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Genetic divergence in germplasm collections of turmeric (*Curcuma longa* L.)[1]

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Abstract

Fifty four turmeric (*Curcuma longa*) cultivars were evaluated at Jagtial (Andhra Pradesh) by subjecting to D^2 statistic to assess the genetic diversity available in the cultivars. The D^2 analysis showed wide diversity among the cultivars and they were grouped into six clusters. Inter-cluster distance values also showed wide genetic divergence among the cultivars. Based on cluster-mean values, the cultivars PTS-38 and Duggirala in cluster I (high cured yield), PCT-5 and PCT-8 in cluster III (high curcumin, essential oil and oleoresin contents) and PCT-13, PCT-14 and PCT-10 in cluster IV (short duration, medium yield with good curcumin content) were identified as potential parents for future breeding programmes.

Key words: *Curcuma longa*, genetic divergence, turmeric.

Existence of wide variability in yield components, yield and quality in turmeric (*Curcuma longa* L.) cultivars is well known (Subbarayudu *et al*. 1976; Reddy *et al.* 1989; Nirmal & Yamgar 1998). Multivariate analysis of D^2 statistic is one of the useful statistical methods for measuring the magnitude of genetic diversity available in a given population in respect of the characters considered together. Keeping this objective in view, 54 turmeric cultivars were evaluated and D^2 statistic was carried out to assess the genetic diversity present in the germplasm.

Fifty four cultivars of turmeric collected from different parts of the country were evaluated for 19 parameters related to their growth, yield and quality at Regional Agricultural Research Station, Jagtial (Andhra Pradesh). The trial was laid out in a Randomized Block Design and replicated twice in a plot size of 3.0 m x 1.2 m during 1995–96 and 1996–97. The recommended spacing (30 cm x 15 cm) and package of practices were adopted uniformly for all the genotypes. Data were recorded for various growth, yield and quality characters following standard procedures. In order to assess the genetic diversity, D^2 statistic was carried out following the procedures of Rao (1952) and Singh & Chaudhary (1977).

The range of magnitude of D^2 value was between 36.32 to 4035.73 suggesting that there was substantial variability in the turmeric cultivars studied. Studies on pattern of distribution of the 54 cultivars showed wide variability among them and they could be

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grouped into six clusters (Table 1). The clustering pattern revealed that the cultivars collected from the same source were distributed in different clusters. Differences in genetic constitution and the influence of environmental factors (Murthy & Arunachalam 1966; Murthy 1977) may be responsible for this type of clustering. Though geographic diversity is considered as one of the criteria for selection, it may not necessarily be the only the factor that determines the genetic diversity in the genotypes. Cultivars from different geographic regions were grouped in the same cluster. This may be due to the free exchange of propagating materials from one location to another or fixed criterion being used during selection in different centres (Murthy & Arunachalam 1966). In the divergence studies of Nambiar (1979), the turmeric genotypes were grouped into four clusters and *C. aromatica* maintained separate identity from *C. longa*.

Based on inter-cluster distances, it was evident that all the clusters are distantly related except cluster III with cluster IV and cluster V with cluster VI (Table 2). This indicated wide divergence in the genetic material with scope to get good recombinants through advanced breeding techniques like protoplast fusion or somatic hybridization. The higher inter-cluster value between clusters I and IV can be expected to exert high heterotic effect in the hybrids when crossed and consequently may generate desirable segregants. Thus, broad spectrum of variability can be created in the ensuing generation. This variability may be helpful in future selections and crop improvement programmes. Bhatt (1973) also reported that involving diverse parents in hybridization could yield good recombinants throughout.

