoot base. Therefore, it is necessary to determine the optimum size of seed rhizomes for turmeric cultivation. Evaluating the effects of seed size on growth and development of plants is very important for increasing yield in the plant species producing different sizes of seed. In turmeric, planting material requirement is very high and it involves 40 per cent of its cost of the total cost of cultivation. Turmeric seed rhizomes are rarely available and typically difficult to obtain. A whole or split rhizome with single bud is used for planting. As cost of planting material is very high in turmeric, there is a need to reduce the cost of seed material by evolving alternative methods of sowing and selection of rhizome of optimum size or rhizome cuttings is investable. Keeping this in view and the increase in demand for turmeric and turmeric powder in India as well as abroad, it was felt essential to identify the suitable planting materials to minimize the seed requirement which will gives the higher yield in turmeric.

MATERIAL AND METHODS

A field experiment entitled "Effect of rhizome size on growth and yield of turmeric cv. GNT-1" was carried out during *Khirf* season of 2013-14 to 2016-17 at College Farm as well as Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari (Gujarat). The treatments comparised of different grades (based on weight) of mother rhizomes and finger rhizomes as given below (Table A and Fig. A). The experiment was laid out in

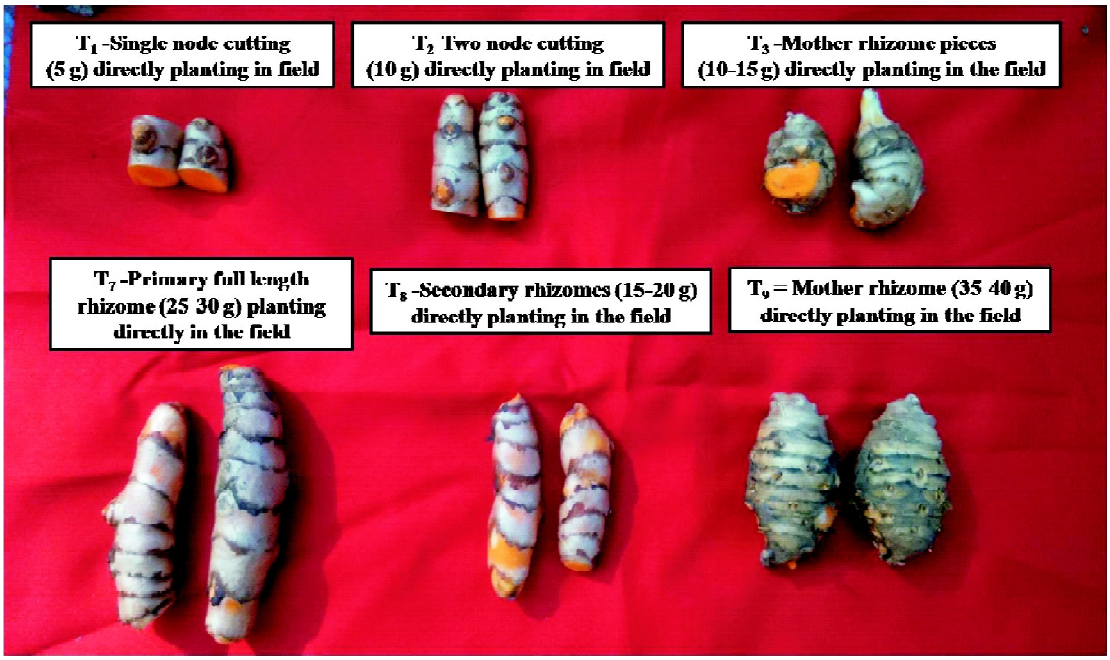

Figure A: Different seed size (fingers and mother rhizome) for planting

Table A
Quantity of seed requirements for planting purpose using different materials

