Evaluation of performance of Turmeric (*Curcuma longa* L.)**varieties in Dharmapuri district of Tamil Nadu, India**

Abstract

Turmeric is an important spice crop cultivated in various states of India and Tamil Nadu is one of the leading producers of Turmeric. The productivity of Turmeric in Tamil Nadu was 3.80 MT/ha (cured rhizome yield) which is lower than the national productivity. Though there are various factors affecting productivity, choice of varieties was one of the important factors among them. On farm trials were conducted to study the performance of Turmeric varieties *viz.* BSR 1, BSR 2, CO 2, Allepey Supreme, PTS 10 and Roma at Krishi Vigyan Kendra, Papparapatty of Dharmapuri district. The experiment was conducted in randomized block design with three replications. The crop management practices are carried out as per Crop Production Guide 2020 of Tamil Nadu Agricultural University, Coimbatore recommendation. The yielddata revealed that there was significant variation among the turmeric varieties in various growth and yield determining parameters. Among the varieties CO 2 performed better than the other varieties with highest yield per plant (468.99 g), cured rhizome yield per hectare (6.82 tonnes/ha) followed by BSR 2. The results of the study show that CO 2 performed better in Dharmapuri district when compared to other varieties and hence can be preferably recommended to the farmers for better yield. The yield attributing factors *viz.* plant height, leaf size, weight of mother rhizome, weight and number of primary and secondary fingersare positively correlated with the yield per plant and hence can be used as criteria for varietal selection.

Key words: *Curcuma longa*, Cured rhizome, Primary fingers, Secondary fingers, Turmeric, Yield

Introduction

Turmeric (*Curcuma longa* L.) belonging to the family Zingiberaceae is an important spice crop of India which is of immense horticultural, social, traditional and medicinal values throughout the history of India. It is a native of tropical South Asia and center of domestication in Indian subcontinent. Turmeric is an important spice crop which is indispensible in Indian

kitchen. Apart from the culinary usage, turmeric is tremendously blooming as a source of medicinal principles of versatile native with proven scientific background. Traditionally it has been used for ages in alternative medicine. Turmeric powder is very frequently used in curries in Indian dishes (Bhowmik*et al*, 2009). It is used in digestion enhancement, as ananthelmentic,for menstrual problems, arthritis, blood purification, local application for wounds. (Bhowmik *et al*, 2009). Turmeric is proven to anefficient antimicrobial agent from time immemorial and has lot of scientific proof (Ankur Gupta *et al*, 2015;ParveenGuland and JehanBohht, 2015; Prasad and Aggarwal, 2011). The other Curcuma species are recognized for their health benefits (Hewlings and Kalman, 2017).

The countries involved in turmeric cultivation other than India are Bangladesh, Pakistan, Srilanka, Taiwan, China, Myanmar, Nigeria, Indonesia (Angles *et al*., 2011). India is the major producer of turmeric globally and 80% of its production consumed domestically.It is also being produced in Latin American countries like Jamaica, Peru and Brazil (Anne Plotto, 2004). India ranks first globally with and export quality of 1.37 tonnes turmeric worth 1,28,690.53 lakh rupees (Spice board 2021). In India, Karnataka, Andhra Pradesh, Tamil Nadu, Orissa and West Bengal are the leading states involved in Turmeric production (Angels *et al*., 2011). India's production is 943.30 thousand MT in 186 thousand hectares. Telangalna rakes first in area and production followed by Maharastra. Tamil Nadustands in third position with an area of 17000 ha and 12.12 lakhMT (Horticulture Statistics, 2017)

According to Horticulture Statistics (2017) the national productivity of India is 5.09 MT of cured rhizomes. Andhra Pradesh stands first is terms of productivity (7.11 t/ha) where as productivity of Tamil Nadu is 3.8 MT/ha. This shows the gap in turmeric productivity in Tamil Nadu when compared to the national and leading state average. A thorough study on value chain analysis in turmeric by directorate of Arecanut and Spices development, Calicut revealed in depth the reasons that affect the productivity in Turmeric (PadmajaKaja and Gelloboina, 2017). The variety of turmeric adopted is one of the major reasons that determine the productivity among the various other crop management techniques and socio economic factors are key in adoption of technologies. UtpalaPartharasarathy*et al.* (2006) also reported that the production growth rate is only 3.37 compared to the area growth rate which is 6.30. This clearly indicates the necessity of various improved agro technical practices adoption to increase the productivity.

