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Evaluation of turmeric genotypes based on growth, yield and quality traits

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Abstract
The investigation entitled evaluation of turmeric genotypes based on growth, yield and quality traits was conducted in Lam Farm, HRS, Guntur District, Andhra Pradesh. The experiment was laid out in Augmented block design (ABD) with forty genotypes and six checks. The genotypes were collected from different sources from Andhra Pradesh and different turmeric growing regions of the country. Observations were recorded on various growth, yield and quality characters. Among the 46 accessions studied including check varieties the genotypes, CA-69 recorded more number of leaves, and CLI-342 recorded more number of tillers. Number of primary rhizomes and mother rhizomes were recorded highest in AC-94 (5.18) and NDH-4 (18.12) and high clump yield per plant in AC-94. (497.20g) while the accessions, Duggirala red, AC-94 and IC- 181919 recorded more weight in mother, primary and secondary rhizomes per plant respectively. Regarding qualitative traits the genotype JTS-315 possessed high curcumin content in rhizomes (58.73 mg/g) and curcumin yield in CLI-342 (5.17 g/plant). Thus, these genotypes may be recommended for commercial cultivation in Andhra Pradesh. They can also be further evaluated to identify best genotypes suitable for cultivation at other locations and also in breeding programmes.

Keywords: ABD, genotypes, checks, curcumin

Introduction
Turmeric (*Curcuma longa* L.) is an herbaceous, perennial plant that belongs to Zingiberaceae family. It is a native of South East Asia particularly India. It is cultivated for its underground rhizome. Turmeric rhizome is the commonly used additive which gives flavour, colour and add spicyness to food preparations in South East Asian countries. The rhizome is valued for its medicinal property and its usefulness as dyeing agent to cotton, silk, *etc*., (Appaji Rao and Sarmal, 1962) [5]. Turmeric is popularly known to the western world throughout history as 'Indian saffron' due to its color and inimitable smell. The rhizome of the turmeric contains colouring pigments known as 'curcuminoids'. The volatile oil contains 'turmerone', which contributes to the typical aroma of the rhizome.

Though, the rhizome is in whole or ground form it is widely used across the world, its cultivation is mainly restricted to South East Asia and partly in Latin America. India is the largest producer and the exporter of turmeric. It ranks fourth in terms of the foreign exchange earning among spices (Naidu and Murthy, 1989). The total area under cultivation and production of turmeric has recorded an increasing trend in the country. In India, the total area under cultivation is 222 thousand hectares with a production of 1056 thousand metric tonnes during 2016-17 (National Horticulture database, 2016-17). Telangana ranked first in production of turmeric in India (2015-16) followed by Maharashtra, Tamil Nadu and Andhra Pradesh. During 2016-17, an estimated area of 16.60 thousand hectares was under cultivation with a production of 134.10 thousand metric tonnes in Andhra Pradesh. Turmeric was extensively cultivated in the districts of Kurnool, Guntur, Kadapa, West Godavari, Visakhapatnam, Krishna and East Godavari in Andhra Pradesh.

It is a traditional medicine used in Ayurveda, Unani, Siddha and other ethno-medicine systems. Turmeric and its bio-active component 'curcumin' have received considerable attention due to their many recognized biological activities. The anti-oxidant attributes of this spice protect against the high energy free radical damage to organic cells (Maheshwari *et al*., 2006). The antibacterial, antiviral, antifungal and antiinflammatory properties of this herb offer effective cure for several diseases (Negi *et al*., 1999; Kim *et al*., 2009; Chen *et al*., 2010; Koosirirat *et al*., 2010) [34, 9, 23].

It is also reported to detoxify the liver, balance cholesterol levels, fight allergies, stimulate digestion, boost immunity and enhance the complexion (Patel and Srinivasan, 1996; Ram *et al.*, 2003; Arafa, 2005) [36, 42, 4]. The other effects such as anti-inflammatory, effects on the gastrointestinal tracts, hepatoprotective activity, anticancer, antitumour and antiproliferative activities, metabolic disorders, immune-stimulants activity, anti-microbial and antiviral and wound healing are widely appreciated (Srimal, 1997) [54].

