Plant Archives Vol. 18 No. 1, 2018 pp. 1026-1032 *ISSN 0972-5210*

ASSESS THE GENETIC DIVERSITY FOR GROWTH YIELD AND QUALITY CHARACTERS AMONG THE GENOTYPES OF TURMERIC

Vijay Kumar Vimal, P. K. Singh and V. P. Pandey

Department of Vegetable Science, N.D. University of Agriculture & Technology, Kumarganj, Faizabd - 224 229 (U.P.), India.

Abstract

The present investigation entitled was carried out in randomized block design with three replications during 2013-14 and 2014-15 to study the variability among the thirty genotypes for growth, yield its attributing characters and quality parameters. The study revealed that wide range of variation observed for all the traits among thirty genotypes. PCV were higher than GCV for all the characters. High estimates of PCV as well as GCV was observed for calcium plant height, number of tillers per clump, plant girth, weight of fresh rhizomes per plant, weight of mother rhizome, weight of primary rhizomes per plant, number of secondary rhizomes per plant, weight of secondary rhizomes per plant in number of tertiary rhizomes per plant in all environments. The high heritability accompanied with high genetic advance was estimated for plant height, number of tillers per clump, weight of fresh rhizome per plant, weight of mother rhizome, width of mother rhizome, weight of primary rhizomes per plant, weight of secondary rhizome, number of tertiary rhizomes per plant, rhizome yield and curcumin in all four environments (E_1, E_2, E_3, E_4) except curcumin in E_3. The study concluded that the improvement of these characters through simple selection.

Key words : Turmeric, yield, quality parameters, GCV, PCV and heritability.

Introduction

Turmeric (*Cucuma longa* L.) is the native of Indo-Malayan region and belongs to the family Zingiberaceae. It is erect, herbaceous, perennial plant but is grown as an annual. It possesses an underground stem or rhizome which is thick and rounded with short blunt fingers. The leaves are tall, thin, light green in colour, lanceolate with a long stalk. Flowers are also borne in cone shaped spikes in the tuft of leaves. The spikes consist of a great number of thin, greenish-white, ovate bracts.

Turmeric is valued globally as a condiment, food colourant, dye, drugs and medicine. The rhizome contains yellow colouring component curcumin (3-9%), essential oil (5-6%) and oleoresin (6-13%). Curcumin is gaining more importance in food industries, pharmaceuticals, preservatives and cosmetics. The ban on artificial colour has prompted the use of curcumin as a food colourant. In pharmaceuticals it is valued for the anti cancerous, anti inflammatory, antiseptic, antimicrobial and antiproliferative activities (Srimal, 1997).

Turmeric being most important to growers, consumers and industries, there is pressing need to increase its productivity and quality to fulfil the increasing demands throughout nation and abroad. Genetic improvement may play a vital role in increasing production and productivity. The magnitude of genetic variability forms the basis for crop improvement. The success of any breeding programme depends on the nature and amount of genetic variability available in the breeding material. Selection and hybridization approaches are easily followed in bringing about the quantitative improvement. In order to bring about desired improvement, it is essential to assess nature and magnitude of variability, heritability and genetic advance for various characters.

Materials and Methods

The experiments were conducted at Main Experiment Station of Department of Vegetable Science, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.) India, which is situated at between 24.47° N latitude and 82.12°E longitude having an elevation of 113 meters above the mean sea level. The second location Lal Bahadur Shastri Krishi Vigayn Kendra, Gopalgram, Gonda (U.P.), India is situated on 27.12°N latitude and 82.85°E longitude having an elevation

of 119 meter above the mean sea level. Geographically both places fall in northeast gangetic alluvial plains of eastern Uttar Pradesh. The soil type of Kumarganj is sandy loam with pH value of 8.2 and soil type of Gopalgram is also sandy loam, medium in organic carbon with 7.6 pH.

The observations were recorded on characters *viz.,* plant height (cm), number of tillers per clump, number of leaves per plant, plant girth (cm), weight of fresh rhizome per plant (g), weight of mother rhizome (g), length of mother rhizome (cm), width of mother rhizome (cm), number of primary rhizomes per plant, weight of primary rhizomes per plant (g), number of secondary rhizomes per plant, weight of secondary rhizomes per plant (g), number of tertiary rhizomes per plant, rhizome yield (q/ha), dry matter, curcumin and oleoresin per cent.