Abeynayaka*et al.*(2020) reported that lack of knowledge on agricultural practicesandnon availability of labour as key reasons which affect turmeric productivity. Dipika (2012) has studied the technological gap in turmeric production. The reports reveal that there is 38 percent technological gap in turmeric varieties along with the various other factors such as seed rhizome treatment, disease management *etc*.

Hence, there is a need for micro level evaluation of varieties to increase the productivity. Therefore the present on farm trials were undertaken in Dharmapuri district ofNorthern Tamil Nadu to study the performance of turmeric varieties released by various institutes across India.

Materials and methods

Dharmapuri district belongs to the tropical region and receives an annual rainfall of 853 mm. Field experiment were conducted in two Kharif seasons during the year 2018 and 2019 at Krishi Vigyan Kendra of Tamil Nadu Agricultural University, Dharmapuri (India). Soil of the farm was red loamy which well drained and aerated. It is well suited for turmeric cultivation.Six turmeric varieties from various states of India *viz.* BSR 1, BSR 2, CO 2, Allepey Supreme, PTS 10 and Roma are tested for their performance.

The field was well ploughed and a raised bed of 15 cm height and 120 cm width. The crop management practices are carried out as per Crop Production Guide 2020 of Tamil Nadu Agricultural University, Coimbatore recommendation. The drip laterals are laid in the center of the raised bed and planting was done. Before planting seed rhizomes were treated with *Pseudomonas florescence* @ 10g/l of water. The seed rhizomes are dipped for 10 minutes and kept in shade. Then they were used for planting. Raised beds of 4 feet width were formed and three rows were planted in each bed at a spacing of 45 X 15 cm. Application of recommended dose of fertilizers through soil and fertigation was done. Irrigation was through drip system. Required pest and disease management strategies were followed. The experiment was conducted in randomized block design with three replications. The plant height was measured during the fourth month of planting in 120 DAP (days after ploughing). The number of tillers per plant, number of leaves per plant, leaf length, and leaf width were recorded at the same time. The rhizomes were harvested and the weight of primary rhizome and girth of primary fingers were recorded. The number of primary and secondary fingers in each clump was recorded. They were

cleaned and their weight was recorded. The weight of the clump per plant was also recorded and expressed as grams per plant. After recording the fresh weight the rhizomes were boiled and dried to determine the dry rhizome yield. The curing percentage was calculated as follows :

$$\text{Curing Percentage (\%)} = \frac{\text{Dry rhizome weight per hectare}}{\text{Fresh rhizome weight per hectare}} \text{ x } 100$$

The data obtained were analyzed statistically as per Gomez and Gomez (1984) using WASP 1.0 software and XLSTAT.

Results and discussion

Turmeric is water and nutrient loving crop and it responds well to fertilizer application. The yield data for two crops from the experiment were presented in Table 1, 2 and the pooled data in Table 3. The pooled data revealed that there was significant variation among the turmeric varieties in various growth and yield determining parameters. Among the varieties CO 2 performed better with highest plant height (112.62 cm) followed by BSR 2 (101.95 cm) according pooled data for both seasons. The shortest plants were found in PTS10 (84.34 cm). There was no significant difference between the varieties based on number of tillers per plant and leaf width. The number of leaves per plant were higher in CO 2 (17.67) followed Allepey supreme (14.67). The lowest number of leaves was found in BSR 1 (11.00). The leaf length was significantly higher in Roma (85.74 cm) followed by BSR 2 (83.79 cm). The lowest was found in PTS 10. The weight of mother rhizomes was higher in PTS 10 followed by Allepey supreme and BSR 2 (81.82 and 81.74 g respectively). The lowest weight was recorded in BSR 1 (68.88 cm)

The girth of mother rhizomes was highest in Roma (22.19 cm) followed by BSR 2 (21.27 cm). The lowest girth was recorded by BSR 1 (14.97). The number and weight of primary fingers per clump followed a different trend. The number of primary fingers was highest in Roma (8.50) followed by CO 2. But the weight was highest in CO 2 (244.27 g) followed byPTS 10 (220.49). This shows that though the number was higher weight in lesser due to the thickness of the primary fingers were highest in the CO 2.The number and weight of secondary rhizomes was the highest in CO 2 (19.00 and 109.39 g/ plant) followed by BSR 2 (16.83 and 87.95 g/ plant). The lowest value was recorded in Roma (11.50 and 62.15 g/ plant).