Phytonutrients play a crucial role in many of the chronic diseases due to their pharmacological and biological properties. The curcuminoids in turmeric are a mixture of demethoxy curcurnin and bis-demethoxy curcumin, curcumin being the main constituent. Curcumin, derived from the rhizome of turmeric is a linear diarylheptanoid, possessing excellent medicinal properties. It is a small molecular weight polyphenolic compound (1, 7-bis (4-hydroxy-3-methoxyphenyl)-1,6-heptadien-3,5-dione) lipophilic in nature. Curcumin is a free radical scavenger with rich antioxidant activity, binds metals, particularly iron and copper, and can function as an iron chelator. It is remarkably non-toxic and exhibits limited bioavailability. Curcumin exhibits great promise as a therapeutic agent and is currently in human clinical trials for a variety of conditions, including cancer, myelodysplastic syndromes, colon cancer, psoriasis and Alzheimer's disease. Curcumin and its derivatives were found to be effective in the treatment of inflammatory disorder (Villagaes *et al*., 2008) [18], anorexia, cough, diabetic wounds (Mohamed *et al*., 2009) [6], tumors, hepatic disorder, cardiovascular disease, rheumatism, sinusitis, multiple sclerosis (Valsala and Peter, 2007) [19], antimicrobial activity and health problems (Morshed *et al*., 2011) [8].

Materials and Methods

The present experimental investigation was carried out during *kharif* in 2017-2018 at Horticultural research station, Guntur District, Andhra Pradesh. The experimental site was situated at an altitude of 31.5 meters above mean sea level, 16° 18° N latitude, 80° 29° E longitude and about 8 km away from the Guntur town in the Krishna-Godavari Agro-climatic zone of Andhra Pradesh India. The soil of the experimental site is rich black cotton soil and has PH of 8.4, EC of 0.16 mmhos/cm and good moisture retentive capacity. The available NPK contents were 200-250, 70-90 and 800-850 kg/ha^{-1}, respectively. The entire experimental area was leveled and divided into plots with a dimension of 2 m x 1.2 m. with a spacing of 60 cm x 20 cm. Seed material (rhizomes) was obtained from last season's crop grown at Horticultural Research Station Lam, Guntur. The healthy seed material was procured. Primary rhizomes were used for planting the crop. The seed material was treated with 1 g l^{-1} Carbendazim and 1 ml l^{-1} Malathion solution for thirty minutes before sowing. The seed material was shade dried for one day and used for planting. The crop is supplied with 25 t ha^{-1} FYM at the time of preparatory cultivation. The recommended dose of 300 kg N, 125 kg P_2O_5 and 200 kg K_2O per hectare was applied as per the package of practices given by Dr YSR Horticultural University to raise a healthy crop. The data was recorded from five randomly selected plants from each treatment in each replication.

Results and Discussion

The data collected on all the fifteen characters were statistically analyzed and the Analysis of Variance of Treatments is presented in Table 1. The perusal of the table indicated that significant differences among the genotypes under the study for all the fifteen traits at 1% probability level except for Leaf width *viz.*, plant height (cm), number of tillers per plant, number of leaves, leaf length (cm), leaf width (cm), number of mother rhizomes, weight of mother rhizomes, number of primary rhizomes, weight of primary rhizomes, number of secondary rhizomes, weight of secondary rhizomes, clump weight, dry recovery, curcumin content in rhizomes and curcumin yield per plant (g).

Evaluation of different quantitative and qualitative traits:

Plant height (cm)

The plant height measured at 150 DAP varied significantly among the genotypes. The values ranged from 105.97 cm (Wynad local) to (TC-14) 30.77 cm with a mean value of 78.91 cm. The genotypes Wynad local and RH-8/80 recorded significantly higher plant height compared to the best check BSR-2 (93.32 cm) (Table-2). Similar findings were reported by Phillip (1983) [37], Indiresh *et al.* (1992) [17], Sheshagiri and Uthaiah (1994) [17], Venkatesha (1994) [57], Lynrah *et al.* (1998), Singh *et al.* (2003), Anasuya (2004), Singh *et al.* (2012), Jan *et al.* (2012), Jilani *et al.* (2012) [21], Rajyalakshmi *et al.* (2013) [41] and Singh and Ramakrishna (2014).

