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Suitability evaluation of rapid multiplication of turmeric (*Curcuma longa* L.) for hilly zone of Karnataka

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Abstract
Turmeric (*Curcuma longa* L.) is one of the most important spice, essentially a tropical crop grown in India. Sakleshpur falls under zone-IX hilly zone - Agro-climatic zone of Karnataka. Traditionally plantation crops like coffee, cardamom and black pepper are predominantly grown and rice is cultivated in the plain region. Due to escalating cost in paddy cultivation, farmers are alternatively attempting ginger in this area. Since ginger experiences high disease load and high cost in production, alternatively turmeric is attempted for this area. Turmeric is hardy for any biotic or abiotic stress in comparison to ginger. As turmeric is propagated through vegetative means through rhizomes, large quantity of planting material is being used (>2.5 tonnes/ha), which comprises >30 per cent of the production cost, also creates storage problem, handling issues, huge labour requirement and transportation problems. Keeping these points in view, an observational field trial was conducted during 2022-24 for two seasons to evaluate different propagation approach of turmeric and their suitability to hilly zones of Karnataka particularly Sakleshpur area. The experiment was conducted under irrigated condition. The soil of experimental plot was sandy loam in texture, pH 5.9 organic carbon content 1.3%, phosphorus 18 kg/ha, potassium 338 kg/ha. Improved variety IISR Pratibha was used in the trial. The trails were laid out in Randomized complete block design (RCBD) with seven replications and three treatments. T1 - Planting of whole mother rhizomes (Seed rate 2500 kg/ha), T2 - Planting of primary rhizomes of 30-40 gm weight (Seed rate 2000 kg/ha) and T3 - Transplanting turmeric seedling raised by single nodes rhizome weighing 6-7 gm (Seed rate 500 kg/ha). The plot size of 3m x 1m was maintained. The spacing followed was 45 cm x 30 cm. For the treatment-3 healthy turmeric seedlings of 35 to 45 days were used for transplanting. The data revealed that by practicing rapid multiplication of turmeric farmers can save >70% of the seed rhizome requirement per unit area. Weeding and irrigation water can be saved up to 45 days in main field. The treatment T_1 and T_2 were recorded highest plant height and number of tillers per clump at 150 DAP followed by T_1. Planting whole mother rhizome or primary rhizome having 30-40g weight recorded significantly higher weight of mother, primary and secondary rhizome. Significantly higher fresh rhizome weight of 23.4 t/ha was observed in treatment where entire mother rhizome was planted closely followed by planting of primary rhizome having 30-40g weight (23.24 t/ha). Higher net returns of Rs.1,35,384 /ha and higher B:C ratio of 1.68 was recorded in T_2. Thus, it can be concluded that by practicing conventional method of turmeric planting using mother or primary rhizome of better size (30-40g) a farmer can get >37 per cent of higher rhizome yield per unit area as compared to transplanting turmeric seedlings raised using single node. In turn it gives net profit of 1.27 to 1.35 lakh per ha. The technology of transplanting seedlings of turmeric is not ideally suited for Sakleshpur condition. The main drawback of rapid multiplication technology is seedlings should be raised at least 35-45 days earlier for the season which exactly coincide with coffee and pepper harvesting and drying operations. Hence mobilizing labour for purpose of turmeric seedling preparation will be challenging in Sakleshpur area. Above all poor growth characters exhibited by transplanted seedlings ultimately reflected in lower yield levels too.

Keywords: Turmeric, Rhizomes, transplanting, yield and net profit

Introduction

Turmeric (*Curcuma longa* L.) is one of the most important spice, essentially a tropical crop grown in India. India is the largest producer and exporter of turmeric in the world and accounts for more than 50 per cent of the world trade. The crop occupies major share of area in Telengana, Tamil Nadu, Andhra Pradesh, Karnataka and West Bengal. Turmeric is valued for its deep yellow colour (0.2-8% curcumin), pungency (2.2-4.2% termerol) and aromatic flavour of volatile oil (1.5-5%). During *vedic* period turmeric is referred as 'earthy herb of the sun' with the orange-yellow rhizome it was regarded as the 'scared spice' (Reshma *et al*., 2020) [1]. Sakleshpur falls under hilly zone of agro climatic zone-IX of Karnataka. Traditionally plantation crops like coffee, cardamom and black pepper are predominantly grown and rice is cultivated in the plain region. Due to escalating cost in paddy cultivation, farmers are alternatively attempting ginger cultivation in this area. Since ginger experiences high disease load and high cost in production alternatively turmeric is attempted. Turmeric is