Statistical analysis

The average values for each genotype in each replication for the traits studied were used for further statistical analysis. A brief outline of the procedure adopted for the estimation of statistical parameters. Analysis of variance, the data for the component traits excluding capsanthin content was analysed as per the following model given by Panse and Sukhatme (1984). The calculated 'F' values were compared with the tabulated 'F' values at 5 % level of significance. If the calculated 'F' value was higher than the tabulated, it was considered to be significant. All the characters which showed significant differences among genotypes were further subjected to the analysis for the different parameters. The phenotypic, genotypic, environmental coefficients of variation, heritability in broad sense (h^2_{bs}) and the expected genetic advance (GA) for different characters content were calculated as suggested by Burton and De Vane (1953) and Johnson *et al.* (1955).

Results and Discussion

The analysis of variance for Randomized Block Design for seventeen characters in each environment is presented in tables 1 & 2. The analysis of variance revealed that the highly significant differences were observed among the genotypes for the characters in all four environments (E_1, E_2, E_3 and E_4). The significant differences for traits in a particular environment indicated that the genotypes had remarkable variation for all the studied characters. The differences due to replications were non-significant for all the characters. The earlier researchers *viz.,* Reddy *et al.* (1988), Indiresh *et al.* (1990), Datta *et al.* (2001), Panja *et al.* (2001), Velmurugan *et al.* (2008) and Jan *et al.* (2012) also reported considerable variability among the genotypes in

Table 1 : Analysis of variance for different characters during environment-1 (MES, 2013-14) and environment -2 (K.V.K. Gonda, 2013-14).

S.no.	Characters	Environment-1			Environment-2		
	S.V.	Replications	Treatments	Error	Replications	Treatments	Error
	D.F.	2	29	58	2	29	58
1.	Plant height (cm)	6.32	2134.18**	4.41	1.95	1975.30**	4.78
2.	Number of tillers per clump	0.43	2.40**	0.18	0.15	1.92**	0.10
3.	Number of leaves per plant	3.34	8.80**	1.28	0.13	9.48**	0.87
4.	Plant girth (cm)	0.51	9.08**	0.97	0.11	7.24**	0.70
5.	Weight of fresh rhizome per plant (g)	0.18	13084.56**	5.54	9.96	12066.09**	3.94
6.	Weight of mother rhizome (g)	3.21	1603.47**	1.62	4.80	1536.14**	2.23
7.	Length of mother rhizome (cm)	0.01	7.98**	0.72	2.27	4.38**	0.81
8.	Width of mother rhizome (cm)	0.87	14.52**	0.40	0.70	14.04**	0.71
9.	Number of primary rhizomes per plant	0.02	2.55**	0.61	0.35	1.62**	0.32
10.	Weight of primary rhizomes per plant (g)	6.21	3522.38**	3.71	1.07	3253.90**	4.70
11.	Number of secondary rhizomes per plant	0.41	11.81**	1.01	1.08	9.93**	1.00
12.	Weight of secondary rhizome per plant (g)	0.70	765.61**	2.49	5.89	649.04**	1.87
13.	Number of tertiary rhizomes per plant	0.26	7.67**	0.27	0.47	7.03**	0.23
14.	Rhizome yield (q/ha)	7.01	5888.72**	11.64	0.20	5373.82**	4.03
15.	Dry matter (%)	0.20	27.48**	1.11	0.001	25.643**	0.926
16.	Curcumin (%)	0.06	1.67**	0.02	0.04	1.69**	0.02
17.	Oleoresin (%)	0.10	2.74**	0.13	0.20	5.37**	0.08

*, ** Significant at 5% and 1% level against error.

Table 2 : Analysis of variance for different characters during environment-3 (MES, 2014-15) and environment 4 (K.V.K Gonda, 2014-15).