The yield per plant was weight of rhizome clump per plant was highest in CO 2 (468.99 g) followed by PTS 10 (375.90 g). The lowest weight was recorded in Roma (258.90 g). The estimated yield hence followed similar trend. The dried rhizome yield after curing was highest in CO 2 (7.55 tonnes/ha) followed by BSR 2 (6.82 tonnes/ha). The lowest cured rhizome yield was recorded in BSR 1 (5.72tonnes/ha) though Roma recorded the lowest fresh rhizome yield per hectare. It was due to the comparatively higher curing percentage in Roma than all the other varieties (22.20 %) which was followed by CO 2 (20.28 %). The lowest curing percentage was recorded by Allepey Supreme (18.97 %) which was on par with BSR 1 (19.01 %).

The correlation between the yield parameters of the turmeric varieties was prevented in Table4. The table shows that the yield parameters are positively correlated with the yield per plant except for leaf length and girth of mother rhizome.The plant height, number of leaves per plant, weight of mother rhizome, number and weight of primary and secondary fingers are all positively correlated with yield. Since rhizome has a different growth nature and in a rhizomatous crop, the correlationeffect of number and weight of primary and secondary fingers were high. It was even noted that enough number of primary fingers was high in PTS 10 the weight was lesser than BSR 2. This may be due to the fact that the size of the secondary fingerswas higher in BSR 2 than PTS 10 and this may be varietal character.

Similar reports were given by Ravi *et al.* (2017) in Ginger. The variety with higher number of primary and secondary fingers recorded highest yield. It was obvious that the vigorous plant growth with other yield determining factors lead to increase in yield (Karthikeyan *et al.* 2018). Venkatesa and Siddhlingayya (2016) claimed that the number of leaves per plant lead to increase in carbohydrate production. Similar result interpretation can be done in the present study. The variety CO 2 with higher number of leaves per plant recorded higher yield. The same authors had reported that the growth of genotypes under identical environment was the genetic constituent of the variety. Hence the performance of CO 2 with higher fresh and dry rhizome yield under the experimental condition shows its superiority under Dharmapuri conditions.

Many workers had reported that the increase in number of leaves, primary and secondary fingers number and weight resulted in higher yield in Turmeric (Kallappa*et al.* 2015*;* Goudar *et al*., 2017). Venkatesa and Siddhlingayya (2016) viewed that the varieties with good vigour and

yield components recorded the highest fresh rhizome yield. The important criteria in selection of turmeric varieties are curing percentage as cured rhizome is the economic produce to be marketed.

Venkatesa and Siddhlingayya (2016) claimed that the variation in the fresh rhizomes and curing percentage determine the final dried rhizome yield. In the present study though Roma recorded comaparatively lesser fresh rhizome yield, it gave highest curing percentage. This was in accordance with Ravindra Kumar *et al.* (2015). They reported that Roma recorded the highest curing percentage of 24.8 % than the other varieties under comparison. They reasoned out the increase in dry matter production as the key factor behind this increase in curing percentage. Similarly in case of the associated characters the number of tillers was high inRoma though not significantly higher than the other varieties.

Conclusion

The results of the on farm trials showed that CO 2 performed better with highest yield and yield attributing characteristicsfollowed by BSR 2 when compared to other varieties and hence can be preferably recommended to the farmers for better yield. The yield attributing factors *viz.* plant height, leaf size, weight of mother rhizome, weight and number of primary and secondary fingersare positively correlated with the yield per plant and hence can be use as criteria for varietal selection.