Treatments/Planting materials	*Quantity of seed requirements (g) for 120 plants*	*Quantity of seed requirements per hectare (Kg/ ha)*
T_1 = Single node cutting (5 g) directly planting in field	900	556
T_2 = Two node cutting (10 g) directly planting in field	1600	988
T_3 = Mother rhizome pieces (10-15 g) directly planting in the field	2200	1358
T_4 = Single node cutting (5 g) planting in pro tray (Transplanting after 1 month)	900	556
T_5 = Two node cutting (10 g) planting in pro tray (Transplanting after 1 month)	1600	988
T_6 = Mother rhizome pieces (10-15 g) planting in pro tray (Transplanting after 1 month)	2200	1358
T_7 = Primary full length rhizome (25-30 g) planting directly in the field	3500	2160
T_8 = Secondary rhizomes (15-20 g) directly planting in the field	2500	1543
T_9 = Mother rhizome (35-40 g) directly planting in the field	4000	2469

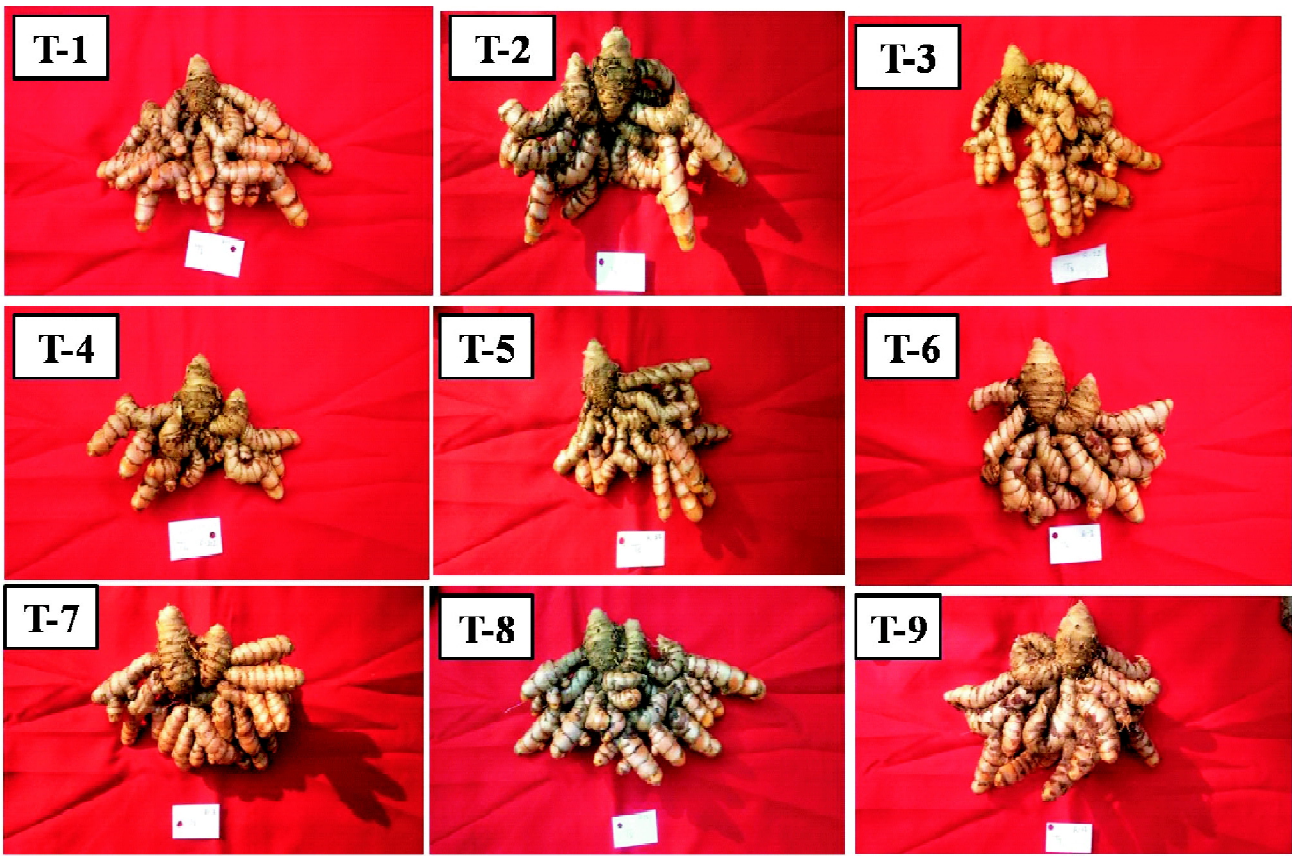

Figure 2 : Effect of rhizome size on yield of turmeric cv. GNT-1

Randomized Block Design (RBD) with three replications on raised bed method having spacing of 45x30cm. Cultural practices were followed as per the recommended package of practices. Observations on growth and yield attributes were recorded. The data were subjected to statistical analysis (Panse and suukhatme, 6).