Number of tillers

The number of tillers observed among the genotypes ranged from 5.95 (CLI-342) to 1.42 (Kasturi) with a mean value of 3.40. The genotypes CLI-342 (5.95), IC-416941 (5.08), GL Puram (4.94), recorded significantly higher number of tillers compared to the best check Duggirala red (4.42) (Table-2). A range of 0-7.27 number of tillers was reported by several workers *viz*., Philip (1983) [37], Satyanarayan and Reddy (1986) [49], Reddy and Rao (1988) [46], Korla *et al.* (1992) [22], Cholke (1993) [8], Babu *et al.* (1993), Venkatesha (1994) [57], Satish Hegde *et al.* (1997) [15]. Jagadeesha (2000), Minipoduval *et al.* (2001) [29], Singh *et al.* (2003), Anasuya (2004), Veena (2012), Lynrah *et al.* (1998), Singh *et al.* (2012) and Rajyalakshmi *et al.* (2013) [41].

Number of leaves

Among the genotypes, significant variation was observed in the number of leaves recorded at 150 DAP. The number of leaves ranged from 27.33 (CA-69) to 6.13 (BSR-1). The mean number of leaves recorded was 16.63. Among the genotypes evaluated, significantly higher number of leaves was recorded in eight entries (CA-69, CLI-342, IC-416941, CCA-301, CLI-333, JTS-154, JTS-317 and Megha) when compared with the best check Duggirala Red (19.20) (Table-2). The trend was in agreement with the observations reported by Jalgaonkar *et al.* (1988), Korla *et al.* (1992) [22], Minipoduval *et al.* (2001) [29], Singh *et al.* (2003), Roy *et al.* (2011) [47], Singh *et al.* (2012), Jan *et al.*(2012), Jilani *et al.* (2012) [21] and Rajyalakshmi *et al.* (2013) [41].

Leaf length (cm)

Considerable genetic variation was observed in the length of leaf measured at 150 DAP. The range of leaf length varied from 55.217 to 21.317 cm with a mean value of 38.486 cm. Among the genotypes evaluated three entries recorded the longest leaf length, Rajendra Sonali (55.21cm), RH-5 (51.61 cm), RH-8/80 (49.66) than the best check Tekuripet

(46.05cm) (Table-2). The results were in accordance with the earlier findings of Roy *et al.* (2011) [47], Jan *et al.* (2012) and Sinker *et al.* (2005).

Leaf width (cm)
Leaf width recorded at 150 DAP ranged from 7.71cm (TC-211) to 18.98 cm (Rajendra Sonali) with a mean of 12.615 cm. Among the genotypes evaluated Rajendra Sonali (18.98 cm) recorded significantly higher leaf width compared to the best check Mydukur (15.35cm) (Table-2). Similar range of leaf width in turmeric was reported by Roy *et al.* (2011) [47], Jan *et al.* (2012) and Sinker *et al.* (2005).

Number of mother rhizomes
The number of mother rhizomes was found vary significantly among the genotypes ranging from 1.55 to 5.18 with a mean value of 3.27. Highest number of mother rhizomes was recorded in NDH-4 (5.18) and Ranga (5.183) when compared with the check Tekuripet (4.35). Least number of mother rhizomes was recorded in CLI-324 (1.55) (Table-3).

Weight of mother rhizomes (g)
The weight of mother rhizomes was recorded highest in Duggirala red (175.75 g) and lowest in CLI-324 (50.13 g) with a mean value of 101.38 g. None of the entries found to be superior to the best check Duggirala red (175.75). (Table-3).

Number of primary rhizomes
The number of primary rhizomes varied from AC-94 (18.12) to TCP-70 (1.84) with a mean value of 6.96. Among the genotypes evaluated seven genotypes recorded significantly higher number of primary rhizomes AC-94(18.12), CLI-342 (15.32), KTS-18 (13.52), CCA-301(12.12), Wynad local (11.02), GL Puram (10.99) and TC-14 (10.32) compared to the best check Tekuripet (9.17). (Table-3).

