Estimation of Variability in Some *Curcuma* Species of Vidarbha Region Using Morphological Traits

S. Jain and S. Surve
PG Department of Botany, Govt. Vidarbha Institute of Science and Humanities, Amravati
drjainsb10@yahoo.in

Abstract:

Genus *Curcuma* is gaining importance worldwide as a potential source of new drugs to combat a variety of ailments as the species contains numerous molecules. Despite the considerable economic potential of this genus, it's phylogeny and taxonomy remain poorly understood, mainly due to extensive polyploidization and hybridization resulting in different levels of genetic and morphological variation among species. In present study individual of *Curcuma decipiens, C. pseudomontana*, and *C. zedoaria* were showed variations for rhizome length and width, plant height, sheath length, petiole length, leaf length and width, leaf area index, total number of leaves, flower length, calyx length and width, corolla length and width and lip length and width. The study revealed that genotypes of *Curcuma* appeared to have narrow genetic base, which have to undergone high level of genetic erosion and selection pressure. Thus, given data can be helpful to select wild parents in order to widen indogenous gene pool of turmeric for future breeding programmes.

Keywords: – *Curcuma decipiens*, *C. pseudomontana*, *C. zedoaria*, genetic erosion, selection pressure.

Introduction:

Curcuma L., a genus of the tribe Zingiberae in the family Zingiberaceae, with at least 120 species is the third largest genus in the Zingiberaceae with the highest diversity is concentrated in India and Thailand. It is a diverse polyploid complex containing many taxa of economic, medicinal, ornamental and cultural importance, the type species of the genus, *C. longa* L. (turmeric) being the best known example.

Despite the considerable economic potential of this genus, it's phylogeny and taxonomy remain poorly understood, mainly due to extensive polyploidization (2x-15x) and hybridization (Leong- Škorničková and *et al.* 2007, Zaveska *et al.* 2011) resulting in different levels of genetic and morphological variation among species and in blurred species boundaries (Škorničková, 2007).

At present, turmeric and few other closely related *Curcuma* species represent some of the most targeted herbs for pharmacological research because of the strong antioxidant properties of curcuminoids, which are abundant in its rhizomes. Generally, cultivated species contain fewer than 10% of the total available genetic diversity, and majority of diversity found in related wild species (Westwood 1989, Reed *et al.* 2004). Therefore, more attention is necessary to shift towards the wild relatives of this species to enlarge the genetic base available to the breeder (Brown, 1989). Thus, conservation of diverse wild germplasm for breeding of current and future food species of *Curcuma* are having importance. The present study deals with *ex situ* conservation of *Curcuma* related three wild species from Vidarbha region of Maharashtra.

Mangaly and Sabu (1993) revised the genus *Curcuma* in South India and provided artificial keys for the identification of the taxa, their descriptions, and

illustrations. Apavatjrut *et al.* (1999) used isozyme as a tool for identification of some *Curcuma* L. species that are taxonomically confused and results were used to describe the relationship within the early flowering group. Škorničková *et al.* (2007) investigated chromosomal and genome size variation in majority of *Curcuma* species from the Indian subcontinent and an assessment was made of the value of these data for taxonomic purpose. Kumar *et al.* (2008) carried out detailed study about the domestication and cultural practices of three selected ornamental gingers i.e. *Bosenbergia siphonantha, Curcuma inodora, and Hitchenia carevana*. Zaveska *et al.* (2012) examined the monophyly and delimitation of *Curcuma*, it's infrageneric relationships by sequencing three plastid regions i.e. trnL- trnF, psbA-trnH, matk and internal transcribed spacer (ITS) of nuclear ribosomal DNA sequence.

Material and Methods:

Three species of *Curcuma* viz. *C. decipiens, C. zedoaria* and *C. pseudomontana* were collected from various regions of Vidarbha during 2010-2011 and brought to research field for further study. The research work comprised of two seasons 2012-2013 and 2013-2014, for 15 individuals of each species with 16 quantitative traits from flowering till maturity and harvest. The quantitative traits comprised of rhizome length , rhizome width, plant height, sheath length, petiole length, leaf length, leaf width, leaf area index, total number of leaves, flower length, calyx length, calyx width, corolla length, corolla width, lip length and lip width.

Data were subjected to simple statistical analysis for all quantitative traits to assess the amount of genetic variation. Objective of this study was to evaluate the pattern of variability and relatedness among the variants of *Curcuma* collected from selected areas of Vidarbha using morphological traits at intraspecific level. This data will be useful for efficient management and differentiation of various landraces.

Results and Discussion:

Curcuma germplasm differed in many traits of agronomic importance including plant height, leaf length, leaf area index, total number of leaves etc. Basic statistics for various quantitative traits of related three species i.e. *C. decipiens, C. zedoaria* and *C. pseudomontana* is given in table- I.

During season 2012-2013, *C. decipiens* showed the highest variation in leaf area index i.e. 2654524.81 where the maximum number of leaves was 6. Similarly, largest variation was found in plant height and leaf length with the variances was 582.68 and 330.85, respectively. The lowest variance was found in corolla width i.e., 0.01. Highest variations were found in leaf area index, plant height and leaf length in *C. pseudomontana* are 429072.85, 143.342 and 60.74, respectively and lowest variance was of lip length i.e. 0.012. For *C. zedoaria* variations were highest for leaf area index i.e. 14630354.97 followed by plant height and leaf length with variances 424.96 and 216.79, respectively and 0.016 was the lowest variation for corolla length.