RESULTS AND DISCUSSION

Growth parameters

The data (Table 1) revealed that the growth parameters *viz.,* plant height, tillers per plant, numbers of leaves per plant and leaf breath were found significant results during years of experimental trial due to different rhizome size. The maximum plant height (128.49 cm) was found in T_9 treatment due to mother rhizome (35-40g) directly planted in field during experimental trial. Larger seed rhizomes contain a larger amount of food reserves that enhanced seedling growth which ultimately resulted in a healthier plant which enhanced early emergence of crop and ultimately enhanced the vegetative growth of plants (Padmadevi *et. al.*, 5). Moreover, tillers per plant (3.18), number of leaves per plant (20.48) and breadth of leaf (11.67 cm), similar trend was observed as per the trend of other growth parameters during experimental study. However, data shows non significant results regarding length of leaves during experimental period but, maximum value were recorded in T_9 (44.94 cm). The shoots with a larger leaf number and larger leaf size received higher solar energy resulted in increased leaf area and utilization for photosynthesis, which ultimately resulted in similar pattern throughout the growth period (Padmadevi *et. al.*, 5). On the contrary, significantly maximum percentage of germination (99.67%) were counted in treatment T_9 whereas, minimum germination (65.33%) was recorded in T_1 treatment as compared to rest of treatments.

Yield and Yield attributes

The performance of yield with different rhizome size was found significant results during the experimental trial (Table 1 and Fig. 2). Maximum number of mother rhizomes per plant (3.26), numbers of finger rhizome per plant (19.67), length of rhizome (15.00 cm) and breadth of rhizome (21.68 cm) was recorded with the treatment of mother rhizome (35-40g) directly planting in field (T_9) during experimental trial. Moreover, maximum weight of rhizomes (369.11 g/plant) with rhizome yield (14.88 kg/plot and 27.14 t/ha) recorded in treatment T_9 i. e. mother rhizome (35-40g) directly planting in field and it was at par with T_6 (24.01 t/ha). The number and size decreased with decreased weight of planting material as also reported by Balwinder Kumar and Gill (2) and Manhas and Gill (4) in turmeric. The effect of different planting material and rhizome sprouts raised in protrays on fresh rhizome yield of turmeric was found significant. Use of higher weight of rhizome planting material and raised in protrays produced significantly higher fresh rhizome yield per hectare than lower weight rhizome for the yield. Lower the weight of planting material reduced the fresh rhizome yield of turmeric significantly. With increase in weight of turmeric seed material rhizome yield increased significantly which in turn increased the dry rhizome yields. Further increase in plant material weight increased the estimated rhizome yield on per hectare basis. Increased rhizome yield where in mother rhizome used as planting material might be attributed to better crop growth in terms of high germination percentage, higher plant height, more leaf area index and more number of tillers per plant which intercepted more photosynthetically active radiation and resulted in higher yield attributing characters which ultimately contributed towards higher yield of the crop. The performance of different treatments of rhizomes can be relied on the source-sink relationship as the mother rhizomes constitute a stronger sink than the fingers. The translocation and

Table 1
Effect of rhizome size on growth and yield of turmeric cv. GNT-1 (Pooled basis)