The study of cluster-means indicated that the cultivars grouped in cluster I had more cured yield with low curcumin content (Table 3). The cultivars in clusters II and IV had medium cured yield with moderate curcumin content. The cultivars in cluster III had low cured yield with maximum curcumin content. The cultivars in cluster V had low cured yield with good curcumin content, whereas

Table 1. Distribution of 54 genotypes of turmeric in different clusters

Cluster no.	No. of genotypes	Genotypes
I	18	PTS-38, Duggirala, TC-4, 21-A, ST-365, Kankipadu, ST-510, BSR-1, TC-2, Waigon, 15-B, PTS-24, Ethamukkala, Armoor, 2-A, Avanigadda, PTS-16, Deepaiguda Peddapasupu.
II	18	CLI-335, CLI-365, CLI-38, CLI-390, CLI-369, CLI-36, CLI-370, CLI-317, CLI-325, CLI-330, CLI-385, CLI-124/6, CLI-367, CLI-361, CLI-320, Thodupuzha, CLI-136, CLI-342.
III	4	PCT-8, PCT-19, Muvattupuzha, PCT-5.
IV	3	PCT-14, PCT-13, PCT-10.
V	4	PCT-2, Shillong, PTS-4, CLI Jyothi.
VI	7	PCT-3, 390, PCT-7, CA-17/1, CA-90, Kasthuri-2, Kasthuri.

Table 2. Intra and inter-cluster average distance (D) values of 6 clusters of 54 genotypes of turmeric

	I	II	III	IV	V	VI
I	20.52	28.26 (M)	53.63 (H)	55.91 (H)	46.37 (H)	49.72 (H)
II		14.70	35.10 (H)	36.12 (H)	28.10 (M)	32.29 (H)
III			15.14	21.58 (C)	23.53 (M)	33.38 (H)
IV				11.87	22.19 (M)	25.97 (M)
V					17.12	21.22 (C)
VI						14.82

H=Highly divergent (>30); M=Moderately divergent (22–30); C=Closely related (<22)

Table 3. Mean values of clusters from 54 genotypes of turmeric

Cluster	Height of plant (cm)	No. of leaves	Girth of stem (cm)	Length of leaf (cm)	Breadth of leaf (cm)	No. of primary fingers	Length of primary finger (cm)	Girth of primary finger (cm)	No. of secondary fingers
I	85.39	8.05	7.94	29.40	8.57	6.73	7.63	5.40	7.60
II	67.91	7.49	8.13	24.57	7.42	7.03	6.29	4.55	7.88
III	88.88	7.18	6.19	26.66	5.51	5.31	6.33	3.60	4.04
IV	64.61	7.32	6.23	21.56	5.84	7.78	7.17	4.34	6.00
V	69.20	6.96	6.58	26.67	5.90	5.54	6.54	3.64	6.11
VI	65.65	6.02	6.75	22.58	6.46	6.64	5.41	4.17	5.77

(Continued below)

Table 3. (Continued)

Cluster	Length of mother rhizome (cm)	Girth of mother rhizome (cm)	Wt. of fresh finger rhizome (g)	Wt. of fresh mother rhizome (g)	Crop duration (days)	Curcumin (%)	Essential oil (%)	Oleoresin (%)	Curing %	Cured yield plant^{-1} (g)
I	6.62	10.34	69.17	25.92	255.19	2.77	4.15	7.52	19.85	18.89
II	5.80	8.62	61.44	27.04	227.68	3.34	4.92	8.94	19.18	16.93
III	4.41	6.49	34.53	12.32	183.56	4.54	6.63	11.66	17.76	8.32
IV	5.02	7.28	76.34	18.61	190.08	4.21	6.49	11.30	17.52	16.58
V	4.46	5.92	45.46	14.69	191.75	3.47	5.06	9.12	17.60	11.22
VI	4.18	6.78	51.67	16.25	185.07	2.73	5.08	8.43	17.60	11.93

in cluster VI, the cultivars had low cured yield coupled with low curcumin content. It can be inferred that, based on cluster-mean values, cross combinations between cluster I cultivars (PTS-38 and Duggirala) with cluster III cultivars (PCT-5 and PCT-8) or cluster IV cultivars (PCT-10, PCT-13 and PCT-14) either through advanced breeding techniques or through crossing programmes may give good recombinants for high yield coupled with high curcumin content.

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