Weight of primary rhizomes (g)
The weight of primary rhizomes varied from IC (22.48 g) to AC-94 (290.28 g) with a mean value of 107.62 g. Among the genotypes evaluated for weight of primary rhizomes, AC-94 (290.28) and CLI-342 (271.58 g) recorded significantly more weight compared to the best check Mydukur (199.25 g). (Table-3).

Number of secondary rhizomes
Number of secondary rhizomes varied from 1.30 (TCP-129) to 12.30 (TCP-70) with a mean value of 7.26. None of the entries was found to be significantly higher than the best check Prathibha (12.22)**.** (Table-3).

Weight of secondary rhizomes (g)
Secondary rhizomes weight was varying from 14.55 g (NDH-79) to 73.01 g (IC-181919) with a mean value of 39.81. Among the genotypes evaluated IC-18191 9(73.01 g), CLI-342 (70.52 g), KTS-18 (69.72 g) and RH-8/80 (69.26 g) recorded significantly more weight compared to the best check Prathibha (64.8 g). (Table-3).

Clump weight (g/plant)
Clump weight for the evaluated genotypes ranged from 106.10 g (TCP-129) to 497.20 g (AC-94) with a mean value of 248.81 g. Among the genotypes evaluated, three genotypes i.e. AC-94 (497.20 g), CLI-342 (496.50 g) and TCP-750 (385.10 g), Wynad Local (370.10 g) recorded significantly higher clump weight compared to the best check Mydukur (353.12g). (Table-3).

Dry recovery (%)
Dry recovery among the genotypes varied from 15.69% (CL-5) to 27.69% (PTS-4) with a mean value of 20.08%. The genotypes PTS-4 (27.69), NDH-79 (24.25), CA-69 (23.82), and KTS-18 (23.79) recorded highest dry recovery compared to the best check Mydukur (22.29). (Table-3).
Considerable variation with respect to yield and yield attributing characters like number of mother rhizomes, weight of mother rhizome, number of primary rhizomes, weight of primary rhizome, number of secondary rhizomes, weight of secondary rhizome, clump weight and dry recovery was reported and acknowledged with earlier studies by Philip *et al.* (1979) [38] Hegde (1992), Babu *et al.* (1993), Lynrah *et al.* (1998), Zachariah *et al.*(1999) [99], Singh *et al.* (2003), Anasuya (2004), Cintra *et al.* (2005), Roy *et al.* (2011) [47], Singh *et al.* (2012) Jan *et al.* (2012), Jilani *et al.* (2012) [21], Mutyalanaidu and Murthy (2013) [32], Rajyalakshmi *et al.* (2013) [41] Singh and Ramakrishna (2014), and Verma *et al.* (2015).
Higher production of mother, primary and secondary rhizomes may be due to better growth and vigour in some genotypes.

Curcumin content in rhizomes (mg/g)
Curcumin content recorded in the rhizomes at harvest, on dry weight basis, ranging from 58.72 mg/g to 3.96 mg/g with a mean value of 34.86 mg/g. JTS-315 (58.73mg/g) recorded significantly higher curcumin content than the best check Prathibha (43.90 mg/g) (Table-4).

Curcumin yield (g/plant)
Curcumin yield ranging from 0.02 g/plant (IC) to 5.17g/plant (CLI-342) to with a mean value of 1.79 g/plant. Among the genotypes evaluated four genotypes recorded significantly higher curcumin yield CLI-342 (5.17g), AC-94 (3.36g), Wynad Local (3.24g) and JTS-315 (3.12g) compared to the best check Mydukur (2.85 g/plant). (Table-4).
Several reports on curcumin content in rhizomes and curcumin yield showed similar and different values depending on the phonological stage of the crop and agro climatic conditions under which the studies were conducted Bhowmik *et al.* Neema *et al*, Zachariah *et al.* (1999) [99], Pujari *et al.* (1987), Rakhunde *et al.*(1988), Ratnambal *et al.* (1986) [48], Vijayakumar *et al.* (1992) [58], Kurian and Valsala (1995) [26], Kurian and Nair (1996), Kurian and Valsala (1996), Lynrah *et al.* (1998), Pathania *et al.* (1988), Shanmugasundaram *et al.* (2001) [51], Rao *et al.* (2004), Bahl *et al.*(2014) [6], Kumar *et al.* (2015) [25] and Geethanjali *et al.* (2016).

