International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(1): 1480-1483

Received: 11-11-2018
Accepted: 15-12-2018

Vamshi Krishna S
Ph. D. Research Scholar (Hort.), Department of Plantation, Spice, Medicinal and Aromatic crops, Bidan Chandra Krishi Vishwavidyalaya, Mohanpur, Nadia, West Bengal, India

Sivakumar V
HRS, Dr. YSR Horticultural University, Chintapalli, Andhra Pradesh, India

Umajyothi K
COH, Dr. YSR Horticultural University Venkataramannagudem, West Godavari Dist, Andhra Pradesh, India

Dorajeerao AVD
COH, Dr. YSR Horticultural University Venkataramannagudem, West Godavari Dist, Andhra Pradesh, India

Umakrishna K
COH, Dr. YSR Horticultural University Venkataramannagudem, West Godavari Dist, Andhra Pradesh, India

Correspondence
Vamshi Krishna S
Ph. D. Research Scholar (Hort.), Department of Plantation, Spice, Medicinal and Aromatic crops, Bidan Chandra Krishi Vishwavidyalaya, Mohanpur, Nadia, West Bengal, India

Evaluation of turmeric (*Curcuma longa* L.) genotypes for yield and quality characters under high altitude and tribal zone of Andhra Pradesh

Vamshi Krishna S, Sivakumar V, Umajyothi K, Dorajeerao AVD and Umakrishna K

Abstract
To identify the best genotype suitable for High Altitude and Tribal Zone of Visakhapatnam, an experiment was carried out with nineteen genotypes of turmeric in Randomized Block Design with three replications during *Kharif* 2017 at Horticulture Research Station, Dr. Y.S.R.H.U, Chinthapalli, Visakhapatnam District. The maximum fresh weight of rhizomes per plant was recorded in CLA-3 (658.32 g), maximum dry weight of rhizomes per plant was recorded in CLA-5 (123.14 g) and maximum yield per plot was observed in CLA-3 (15.10 kg), whereas the minimum was recorded in CLA-10 (8.04 kg). The maximum estimated fresh rhizome yield per hectare was recorded in CLA-3 (50.35 t) and the lowest in the genotype CLA-10 (26.80 t). The maximum dry recovery percentage was recorded in CLA-6 (27.86%) and CLA-11 recorded the highest curcumin content (5.35%) and oleoresin content of rhizomes (10.13%) compared to other genotypes under HAT zone conditions.

Keywords: evaluation, turmeric, yield, quality, high altitude and tribal zone

Introduction
Turmeric (*Curcuma longa* L.) is one of the important spice and also condiment crops grown in India since times immemorial. It is regarded as a symbol of well-being and widely used in ceremonies and religious functions. It is an erect, herbaceous perennial belonging to the family *Zingiberaceae* and native to South East Asia. Turmeric of commerce is the dried underground rhizome, valued for its deep yellow colour and pungent aromatic flavour due to the presence of colouring matter ''Curcumin'' and a volatile oil ''Termerole''. It is also an important condiment which finds a unique place in culinary arts and as a colouring agent in textile, food, confectionary, cosmetics and drug industries in the preparation of anticancer medicines. Turmeric is either grown as a pure crop or inter/mixed crop in coconut, areca nut and coffee plantations. In India, it is being cultivated in more than 20 states in an area of 2.37 lakh ha with an annual production of 11.63 MT and earning 1241.89 crores by exporting 1.16 MT to other countries. In India, it is mainly grown in Telangana, Andhra Pradesh, Odisha, West Bengal, Tamil Nadu, Assam, Maharashtra, Karnataka, Bihar and Kerala. Among these, Telangana occupies 50,000 ha of the total area and 2.55 MT of total production of the country. The national productivity of crop is 5 tonnes per hectare. (NHB, 2017-18).
Even though wide genetic variability exists in turmeric with regards to yield and quality parameters, no much work has been done on crop improvement through section of superior types in combination with high yield as well as quality under high altitude and tribal zone of Andhra Pradesh. So, recommendations are not available regarding suitability of varieties especially for this region. Keeping in view of the above, this experiment was done.

Materials and Methods
The experimental site was located in the Horticulture Research Station, Chinthapalli, Andhra Pradesh. The location falls under Agro-climatic zone of High Altitude and Tribal Zone with average annual rainfall from South-West monsoon of more than 1300 mm, maximum temperature range 17 to 35 ºC, minimum temperature range from 5 to 24 ºC and is located at an altitude of 933 m MSL. The geographical situation is 170.13' N latitude and 840.33' E longitudes. The experiment was laid out in Randomised Block Design with 19

treatments and 3 replications. The planting was done on raised beds spaced row to row 30 cm with plant to plant distance of 25 cm and the net plot size was 3 x 1 m^2. The soil of the experimental field was alluvial and it was endowed with good drainage. Recommended package of practices and plant protection measures were followed to raise a healthy crop. The observations were recorded for growth parameters *viz*., fresh and dry weight of rhizome per plant (g), yield per plot (kg) and estimated fresh and dry yield per hectare (t), duration of crop (days), dry recovery (%), curcumin content (%) and oleoresin content (%). The data were analysed as per statistical procedure given by Verma *et al.* (1987).