Table 1. Performance of Turmeric varieties for growth and yield characteristics (First crop)

Varieties	Plant height (cm)	No. of tillers per plant	No. of leaves	Leaf Length (cm)	Leaf width (cm)	Weight of mother rhizome (g)	Girth of mother rhizome (cm)	No. of primary fingers	Weight of primary fingers (g)	No. of secondary finger	Weight of secondary fingers (g)	Yield per plant (g)	Yield per hectare (tonne)	Cured rhizome yield (tonne)	Curing percentage
BSR 1	89.27	3.00	11.67	75.17	13.84	69.55	15.23	8.33	134.90	16.00	69.00	290.45	30.51	5.92	19.41
BSR 2	101.97	3.33	14.00	85.87	13.67	83.87	21.44	8.33	165.90	17.33	87.37	348.53	37.25	6.73	18.07
CO 2	113.03	3.00	17.67	86.27	15.20	86.36	15.59	12.33	252.33	20.00	115.07	492.59	35.17	7.19	20.44
Alleppey Supreme	99.17	3.33	15.33	72.70	13.34	82.91	18.34	6.67	151.50	15.67	62.87	324.24	31.97	5.55	17.92
PTS 10	85.97	3.67	14.00	71.77	15.89	84.03	20.42	7.33	235.39	14.00	80.66	383.02	33.60	6.13	18.24
Roma	104.80	4.33	11.33	76.40	15.36	78.53	21.54	8.67	119.63	12.67	63.10	282.26	28.97	6.30	21.75
S.Ed	5.269	0.000	1.628	2.820	0.000	4.012	1.184	0.886	6.666	1.360	2.014	3.280	2.233	0.449	0.220
CD (0.05)	14.377	-	4.444	7.950	-	10.947	3.230	2.418	18.189	5.233	7.430	177.069	6.092	1.225	0.600

Table 2. Performance of Turmeric varieties for growth and yield characteristics (Second crop)

Varieties	Plant height (cm)	No. of tillers per plant	No. of leaves	Leaf Length (cm)	Leaf width (cm)	Weight of mother rhizome (g)	Girth of mother rhizome (cm)	No. of primary fingers	Weight of primary fingers (g)	No. of secondary finger	Weight of secondary fingers (g)	Yield per plant (g)	Yield per hectare (tonne)	Cured rhizome yield (tonne)	Curing percentage
BSR 1	87.73	2.67	10.33	74.97	13.47	68.20	14.70	6.67	118.21	15.00	66.43	249.05	29.59	5.51	18.61
BSR 2	101.93	3.33	12.33	81.70	13.30	79.60	21.10	7.67	139.00	16.33	88.53	321.12	34.71	6.90	19.87
CO 2	112.20	3.67	17.67	85.20	14.80	69.23	15.33	9.67	236.21	18.00	103.70	445.38	39.25	7.90	20.12
Allepey Supreme	94.97	3.33	14.00	77.13	12.83	80.73	18.00	5.67	131.07	16.67	59.67	308.07	30.30	5.54	18.28
PTS 10	82.70	3.67	13.67	76.13	15.43	82.67	21.13	6.67	205.59	15.67	72.67	368.78	32.89	6.29	19.12
Roma	95.87	4.33	11.67	73.27	15.83	80.77	22.83	8.33	102.40	10.33	61.20	235.53	27.42	6.21	22.65
S.Ed	2.604	0.000	1.235	2.603	0.000	3.179	0.900	0.795	6.391	1.479	7.935	7.169	0.985	0.376	0.958
CD (0.05)	7.105	-	3.371	7.103	-	8.674	2.455	2.169	17.439	4.036	21.651	19.651	2.687	2.687	2.615

Table 3. Performance of Turmeric varieties for growth and yield characteristics (Pooled data)