Table 1: Analysis of variance table (Treatments) for growth, yield and quality characters in 46 genotypes in turmeric

S. No.	Characters	Treatment Mean sum of squares (df=45)
1	Plant height (cm)	384.44**
2	Number of tillers	0.99**
3	Number of leaves	26.83**
4	Leaf length (cm)	62.28**
5	Leaf width (cm)	6.57*
6	Number of mother rhizomes	0.67**
7	Weight of mother rhizome (g)	1673.94**
8	Number of primary rhizomes	11.10**
9	Weight of primary rhizomes (g)	4580.40**
10	Number of secondary rhizomes	7.32**
11	Weight of secondary rhizomes (g)	286.47**
12	Clump weight (g/Plant)	9258.58**
13	Dry recovery (%)	6.19**
14	Curcumin content in rhzome (mg/g) (dry weight basis)	176.25**
15	Curcumin yield (g/Plant) (dry weight basis)	1.22**

** - Significance at 1% level of probability; * - Significance at 5% level of probability

Table 2: Growth parameters for turmeric accessions (means)

S.no	Accessions	Plant height (cm)	No. of tillers	No. of leaves	Leaf length (cm)	Leaf width (cm)
1	NDH-4	93.27	2.83	15.66	40.78	14.38
2	RANGA	89.07	3.23	12.66	42.18	12.58
3	IC	84.67	3.63	16.86	43.58	14.38
4	PTS-4	87.27	3.23	18.06	40.58	14.18
5	TC-211	69.87	2.23	12.86	31.58	7.98
6	TCP-10	88.47	2.63	15.26	40.38	13.38
7	JTS-1	80.87	2.03	13.26	38.18	12.18
8	Alleppey Supreme	87.67	1.83	12.86	34.18	13.38
9	Chintapalle Local	76.47	1.63	14.76	43.58	14.58
10	Kasturi	66.87	1.43	9.36	24.78	11.78
11	Megha	88.72	4.48	22.50	45.42	13.58
12	TCP-70	94.32	2.48	14.70	46.42	13.98
13	CL-5	84.72	3.88	18.70	43.62	15.18
14	IC-181919	97.72	3.68	18.10	47.02	14.38
15	IC-416941	100.72	5.08	26.10	49.42	15.18
16	Rajendra Sonali	99.52	3.88	18.90	55.22	18.98
17	TCP-129	83.72	3.08	11.10	45.02	14.18
18	RH-8/80	105.72	4.48	20.90	49.67	13.18
19	RH-5	86.72	3.48	17.10	51.62	14.18
20	CLI-324	102.72	4.28	20.30	45.22	15.18
21	CLI-39	64.57	2.16	15.13	28.12	8.32
22	BSR-1	55.57	2.16	6.13	29.32	11.32
23	TC-14	30.77	2.96	10.13	21.32	7.92
24	KTS-18	56.17	3.56	13.93	32.32	12.92
25	CCA-301	87.77	4.36	25.93	36.32	9.72
26	JTS-315	102.77	3.96	16.53	41.12	9.72
27	Wynad local	105.97	3.36	16.73	40.52	8.92
28	Ac -94	93.37	3.76	16.93	46.12	12.12
29	JTS -317	79.37	3.76	23.33	37.72	11.12
30	CLI-342	89.77	5.96	26.53	39.72	11.52
31	CA-69	88.84	4.54	27.33	46.08	14.32
32	JTS-154	72.64	4.54	24.3	34.28	13.12
33	JTS-607	34.14	2.54	8.13	23.28	9.32
34	GL Puram	46.04	4.94	14.93	33.08	13.52
35	ST-510	62.14	4.54	17.73	31.68	12.12
36	CLT-506	58.14	2.74	17.33	30.48	12.72
37	Nagaland	58.64	1.94	10.53	25.68	7.72
38	CLI-333	65.24	3.54	25.13	34.88	10.92
39	NDH-79	68.64	3.94	18.53	32.08	12.12
40	CLI-196	45.14	2.44	10.53	25.48	11.72
41	Mydukur	83.45	3.05	12.65	41.90	15.35
42	BSR-2	93.33	3.63	14.40	38.45	14.40
43	Salem	84.00	3.40	14.20	39.25	13.05
44	Tekuripeta	81.98	3.25	14.40	46.05	12.70
45	Prathibha	76.38	3.60	14.50	39.20	13.85