Results and Discussion

In the present investigation, different turmeric cultivars showed significant variation with regard to the number of days taken from planting to harvest varied from 196-255 days. Roma took more number of days (255 days) to attain maturity, followed by CLA-6 (254 days) and CLA-13(252 days) whereas minimum number of days taken from planting to harvest by Chinthapalli Local (196 days) followed by CLA-7 (211 days) and CLA-11 (212 days) (Table 1). The short duration genotypes exhibited moderate growth and yield, while the medium and long duration excelled in plant and rhizome characters which can be ascribed due to the accumulation of more dry matter, maintenance of leaf area and chlorophyll content for longer period, which was reflected in the final yield. However, the genotype CLA-4, even though it was long duration (250 days) type, the yield was very low (28.1 tonnes per hectare) and the reason could be attributed to the growth and development of the genotypes, which were highly depend on the climate conditions and soil factors under which they were grown and also the region specificity of the genotype. These results are in line with the findings of Shanmugasundaram (2001) [12], Singh *et al.* (2008) [14] and Ravindrakumar *et al.* (2015) [11].

The maximum fresh weight of rhizomes per plant was recorded in CLA-3 (658.32 g) followed by CLA-5 (574.35 g) and CLA-2 (451.51 g). The maximum dry weight of rhizomes per plant was recorded in CLA-5 (123.14 g) followed by CLA-3 (114.94 g). The maximum yield per plot was observed in CLA-3 (15.10 kg), whereas the minimum was recorded in CLA-10 (8.04 kg). The maximum estimated fresh rhizome yield per hectare was recorded in CLA-3 (50.35 t), which was followed by CLA-5 (48.49 t) and these two were on par with each other. The lowest estimated fresh rhizome yield was recorded in the genotype CLA-10 (26.80 t). The yield is governed by genetic and environmental factors and varies with the genotypes which are in collaboration with the findings of Sheshagiri and Uthaiaha (1994) [13] and Nirmal *et al.* (1993) [7]. The yield of any crop majorly depends on the vigour of the plant as indicated by various growth parameters like plant height, number of leaves and rhizome characters. The best growth normally results in high yield and is influenced by genetic and environmental factors too under which the crop is grown. The highest estimated fresh rhizome yield per ha was recorded in CLA-3 (50.35 tonnes per hectare), followed by CLA-5 (48.49 tonnes per hectare), whereas the highest estimated dry rhizome yield per ha was recorded in CLA-5 (10.14 t) and it was followed by NDH-98 (9.23 t) and CLA-1 (8.90 t). (Table 1), It might be attributed to the active photosynthesis favouring accumulation and assimilation of carbohydrates, as this genotype had recorded higher values for plant height, number of leaves and leaf area. These results are in concordance with the earlier works of Yadav (2002) [17], Pirjade *et al.* (2007) [8] and Jadhav *et al.* (2009) [4] in turmeric with regard to the relationship between yield and growth parameters.

The maximum dry recovery percentage was recorded in CLA-6 (27.86%) followed by Roma (27.31%) and CLA-10 (26.94%) and these three genotypes were on par with one another, whereas the minimum dry recovery percentage was recorded in CLA-3 (15.63%) (Table 2), the results obtained from this investigation for dry recovery are in conformity with the findings of Rao *et al.* (2004) [9] who reported that high dry recovery in Armoor, a long duration type and opined that dry recovery increased with increase in age and attains its peak at maturity. On contrary, Ratnambal (1986) [10], Ghosh and Govind (1982) [3] and Anandaraj *et al.* (2014) [1] reported that the most of the short and medium duration genotypes were having more dry recovery percentage than long duration types. However the dry recovery depends on the genotype, duration, soil, major and micronutrients, management practices and agro-climatic conditions.

Among the genotypes CLA-11 recorded the highest curcumin content (5.35%), followed by Chinthapalli Local (5.02%) and CLA-1 (4.73%) and the lowest curcumin content was observed in CLA-12 (1.55%) followed by CLA-4 (2.16%). The maximum oleoresin content of rhizomes (10.13%) was recorded in IISR-Prathibha, followed by CLA-8 (8.72%) and NDH-98 (8.17%), while the lowest oleoresin content was recorded in BSR-2 (3.83%) (Table 2), several reports on curcumin content showed contradictory results and variations in curcumin content in different agro-climatic conditions. (Manohar Rao *et al.* 2005. Sinkar *et al.* 2005. Singh *et al.* 2013. Anandaraj *et al.* 2014. Geethanjali *et al.* 2016 and Mohan *et al.* 2017) [5, 16, 15, 1, 2], this quality trait is highly sensitive to micro, macro changes in environment and variations in different agro-climatic conditions. Similar results were also reported by Ghosh and Govind (1982) [3].