Varieties	Plant height (cm)	No. of tillers per plant	No. of leaves	Leaf Length (cm)	Leaf width (cm)	Weight of mother rhizome (g)	Girth of mother rhizome(cm)	No. of primary fingers	Weight of primary fingers (g)	No. of secondary finger	Weight of secondary fingers (g)	Yield per plant (g)	Yield per hectare (tonne)	Cured rhizome yield (tonne)	Curing percentage
BSR 1	88.50	2.84	11.00	75.07	13.66	68.88	14.97	7.50	126.56	15.50	67.72	269.75	30.05	5.72	19.01
BSR 2	101.95	3.33	13.17	83.79	13.49	81.74	21.27	8.00	152.45	16.83	87.95	334.83	35.98	6.82	18.97
CO 2	112.62	3.34	17.67	85.74	15.00	77.80	15.46	11.00	244.27	19.00	109.39	468.99	37.21	7.55	20.28
Alleppey Supreme	97.07	3.33	14.67	74.92	13.09	81.82	18.17	6.17	141.29	16.17	61.27	316.16	31.14	5.55	18.10
PTS 10	84.34	3.67	13.84	73.95	15.66	83.35	20.78	7.00	220.49	14.84	76.67	375.90	33.25	6.21	18.68
Roma	100.34	4.33	11.50	74.84	15.60	79.65	22.19	8.50	111.02	11.50	62.15	258.90	28.20	6.26	22.20
S.Ed	2.60	0.00	1.24	2.60	0.00	3.18	0.90	0.79	6.39	1.48	7.93	7.17	0.98	0.38	0.96
CD (0.05)	8.710	-	3.021	5.798	-	8.457	2.471	1.097	13.657	3.316	11.356	13.509	3.503	0.742	1.258

Table 4. Correlation matrix among different traits of Turmeric

Variables	Plant height	No. of tillers per plant	No. of leaves	Leaf Length	Leaf width	Weight of mother rhizome	Girth of mother rhizome	No. of primary fingers	Wt. of primary fingers	No. of secondary finger	Wt. of secondary fingers	Yield per plant	Yield per hectare	Cured rhizome yield	Curing percentage
Plant height	**1**	0.118	0.602	0.809	-0.016	0.107	-0.136	0.776	0.226	0.446	0.630	0.477	0.494	0.746	0.438
No. of tillers per plant	0.118	**1**	-0.123	-0.235	0.702	0.550	0.769	0.099	-0.122	-0.700	-0.229	-0.161	0.336	0.099	0.714
No. of leaves	0.602	-0.123	**1**	0.615	0.083	0.362	-0.322	0.511	0.815	0.755	0.739	0.925	0.753	0.631	-0.150
Leaf Length	0.809	-0.235	0.615	**1**	-0.111	0.057	-0.211	0.750	0.476	0.737	0.899	0.668	0.855	0.886	0.090
Leaf width	-0.016	0.702	0.083	-0.111	**1**	0.229	0.340	0.412	0.404	-0.399	0.177	0.257	-0.049	0.362	0.633
Weight of mother rhizome	0.107	0.550	0.362	0.057	0.229	**1**	0.720	-0.176	0.282	-0.062	0.061	0.283	0.276	0.170	-0.081
Girth of mother rhizome	-0.136	0.769	-0.322	-0.211	0.340	0.720	**1**	-0.282	-0.249	-0.618	-0.302	-0.304	-0.185	-0.045	0.278
No. of primary fingers	0.776	0.099	0.511	0.750	0.412	-0.176	-0.282	**1**	0.487	0.383	0.799	0.605	0.513	0.891	0.591
Wt. of primary fingers	0.226	-0.122	0.815	0.476	0.404	0.282	-0.249	0.487	**1**	0.634	0.789	0.957	0.775	0.652	-0.178
No. of secondary finger	0.446	-0.700	0.755	0.737	-0.399	-0.062	-0.618	0.383	0.634	**1**	0.767	0.761	0.848	0.517	-0.499
Wt. of secondary fingers	0.630	-0.229	0.739	0.899	0.177	0.061	-0.302	0.799	0.789	0.767	**1**	0.884	0.919	0.932	0.044
Yield per plant	0.477	-0.161	0.925	0.668	0.257	0.283	-0.304	0.605	0.957	0.761	0.884	**1**	0.866	0.762	-0.133
Yield per hectare	0.494	-0.336	0.753	0.855	-0.049	0.276	-0.185	0.513	0.775	0.848	0.919	0.866	**1**	0.790	-0.282
Cured rhizome yield	0.746	0.099	0.631	0.886	0.362	0.170	-0.045	0.891	0.652	0.517	0.932	0.762	0.790	**1**	0.362
Curing percentage	0.438	0.714	0.150	0.090	0.633	-0.081	0.278	0.591	-0.178	-0.499	0.044	-0.133	-0.282	0.362	**1**

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