46	Duggirala red	76.10	4.43	19.20	37.45	12.95
	Mean	78.91	3.40	16.62	38.49	12.61
	LSD (P=0.05)	9.82	0.40	1.89	3.38	2.18
	CV %	9.67	9.16	10.33	6.80	12.89

Table 3: Yield parameters of turmeric accessions (means)

S.no	Accessions	NMR	WMR	NPR	WPR	NSR	WSR	CLW	DRC
1	NDH-4	5.18	101.75	3.94	48.48	8.68	37.71	187.95	20.59
2	RANGA	5.18	122.75	3.34	52.48	9.68	41.71	216.95	18.88
3	IC	2.38	85.75	2.54	22.48	4.48	20.71	128.95	22.08
4	PTS-4	4.38	127.75	7.34	141.48	10.28	43.71	312.95	27.69
5	TC-211	3.78	87.75	3.14	39.48	8.88	34.71	161.95	18.30
6	TCP-10	3.78	97.75	5.14	81.28	10.88	57.71	236.75	20.60
7	JTS-1	3.38	105.75	4.94	57.48	9.68	56.71	219.95	19.20
8	Alleppey Supreme	3.88	87.75	4.34	51.48	8.08	39.71	178.95	18.59
9	Chintapalle Local	3.58	97.75	4.84	147.48	9.78	32.41	277.65	20.65
10	Kasturi	3.38	97.75	6.54	49.48	9.48	39.71	186.95	15.75
11	Megha	3.55	98.14	5.74	76.45	9.90	54.01	228.60	15.78
12	TCP-70	3.55	105.64	1.84	206.45	12.30	73.01	385.10	17.30
13	CL-5	2.95	118.14	5.14	71.45	4.70	35.01	224.60	15.69
14	IC-181919	2.05	95.64	7.34	83.95	7.30	73.01	252.60	21.71
15	IC-416941	2.35	80.64	9.64	183.95	6.80	38.01	302.60	17.88
16	Rajendra Sonali	2.95	78.14	5.54	78.45	6.10	31.01	187.60	17.59
17	TCP-129	2.55	64.14	3.94	26.45	1.30	15.51	106.10	16.88
18	RH-8/80	4.25	144.84	8.04	129.75	10.00	69.26	343.85	17.48
19	RH-5	2.95	112.14	6.94	128.45	6.10	44.01	284.60	25.01
20	CLI-324	1.55	50.14	3.94	61.45	4.70	36.01	147.60	20.41
21	CLI-39	2.57	69.39	5.13	68.78	5.57	29.73	167.90	21.90
22	BSR-1	2.47	73.89	7.33	103.78	5.67	26.73	204.40	22.99
23	TC-14	2.37	61.39	10.33	129.78	5.17	30.73	221.90	18.20
24	KTS-18	3.17	101.39	13.53	24.78	10.77	69.73	195.90	23.79
25	CCA-301	3.47	137.69	12.13	169.48	8.47	51.73	358.90	19.18
26	JTS-315	3.17	93.89	9.83	126.58	6.97	41.73	262.20	20.67
27	Wynad local	2.87	156.39	11.03	169.48	8.47	44.23	370.10	20.59
28	Ac -94	4.17	148.89	18.13	290.28	8.67	58.03	497.20	19.16
29	JTS-317	3.17	143.89	8.73	152.78	4.67	33.03	329.70	20.05
30	CLI-342	4.17	154.39	15.33	271.58	7.97	70.53	496.50	18.87
31	CA-69	2.90	69.02	5.59	37.08	5.35	30.85	136.95	23.83
32	JTS-154	2.80	79.42	3.79	36.58	4.05	34.55	150.55	18.94
33	JTS-607	3.10	90.22	4.09	38.28	6.55	23.35	151.85	19.31
34	GL Puram	4.10	113.72	10.99	188.28	7.65	39.55	341.55	20.19
35	ST-510	2.80	69.42	5.79	61.58	6.05	27.95	158.95	20.98
36	CLT-506	3.50	97.72	7.79	151.28	7.75	38.55	287.55	20.81
37	Nagaland	2.10	65.22	2.29	53.28	3.05	17.05	135.55	19.39
38	CLI-333	2.80	62.72	7.49	136.58	4.35	26.25	225.55	19.99
39	NDH-79	2.10	52.72	7.79	104.98	4.05	14.55	172.25	24.26
40	CLI-196	3.90	108.72	7.79	108.28	6.65	31.55	248.55	20.63
4	Mydukur (c)	3.08	123.00	5.90	199.25	5.95	30.88	353.13	22.29
42	BSR-2 (c)	3.23	86.00	6.30	150.00	7.03	33.65	269.65	21.58
43	Salem (c)	3.25	100.83	6.75	96.25	7.08	30.33	227.40	19.61
44	Tekuripeta (c)	4.35	174.88	9.18	127.13	7.65	29.50	331.50	20.65
45	Prathibha (c)	3.25	92.88	7.63	119.95	12.23	60.45	273.28	18.25
46	Duggirala red (c)	3.95	175.750	5.70	96.13	7.18	32.58	304.45	19.70
	Mean	3.27	101.38	6.97	107.62	7.26	39.81	248.82	20.09
	LSD (P=0.05)	0.4	12.97	1.0	10.35	0.80	4.35	21.53	1.2
	CV %	10.27	9.20	12.12	6.40	8.30	9.76	5.97	4.93