From the present investigation it was concluded that for fresh rhizome yield per hectare, genotypes CLA-3 (50.35 t), CLA-5 (48.49 t) and CLA-7 (40.52 t) were excelled than both the checks *i.e.* IISR Prathibha (28.84 t) and Chinthapalli Local (25.86 t), whereas dry yield per hectare was highest in CLA-5 (10.14 t) and it was followed by NDH-98 (9.23 t) and CLA-1 (8.90 t). With regards to quality parameters, highest curcumin content was observed in CLA-11 (5.35%), followed by Chinthapalli Local (5.02%) and CLA-1 (4.73%) respectively and highest oleoresin was observed in IISR-Prathibha (10.13%), followed by CLA-8 (8.72%) and NDH-98 (8.17%). Hence, these genotypes can be adopted for commercial cultivation after further testing.

Table 1: Mean performance of turmeric genotypes for rhizome yield.

S. No	Genotypes	Duration of the crop (days)	Fresh weight of rhizome per plant (g)	Dry weight of rhizome per plant (g)	Yield per plot (kg)	Estimated fresh rhizome yield per ha (t)	Estimated dry rhizome yield per ha (t)
1.	CLA-1	233.00	384.51	95.63	10.87	36.24	8.90
2.	CLA-2	232.00	451.51	78.98	11.24	37.49	6.15
3.	CLA-3	233.00	658.32	114.94	15.10	50.35	7.85
4.	CLA-4	250.00	326.04	87.79	8.43	28.10	7.01
5.	CLA-5	236.00	574.35	123.14	14.54	48.49	10.14

6.	CLA-6	254.00	275.88	77.58	8.56	28.55	7.96
7.	CLA-7	211.00	397.44	76.15	12.15	40.52	7.33
6.	CLA-8	212.00	315.31	64.70	9.51	31.70	5.89
9.	CLA-9	212.00	291.86	62.02	10.17	33.90	6.78
10.	CLA-10	240.00	301.03	77.31	8.04	26.80	7.19
11.	BSR-2	238.00	385.83	87.71	9.17	30.56	5.86
12.	CLA-11	212.00	183.63	41.38	8.39	27.97	6.44
13.	CLA-12	213.00	332.04	68.42	10.33	34.44	6.27
14.	CLA-13	252.00	369.27	79.83	10.47	34.92	8.79
15.	CLA-14	212.00	334.25	63.25	9.35	31.19	6.02
16.	NDH-98	238.00	385.83	87.71	10.99	36.65	9.23
17.	Roma	255.00	306.28	91.60	8.76	29.21	7.97
18.	IISR-Prathibha	241.00	379.24	87.11	8.65	28.84	6.92
19.	Chinthapalli Local	196.00	250.92	45.71	7.71	25.86	4.46
	SE(m) ±	2.01	11.30	4.30	0.93	3.10	0.73
	CD at 5%	5.79	32.43	12.34	2.70	8.94	2.10

Table 2: Mean performance of turmeric genotypes for quality parameters.

S. No	Genotypes	Dry recovery(%)	Curcumin content (%)	Oleoresin content (%)
1.	CLA-1	24.45 (29.62)*	4.73 (12.55)*	6.94 (15.25)*
2.	CLA-2	16.55 (23.99)	3.38 (10.59)	7.08 (15.42)
3.	CLA-3	15.63 (23.26)	3.26 (10.40)	6.44 (14.70)
4.	CLA-4	25.09 (30.04)	2.16 (8.44)	7.0 (15.34)
5.	CLA-5	20.83 (27.14)	4.45 (12.17)	7.46 (15.84)
6.	CLA-6	27.86 (31.84)	4.62 (12.40)	4.84 (12.71)
7.	CLA-7	18.03 (25.10)	3.56 (10.86)	5.88 (14.02)
6.	CLA-8	18.52 (25.47)	4.25 (11.89)	8.72 (17.17)
9.	CLA-9	20.05 (26.59)	3.78 (11.20)	5.04 (12.95)
10.	CLA-10	26.94 (31.25)	3.11 (10.16)	5.34 (13.34)
11.	BSR-2	25.23 (26.00)	4.71 (12.52)	3.83 (11.27)
12.	CLA-11	22.99 (28.62)	5.35 (13.37)	6.90 (15.21)
13.	CLA-12	18.06 (25.11)	1.55 (7.15)	6.86 (15.18)
14.	CLA-13	25.29 (30.17)	3.86 (11.32)	4.15(11.74)
15.	CLA-14	19.27 (26.03)	4.57 (12.33)	3.85 (11.30)
16.	NDH-98	25.23 (30.13)	2.55 (9.18)	8.17 (16.59)
17.	Roma	27.31 (31.49)	4.41 (12.11)	5.24 (13.22)
18.	IISR-Prathibha	23.87 (29.23)	4.29 (11.91)	10.13 (18.54)
19.	Chinthapalli Local	17.18 (24.47)	5.02 (12.93)	6.52 (14.78)
	SE(m) ±	0.55	0.25	0.28
	CD at 5%	1.57	0.73	0.82