Treatments	*Plant height (cm)*	*Tillers/ plant*	*No. of leaves/ plant*	*Length of leaves (cm)*	*Breadth of leaf (cm)*	*Germination (%)*	*No. of mother rhizomes/ plant*	*No. of fingers rhizome/ plant*	*Length of rhizome (cm)*	*Breadth of rhizome (cm)*	*Weight of rhizome (g/plant)*	*Rhizome yield (kg/plot)*	*Rhizome yield (t/ha)*
T_1	84.40	2.04	12.91	42.40	10.58	65.33	2.43	11.89	9.68	12.80	187.44	7.26	13.45
T_2	93.36	2.21	13.66	42.11	10.76	71.82	2.34	13.61	9.80	13.60	214.78	8.41	15.57
T_3	99.51	2.41	15.60	43.66	10.56	93.23	2.67	16.94	11.66	15.31	293.67	10.64	19.70
T_4	86.20	2.24	14.26	42.56	10.60	80.67	2.47	15.20	11.23	14.10	222.96	8.54	15.81
T_5	96.98	2.31	15.49	42.68	10.84	89.33	2.73	16.17	11.79	16.37	268.11	9.95	18.42
T_6	112.44	2.92	17.43	44.02	11.00	96.67	2.96	19.29	14.12	19.24	325.56	12.97	24.01
T_7	109.31	2.78	17.32	43.46	11.11	91.35	2.86	17.71	12.99	18.56	312.11	12.58	23.30
T_8	94.24	2.30	14.62	42.68	11.04	76.58	2.71	17.07	11.80	14.34	240.56	9.27	17.17
T_9	128.49	3.18	20.48	44.94	11.67	99.67	3.26	19.67	15.00	21.68	369.11	14.66	27.14
S. Em.±	4.25	0.09	0.55	0.56	0.16	2.29	0.10	0.58	0.40	0.58	13.41	0.61	1.13
C. D. at 5 %	12.09	0.24	1.56	1.59	0.47	6.85	0.28	1.64	1.14	1.65	38.13	1.73	3.20

Table 2
Economic of treatments (Pooled basis)

Treatments	*Rhizome yield (t/ha)*	*Mortality (%)*	*Seed requirement (kg/ha)*	*Cost of seed material (₹/ ha)*	*Cost of cultivation (₹/ ha)*	*Total expenditure (₹/ ha)*	*Gross realization (₹/ ha)*	*Net return (₹/ ha)*	*BCR (₹)*
T1	13.45	35.0	556	11120.00	78886.00	90006.00	269000.00	178994.00	1.99
T2	15.57	25.18	988	19760.00	78886.00	98646.00	311400.00	212754.00	2.16
T3	19.70	6.77	1358	27160.00	78886.00	106046.00	394000.00	287954.00	2.72
T4	15.81	19.33	556	11120.00	90461.00	101581.00	316200.00	214619.00	2.11
T5	18.42	10.67	988	19760.00	90461.00	110221.00	368400.00	258179.00	2.34
T6	25.57	3.33	1358	27160.00	90461.00	117621.00	511400.00	393779.00	3.34
T7	23.30	8.65	2160	43200.00	78886.00	122086.00	466000.00	343914.00	2.82
T8	17.17	23.42	1543	30860.00	78886.00	109746.00	343400.00	233654.00	2.13
T9	25.57	0.33	2469	49380.00	78886.00	128266.00	511400.00	383134.00	2.98

Selling cost of turmeric= Rs. 20/kg.

Note: The average yield i.e. 25.57 t/ha was calculated from T9 (27.14t/ha) and T6 (24.01 t/ha) and mention into both treatments for economic point of view.

mobilization of assimilates and nutrients are more in heavier rhizomes thereby making the mother rhizomes raised in protrays resulted in quantitative, qualitative increase. Thus, the plants resulting from heavier rhizomes in protrays are more vigorous and yield better as compared to finger plant material as reported by Hossain *et al.* (3) in turmeric.

Economics

Economic efficiency and the viability of crop cultivation are mainly the outcome of the yield of crops with larger management costs. Higher crop productivity with lesser cost of cultivation could result in better economic parameters like net returns and B:C ratio. The cost of cultivation, gross return, net return and B:C ratios were worked out for different treatments in turmeric are presented in the table 2. The variation in cost of production was noticed in different treatments combinations comprising different planting material. The maximum net realization (₹ 393779.00) and BCR (3.34) were obtained in treatment T_6 (mother rhizome pieces @ 10-15 g planting in pro tray (Transplanting after 1 month) followed by treatment T_9 (mother rhizomes of 35-40 g when directly planted into field) i.e. ₹ 383134.00 net realization with 2.98 BCR and 0.33 per cent mortality. These results are in conformity with the findings reported by Balwinder Kumar and Gill (2), Manhas and Gill (2012) and Singh *et al.* (4) in turmeric.

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