NMR: Number of mother rhizomes, WMR: Weight of mother rhizomes (g), NPR: Number of primary rhizomes, WPR: Weight of primary rhizomes (g), NSR: Number of secondary rhizomes, WSR: Weight of secondary rhizomes (g), CLW: Clump weight (g)

Table 4: Quality parameters of turmeric accessions (means)

S.no	Accessions	Curcumin content in rhizomes (mg/g)	Curcumin yield (g/plant)
1	NDH-4	36.46	1.38
2	RANGA	42.66	1.73
3	IC	3.96	0.02
4	PTS-4	47.16	4.17
5	TC-211	19.47	0.51
6	TCP-10	32.96	1.59
7	JTS-1	38.46	1.60
8	Alleppey Supreme	29.06	0.91
9	Chintapalle Local	52.06	3.01
10	Kasturi	24.06	0.64
11	Megha	48.33	1.74
12	TCP-70	38.83	2.65
13	CL-5	25.83	0.81
14	IC-181919	48.43	2.72
15	IC-416941	12.63	0.57
16	Rajendra Sonali	34.43	1.07
17	TCP-129	43.73	0.69
18	RH-8/80	47.13	2.92
19	RH-5	16.23	1.09
20	CLI-324	28.73	0.77
21	CLI-39	32.23	1.22
22	BSR-1	18.93	0.94
23	TC-14	37.43	1.54
24	KTS-18	36.83	1.71
25	CCA-301	8.23	0.61
26	JTS-315	58.73	3.12
27	Wynad local	43.33	3.25
28	AC -94	36.03	3.37
29	JTS-317	44.43	2.89
30	CLI-342	56.43	5.17
31	CA-69	23.48	0.89
32	JTS-154	46.77	1.41
33	JTS-607	53.57	1.63
34	Gl puram	43.08	2.91
35	ST-510	33.38	1.21
36	CLT-506	30.67	1.87
37	Nagaland	13.47	0.52
38	CLI-333	26.78	1.29
39	NDH-79	47.08	2.00
40	CLI-196	39.88	2.064
41	Mydukur	36.17	2.85
42	BSR-2	22.30	1.29
43	Salem	32.92	1.47
44	Tekuripet	32.25	2.21
45	Prathibha	43.90	2.21
46	Duggirala red	34.62	2.08
	Mean	34.86	1.79
	LSD (P=0.05)	12.72	0.26
	CV %	6.14	10.4

Conclusion

Higher yield components contribute positively for the higher yield in crop plants. On evaluation of 46 genotypes for vegetative, rhizome and curcumin characters, the genotypes namely CA-69, Wynad local, CLI-342, AC-94, NDH-4, and the accessions Duggirala red, IC-181919, JTS-315 has excelled in production in the Krishna-Godavari agroclimatic zone of Andhra Pradesh.

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