hardy with majority of biotic and abiotic stress in comparison to ginger. As turmeric is propagated through vegetative means through rhizomes, large quantity of planting material is being used (>2.5 tonnes/ha), because of the low efficiency of vegetative propagation, which comprises >30 per cent of the production cost, also creates storage problem, handling issues, huge labour requirement and transportation problems. Apart from high seed rate, it is difficult to practice seed rhizome treatment because bulky nature. It adds additional cost for production. In rainfed conditions, serious irrigation problem areas and labour shortage areas it is quite difficult to carry out the operations timely. The survival percentage of plants through rhizomes is approximately 80-85 per cent only and there is no gap filling opportunity in the main field conditions. The mortality of 10-15 per cent also seen in case of rhizome planted seedlings. The establishment of the crop is confirmed only 45 days after sowing only. The availability of quality planting material is also low during the cropping season. In order to overcome these problems, a technology of rapid multiplication of turmeric using single bud rhizome has been assessed to know the suitability to the local conditions. In protray technique of turmeric, planting material requirement will be reduced; about 75 per cent of planting material requirement can be reduced. As rhizome is cut and used for the preparation of planting material, the diseased rhizome can be eliminated. So, it helps in screening of rhizomes for diseases and the planting material will be disease free. Due to these advantages, the turmeric transplants derived from rhizome bud can be selected as the planting material for turmeric cultivation which will augment the turmeric cultivation with good propagating materials and also increase the farmer income. It is not only a simple technique for adoption, but also accounts high success rate (Chandana, 2021) [2].

Material and methods

Material and methods

An observational field trial was conducted at Spices Board, Indian Cardamom Research Institutes' Regional Research Station, Sakleshpur, Karnataka, India. The study reported here was initiated in April 2022 and was repeated for a period of two seasons (2022-2023. 2023-2024). The area falls under hilly zone, (IX agroclimatic zone of Karnataka). The experiment was conducted under irrigated condition. The soil of experimental plot was sandy loam in texture, pH 5.9 organic carbon content 1.3%, phosphorus 18 kg/ha, potassium 338 kg/ha. Improved variety IISR Pratibha was used in the trial.

The trail was laid out in Randomized complete block design (RCBD) with seven replications and three treatments. The treatment details are as follows:

T1 - Planting of whole mother rhizomes (Seed rate 2500 kg/ha)

T2 - Planting of primary rhizomes of 30-40 gm weight (Seed rate 2000 kg/ha)

T3 - Transplanting turmeric seedling raised by single nodes rhizome weighing 6-7 gm (Seed rate 500 kg/ha)

The plot size is 3m x 1m (18 plants) was maintained. The spacing followed was 45 cm x 30 cm. For the treatment-3 the cut rhizomes were planted in pro-trays during first week of March. Fill the pro trays (50 well) with nursery medium containing partially decomposed coir pith and FYM (50:50), enriched with Trichoderma @ 10gm/kg of mixture. Sliced rhizomes are planted in portray and allowed for germination and growth. Healthy seedlings will be ready for transplanting by 35 to 45 days. All agronomic practices *viz*., irrigation, manuring, fertilizer application, weeding, plant protection was done according to the IISR Kozhikode guidelines Observations on growth attributes were recorded at 150 DAP. Obtained data was statistically analysed following statistical procedures outlined by Gomez and Gomez.1984 [3].

Results and discussion

Seed Rhizome Preparation: Significant differences were noticed with respect to the seed rhizome requirement per unit area, it was recorded that seed rate is very low i.e., 500 kg/ha in the treatment T3 (Rapid multiplication of turmeric) as compared to T1 (2500 kg/ha) and T2 (2000 kg/ha). The data revealed that by practicing rapid multiplication of turmeric a farmer can save up to 80 per cent of the seed rhizomes requirement and the production cost of Rs.40,000 to 45000 per ha. Here, only 500 kg seed rhizomes are sufficient for producing turmeric seedlings for planting in a hectare instead of 2000 to 2500 kg. Significant differences were noticed among the treatments with respect to plant height at different stages of crop growth (Table 1). The treatment T_2 and T_3 were recorded highest plant height and number of tillers per clump at 150 DAP followed by T_1. This might be due to well established healthy seedlings due to better size of mother rhizome and consistent supply food in the initial plant growth time. As once it emerges as a healthy plant and planted in the field, the favourable conditions, environment will boost and enhances the growth and plant acts normal, produces more and normal number of potential clumps per plant. Larger seed rhizomes contain a larger amount of reserves that enhanced seedling growth, which ultimately resulted in a taller plant Hossain *et al*. (2005) [4] and (Manjunathgoud, 2002). A significant variation was noticed for yield and yield attributes between the treatments. Table 1 shows highly significant variations among the treatments for the weight of mother, primary and secondary rhizome. Planting whole mother rhizome or primary rhizome having 30-40g weight recorded significantly higher weight of mother, primary and secondary rhizome.