S.no.	Characters	Environment-3			Environment-4		
	S.V.	Replications	Treatments	Error	Replications	Treatments	Error
	D.F.	2	29	58	2	29	58
1.	Plant height (cm)	3.02	2087.23**	3.16	3.25	2061.49**	3.84
2.	Number of tillers per clump	0.40	1.75**	0.18	0.07	1.53**	0.08
3.	Number of leaves per plant	0.54	7.21**	1.18	0.90	9.27**	0.76
4.	Plant girth (cm)	1.03	9.22**	0.65	0.34	8.96**	0.41
5.	Weight of fresh rhizome per plant (g)	1.10	13068.36**	5.40	5.51	12367.96**	3.89
6.	Weight of mother rhizome (cm)	3.49	1645.57**	2.19	13.04	1592.42**	4.21
7.	Length of mother rhizome (cm)	1.23	8.73**	0.47	0.51	5.57**	0.83
8.	Widtht of mother rhizome (g)	0.15	12.95**	0.51	0.12	15.10**	0.54
9.	Number of primary rhizomes/plant	0.26	2.61**	0.40	0.48	2.84**	0.29
10.	Weight of primary rhizomes/plant (g)	0.09	3753.80**	2.04	1.10	3157.93**	4.03
11.	Number of secondary rhizomes/plant	0.84	12.15**	0.78	0.31	8.80**	0.99
12.	Weight of secondary rhizome/plant (g)	3.26	761.50**	3.27	3.86	663.21**	2.49
13.	Number of tertiary rhizomes/plant	0.35	7.12**	0.30	0.001	6.974**	0.152
14.	Rhizome yield (q/ha)	1.15	6046.69**	7.76	29.10	5484.77**	55.75
15.	Dry matter (%)	0.05	40.88**	1.33	1.26	33.81**	1.66
16.	Curcumin (%)	0.02	0.96**	0.03	0.0004	1.3367**	0.0110
17.	Oleoresin (%)	0.20	2.11**	0.09	0.12	2.97**	0.10

*, ** Significant at 5% and 1% level against error.

individual environment.

In the present study, the extent of variability was examined in 30 genotypes of turmeric for 17 characters in (table 3) four environments *i.e.* E_1, E_2, E_3 and E_4. The maximum phenotypic as well as genotypic coefficients of variability were observed for plant height, number of tillers per clump, plant girth, weight of fresh rhizomes per plant, weight of mother rhizome, weight of primary rhizomes per plant, number of secondary rhizomes per plant, weight of secondary rhizomes per plant in number of tertiary rhizomes per plant in all environments whereas, rhizome yield, dry matter and curcumin showed moderate values of phenotypic and genotypic coefficient of variation. In general, the phenotypic coefficient of variability was higher than genotypic coefficient of variability, which indicated that environment played a considerable role in expression of these traits. The similar results were reported by Yudhvir *et al.* (2003), Sinkar *et al.* (2005), Singh *et al.* (2007), Singh *et al.* (2008), Singh *et al.* (2012), Singh *et al.* (2012), Prajapati *et al.* (2014) and Verma *et al.* (2014).

In the present study, high estimates of heritability (>80%) were observed for plant height, weight of fresh rhizomes per plant, weight of mother rhizome, width of mother rhizome, weight of primary rhizomes per plant, weight of secondary rhizomes per plant, number of tertiary rhizomes per plant, rhizome yield, dry matter, curcumin and oleoresin in all four environments (E_1, E_2, E_3, E_4). Whereas, number of tillers per clump in E_1, E_2 and E_3, plant girth in E_1 and E_2, length of mother rhizome in E_3, number of secondary rhizomes per plant in E_3 showed high estimates of heritability which indicated that the improvement of these characters through simple phenotypic selection. The findings of present study are in agreement with those of Singh *et al.* (2012), Singh *et al.* (2014), Mishra *et al.* (2015) and Gupta *et al.* (2016) reported high heritability for yield and growth characters.

Moderate estimates of heritability (60-80%) were observed for number of leaves per plant, in all four environments (E_1, E_2, E_3, E_4) and number of tillers per clump only in E_3, plant girth in E_1 and E_2 length of mother rhizome in E_1, E_2, and E_4 number of primary rhizomes per plant in E_3 and E_4 and number of secondary rhizomes per plant in E_1, E_2 and E_4. However, low estimates of heritability (<60 %) were observed for number of primary branches per plant in E_1 and E_2.