*Figures in the parenthesis are angular transformed values

References

1. Anandaraj M, Prasath D, Kandiannan K, Johnzachariah T, Srinivasan V, Jha AK *et al*. Genotype by environment interaction effects on yield and Curcumin in turmeric (*Curcuma longa* L.). Industrial Crops and Products. 2014; 53:358-64.
2. Geethanjali A, Lalitha P, Jannathul Firdhouse M. Analysis of Curcumin Content of Turmeric Samples from Various States of India International Journal of Pharma and Chemical Research. 2016; 2(1).
3. Ghosh SP, Govind S. Yield and Quality of Turmeric in North-Eastern Hills Indian Journal of Horticulture. 1982; 39(3):230-32.
4. Jadhav GG, Kankal DS, Ganvir MM. Evaluation of turmeric genotypes in relation to growth, yield and quality parameters. Annals of Plant Physiology. 2009; 23(2):204-06.
5. Manohar RA, Venkat Rao P, Naranayana Reddy Y. Growth analysis and Curcumin conent of long, medium and short duration turmeric (*Curcuma longa* L.) genotypes. Journal of Spice and Aromatic Crops. 2005; 15(1):42-47.
6. NHB. State wise area and production of spices In: Indian Horticulture Board data base, 2014, Ed. Chander, P. Gandi, National Horticulture Board, Ministry of Agriculture and Farmers welfare, Government of India, Gurgaon, 2015. (http://www.nhb.gov.in).
7. Nirmal BK, Sasikumar B, Ratnambal MJ, George Johnson, Ravindran PN. Genetic variability in turmeric (*Curcuma longa* L.). The Indian Journal of Genetics and Plant Breeding. 1993; 53(191-93):0019-5200.
8. Pirjade FN, Jogdande ND, Nandre DR, Ghawade SM, Patil PA. Varietal performance of turmeric. Plant Archives. 2007; 7(1):363-64.
9. Rao AM, Rao PV, Reddy YN, Ganesh M. Variability and correlation studies in turmeric (*Curcuma longa* L.). Crop Research Hisar. 2004; 27(2, 3):275-81.
10. Ratnambal MJ. Evaluation of turmeric accessions for quality. Qualitas Plantarum Plant Foods for Human Nutrition. 1986; 36(3):243-252.
11. Ravindrakumar K, Narasimha RS, Raja Kumar N. Evaluation of turmeric (*Curcuma longa* L.) cultivars at agency areas of north coastal Andhra Pradesh. An International Journal Society for Scientific Development in Agriculture and Technology. 2015; 10(4):2417-420.
12. Shanmugasundaram KA, Thangaraj T, Azhakiamanavalan RS, Ganga M. Evaluation and selection of turmeric (*Curcuma longa* L.) genotypes.

Journal of Spices and Aromatic Crops. 2001; 10(1):33-36.
13. Sheshagiri KS, Uthaiah BC. Performance of turmeric (*Curcuma longa* L.) varieties at the hill zone of Karnataka, India. Journal of Spices & Aromatic Crops. 1994; 3(2):161-63.
14. Singh B, Kumar Mukul, Kumar Deepak, Pal MK. A study on character association, variability, heritability and genetic advance in turmeric (*Curcuma longa* L.). Advances in Plant Sciences. 2008; 21(2):641-43.
15. Singh BK, Ramakrishna Y, Verma VK, Pathak KA. Varieties and planting dates affect the growth, yield and quality of turmeric (*Curcuma longa* L.) in mild-tropical environment. Veg. Sci., 2013; 40(1):40-44.
16. Sinkar PV, Haldankar PM, Khandekar RG, Ranpise SA, Joshi GD, Mahale BB. Preliminary evaluation of turmeric (*Curcuma longa* L.) varieties at Konkan region of Maharashtra. Journal of Spices and Aromatic crops. 2005; 14(1):28-33.
17. Yadav RK. Performance of ginger and turmeric genotypes in Raigarh district of Chhattisgarh. Journal of Spices and Aromatic Crops. 2002; 11(1):62-63.