Table 1: Effect of turmeric planting systems on growth and yield characters (pooled data of two years)

Treatments	Plant height (cm)	Number of tillers/clump	Mother rhizome weight (g/clump)	Primary rhizome weight (g/clump)	Secondary rhizome weight (g/clump)
T1 - Planting whole mother rhizome	120.8	7.8	65.25	230.2	38.9
T2 - Planting primary rhizomes of 30-40 gm weight	124.2	8.2	63.4	228.6	40.1
T3 - Transplanting turmeric seedling	108.4	3.4	45.2	170.2	12.4
S.Em (±)	3.1	0.4	2.2	3.8	1.8
CD @5%	9.3	1.2	6.6	11.4	5.4

Table 2: Effect of turmeric planting systems on yield characters (pooled data of two years)

Treatments	Fresh rhizome weight/clump (g/clump)	Fresh rhizome weight/ha (tonnes/ha)	Curing %	dry rhizome weight/ha (tonnes/ha)
T1 - Planting whole mother rhizome	334.30	23.40	20.56	4.81
T2 - Planting primary rhizomes of 30-40 gm weight	332.10	23.25	20.61	4.79
T3 - Transplanting turmeric seedling	227.80	15.95	20.62	3.29
S.Em (±)	9.8	0.98	0.52	0.24
CD @5%	29.4	2.94	NS	0.72

This has helped in realising higher fresh rhizome weight per clump in T_1 and T_2 as compared to T_3. Even though transplanted turmeric seedlings established well in field compared to regular rhizome planting, relative bio accumulation in the above ground was too poor. Hence low bio mass accumulation resulted in poor rhizome development. In fact, in the transplanted treatment T_3 there was very poor formation of secondary rhizomes. Hence it reduced further yield level. Due to over all reduction in growth as well as yield related attributes ultimately reflected in poor rhizome yield of turmeric in transplanted condition at Sakleshpur region. Significantly higher fresh rhizome weight of 23.4 t/ha was observed in treatment where entire mother rhizome was planted closely followed by planting of primary rhizome having 30-40g weight (23.24 t/ha) (Table.2) Yield of a turmeric increased as the seed size increased up to a certain level, and a further increase in seed size had little effect on the yield (Hossain *et al*. (2005) [4].

There is no significant difference with the curing percentage, it shows difference in the planting material may not affects the accumulation of the substrates in the rhizomes. The variety has exhibited its potential with respect to curing percentage, irrespective of the size of the planting material used for the propagation.

Higher net returns of Rs.1,35,384 /ha and higher B:C ratio of 1.68 was recorded in T2. This might be due to higher seed rhizome yield and lower expenses towards seed rhizome cost in comparison to planting entire mother rhizome. Higher yield contributed to increase in gross income and higher B:C ratio of T_1 and T_2. Thus it can be concluded that by practicing conventional method of turmeric planting using mother or primary rhizome of better size (30-40g) a farmers can get >37 per cent of higher rhizome yield per unit area. In turn it gives net profit of 1.27 to 1.35 lakh per ha. (Table.3)

Table 3: Effect of turmeric planting systems on economics (pooled data of two years)

Treatments	dry rhizome weight/ha (tonnes/ha)	Cost of production (Rs)	Gross return (Rs)	Net return (Rs)	B C ratio
T1 - Planting whole mother rhizome	4.81	2,10,000	3,36,837.6	1,26,837.6	1.60
T2 - Planting primary rhizomes of 30-40 gm weight	4.79	2,00,000	3,35,384.5	1,35,384.5	1.68
T3 - Transplanting turmeric seedling	3.29	1,80,000	2,30,164.6	50,164.56	1.28

Price of seed rhizome Rs 20/kg
Price of dried rhizome Rs 70,000/tonne

The technology of rapid multiplication of turmeric or planting seedlings of turmeric instead of regular rhizome planting is not ideally suited for Sakleshpur condition. The main drawback of rapid multiplication technology is seedlings should be raised at least 35-45 days earlier for the season which exactly coincide with coffee and pepper harvesting and drying operations. Hence mobilizing labour for purpose of turmeric seedling preparation will be challenging in Sakleshpur area. Above all poor growth characters exhibited by transplanted seedlings ultimately reflected in lower yield levels too. Summarizing the results obtained in the present study, we may conclude that turmeric can be successfully grown for higher fresh rhizome yield by conventional method of planting either mother or primary rhizome as compared to transplant system using single/two sprout with comparable yield and operational convenience. However, the transplant system benefitted significantly from reduced seed rhizome quantity. This would eventually reduce the cost incurred on seeds but not on net return. Hence transplanting technique may ideally suit for multiplication of rhizomes quickly under a situation where shortage of seed rhizome is critical.

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