High heritability accompanied with high genetic advance was estimated for plant height, number of tillers per clump, weight of fresh rhizome per plant, weight of mother rhizome, width of mother rhizome, weight of

Table 3 : Range, mean, coefficient of variation, heritability and genetic advance for different characters in different environments E_1 (MES, 2013-14), E_2 (K.V.K Gonda, 2013-14), E_3 (MES, 2014-15) and E_4 (K.V.K Gonda, 2014-15).

S.no.	Characters	Environ.	Range mean SE±	General	Genotypic coefficient of variation	Phenotypic coefficient of variation	Heritability (%) in broad sense	Genetic advance	Genetic advance in per cent of mean
		1	2	3	4	5	6	7	8
1.	Plant height (cm)	E_1	40.20-130.50	70.89	37.58	37.70	99	54.17	69.42
		E_2	39.40-125.20	67.90	37.74	37.88	99	52.60	77.47
		E_3	43.20-140.30	71.78	36.72	36.80	100	54.72	70.12
		E_4	38.20-128.50	68.32	38.33	38.44	99	53.80	78.75
2.	Number of tillers per clump	E_1	1.00-5.33	2.70	31.83	35.55	80	1.59	58.72
		E_2	1.00-4.67	2.19	35.60	38.47	86	1.49	67.86
		E_3	2.00-5.67	3.00	24.06	27.98	74	1.28	42.62
		E_4	1.00-4.33	1.93	35.97	38.68	86	1.33	68.91
3.	Number of leaves per plant	E_1	7.00-14.67	9.59	16.51	20.28	66	2.66	27.69
		E_2	4.67-14.00	7.93	21.36	24.38	77	1.90	38.54
		E_3	8.00-15.00	10.51	13.49	16.99	.63	2.32	22.08
		E_4	4.67-14.00	8.03	20.97	23.61	79	3.08	38.35
4.	Plant girth (cm)	E_1	5.47-12.63	7.22	22.77	26.55	74	2.90	40.23
		E_2	4.40-10.67	6.22	23.74	27.28	76	3.06	42.58
		E_3	5.50-13.43	7.36	22.96	25.45	81	3.14	42.67
		E_4	3.57-12.07	6.25	27.01	28.89	87	3.25	52.01
5.	Weight of fresh rhizome per plant (g)	E_1	68.50-390.67	152.34	43.34	43.37	100	135.93	89.23
		E_2	64.40-388.77	143.21	44.28	44.30	100	2.65	91.16
		E_3	76.57-407.80	155.88	42.33	42.36	100	135.85	87.15
		E_4	66.50-387.70	146.83	43.72	43.74	100	132.19	90.02
6.	Weight of mother rhizome (cm)	E_1	12.30-134.97	32.78	70.48	70.59	100	47.53	144.97
		E_2	4.40-10.67	29.54	76.54	76.70	100	130.56	157.32
		E_3	13.70-137.93	34.31	68.21	68.34	100	48.12	140.23
		E_4	10.10-136.07	30.33	75.86	76.17	99	47.21	155.66

Table 3 continued....

Table 3 continued....

7. Length of mother rhizome (cm)	E_1	4.37-12.53	6.54	23.81	27.11	77	2.82	43.08
	E_2	64.40-388.77	5.71	19.09	24.78	59	46.48	30.28
	E_3	4.33-14.00	7.08	23.43	25.35	85	3.16	44.60
	E_4	4.00-10.43	5.85	21.49	26.55	66	2.10	35.84
8. Width of mother rhizome (cm)	E_1	7.27-16.53	10.39	20.89	21.76	92	4.29	41.30
	E_2	10.30-133.50	9.57	22.04	23.73	86	1.73	42.17
	E_3	7.93-17.33	11.11	18.33	19.43	89	3.96	35.64
	E_4	6.70-16.30	9.74	22.62	23.85	90	4.30	44.18
9. Number of primary rhizomes per plant	E_1	3.67-7.33	4.98	16.15	22.53	51	1.19	23.85
	E_2	2.67-6.00	3.79	17.35	22.95	57	4.03	27.02
	E_3	3.67-7.33	4.97	16.65	20.72	65	1.42	27.55
	E_4	2.00-6.67	3.99	23.12	26.75	75	1.64	41.15
10. Weight of primary rhizomes/plant (g)	E_1	30.63-145.43	74.71	45.84	45.91	100	70.44	94.28
	E_2	28.36-143.30	71.05	46.32	46.42	100	1.02	95.21
	E_3	30.37-154.27	76.76	46.07	46.11	100	72.79	94.83
	E_4	27.80-144.10	71.57	45.30	45.39	100	66.67	93.15
11. Number of secondary rhizomes/plant	E_1	4.00-10.67	7.59	25.00	28.29	78	3.45	45.52
	E_2	3.733-9.400	6.02	28.65	33.11	75	67.65	51.09
	E_3	5.00-12.33	7.89	24.68	27.09	83	3.65	46.32
	E_4	3.33-8.33	5.91	27.30	32.07	72	2.83	47.88
12. Weight of secondary rhizome/plant (g)	E_1	8.20-72.33	29.46	54.13	54.40	99	32.70	110.97
	E_2	7.60-66.63	26.91	54.57	54.81	99	3.08	111.94
	E_3	11.40-74.33	31.32	50.76	51.09	99	32.54	103.90
	E_4	8.77-66.40	27.60	53.78	54.08	99	30.40	110.16
13. Number of tertiary rhizomes/plant	E_1	1.33-8.33	3.88	40.48	42.67	90	3.07	79.13
	E_2	7.00-15.50	2.76	54.66	57.34	91	30.13	107.33
	E_3	1.00-7.33	3.59	42.00	44.72	88	2.92	81.25
	E_4	1.00-7.33	2.63	57.27	59.14	94	3.01	114.22

Table 3 continued....

Table 3 continued....

.14.	Rhizome yield (q/ha)	E_1	200.70-423.07	286.17	15.47	15.51	99	90.91	31.77
		E_2	2.67-6.00	277.42	15.25	15.27	100	87.06	31.38
		E_3	204.43-433.03	289.16	15.52	15.55	100	92.25	31.90
		E_4	192.40-400.70	276.68	15.38	15.61	97	86.31	31.20
15.	Dry matter (%)	E_1	19.20-32.53	23.24	12.76	13.54	89	5.75	24.76
		E_2	28.37-143.30	19.45	14.75	15.56	90	5.61	28.82
		E_3	20.07-37.17	24.33	14.92	15.66	91	7.13	29.29
		E_4	16.13-31.93	20.49	15.98	17.17	87	6.28	30.63
16.	Curcumin (%)	E_1	3.13-5.60	4.74	15.62	15.94	96	1.49	31.54
		E_2	2.40-5.60	4.35	17.15	17.39	97	1.52	34.82
		E_3	3.13-5.73	5.09	10.94	11.39	92	1.10	21.66
		E_4	2.90-5.60	4.47	14.89	15.07	98	1.35	30.29
17.	Oleoresin (%)	E_1	8.67-12.70	11.49	8.11	8.71	87	1.79	15.57
		E_2	2.67-9.33	10.80	12.30	12.58	96	2.68	24.80
		E_3	9.03-12.37	11.08	7.40	7.88	88	1.58	14.30
		E_4	8.23-12.50	10.66	9.18	9.64	91	1.92	18.00

primary rhizomes per plant, weight of secondary rhizome, number of tertiary rhizomes per plant, rhizome yield and curcumin in all four environments (E_1, E_2, E_3, E_4) except curcumin in E_3. While, plant girth, length of rhizome and number secondary rhizomes per plant showed high heritability along with high genetic advance only in E_3, $E_{4,}$ E_3, respectively. However, high heritability and moderate genetic advance was analysed for dry matter in E_1, E_2 and E_3 and it showed high heritability along high heritability in environment E_4. Oleoresin % showed high heritability accompanied with moderate heritability in E_1, E_2 and E_4. While, moderate heritability coupled high genetic advance was observed in case of number of leaves in E_2 and E_4, plant girth in E_1 and E-$_2$, length of mother rhizome in E_1, E_2 and E_4, number of primary rhizomes per plant in E_4 and number of secondary rhizomes per plant in E_1, E_2, E_4 (Yudhvir *et al*., 2003 and Singh *et al*., 2012).

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