In the next season i.e. 2013-2014, highest variations were found for leaf area index in all three species i.e. 44131615.31, 3591665.3 and 483162924 for *C.*

decipiens, *C. pseudomontana* and *C. zedoaria*, respectively. Similarly, variances for plant height and leaf length were 903.83 and 308.97 in *C. decipiens*, 316.53 and 145.64 in *C. pseudomontana*, 150.17 and 46.09 in *C. zedoaria* respectively. Lowest values of variances were found for corolla width i.e. 0.016 in *C. decipiens*. Whereas in *C. pseudomontana* 0.0123 for calyx width and 0.0168 for corolla length in *C. zedoaria*.

Hikmat *et al.* (2012) also observed largest variations for plant height, leaf length, leaf width, total and fresh number of leaves, whereas relatively, a low level of variability in most of the other traits in *Curcuma longa*. Chaveerach *et al.* (2008) reported variations in leaf sheath, leaf blades, petiole length, corolla tube and rhizome length in *C. sattayasaii and C. zedoaroides*. Similarly Rattan *et al.* (1988) reported that multiple regression analysis using morphological characters indicated that the final yield of ginger could be predicted by taking into consideration of plant height, number of leaves and breadth. High heritability with appreciable genetic advance was reported for various traits including plant height, number of leaves etc. in turmeric (Yadav and Singh, 1996). The morphology of *C. domestica* from Tanegashima, Taiwan and Java were compared and also with *C. zedoaria* and Aoi (1992) reported that there were correlations between the leaf number and weights of above or below ground parts of the species. The present findings were similar to the work of Preter (2001) and Chaveerach *et al.* (2008). Similarly, rhizome length was studied by Schonbeck and Frey (2005) and stated that the length varies in different individuals of *Curcuma* species.

Table. 1- Showing Basic statistical analysis for 16 quantitative traits of *Curcuma* species genotypes characterized under field condition.

Traits			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2012-2013	Sp 1	AVR	4.43	3.78	54.38	9.96	12.52	34.07	10.1	1573.58	4.066	2.74	1.26	0.61	1.52	1.10	1.74	1.36
		SD	1.72	1.98	24.13	4.71	3.82	18.18	3.00	1629.27	0.88	0.25	0.24	0.15	0.14	0.13	0.20	0.17
		VAR	2.97	3.92	582.68	22.25	14.61	330.85	9.03	2654524.81	0.78	0.06	0.05	0.02	0.02	0.01	0.04	0.02
	Sp 2	AVR	3.21	3.72	48.69	11.88	13.28	25.66	8.91	844.68	3.2	2.76	1.15	0.68	1.79	1.20	1.65	1.36
		SD	0.82	0.94	11.97	2.86	3.10	7.79	2.74	655.03	1.20	0.26	0.17	0.15	0.20	0.29	0.11	0.16
		VAR	0.67	0.90	143.34	8.20	9.62	60.74	7.55	429072.85	1.45	0.07	0.02	0.02	0.04	0.08	0.01	0.02
	Sp 3	AVR	8.14	4.79	83.22	17.71	20.46	49.91	10.92	5389.789	8.6	2.56	0.88	0.51	2.15	1.64	1.65	1.82
		SD	0.82	2.81	20.61	3.29	3.63	14.72	3.02	3824.96	2.41	0.35	0.16	0.17	0.12	0.19	0.26	0.14
		VAR	167	7.88	424.96	10.83	13.21	216.79	9.13	14630354.97	5.82	0.12	0.02	0.03	0.02	0.04	0.07	0.02
2013-2014	Sp 1	AVR	4.43	3.78	85.77	19.08	18.74	49.42	18.3	6716.77	6.4	3.71	1.46	0.76	1.76	1.27	1.93	1.42
		SD	1.72	1.98	30.06	8.39	5.57	17.57	4.97	6643.16	1.95	0.27	0.23	0.20	0.15	0.12	0.17	0.20
		VAR	2.97	3.92	903.83	70.54	31.13	308.97	24.71	44131615.31	3.82	0.07	0.05	0.41	0.02	0.01	0.02	0.04
	Sp 2	AVR	3.21	3.72	72.49	16.73	18.04	38.64	13.14	366.94	6.8	2.93	1.23	0.76	1.89	1.28	1.72	1.46
		SD	0.82	0.94	17.79	3.05	3.79	12.06	2.81	1895.17	1.74	0.1290	0.11	0.13	0.16	0.39	0.12	0.15
		VAR	0.67	0.90	316.53	12.27	14.39	145.64	7.93	3591665.3	3.02	0.01	0.01	0.01	0.02	0.15	0.01	0.02
	Sp 3	AVR	8.14	4.79	118.83	26.70	28.14	65.35	10.59	17892.20	19.2	2.89	1.34	0.72	2.13	1.72	1.8	0.02
		SD	0.82	2.81	12.25	3.19	3.08	6.78	1.73	21981	2.59	0.40	1.57	0.19	0.24	0.17	0.16	0.12
		VAR	167	7.88	150.17	10.18	9.50	46.09	3.01	483162924	6.74	0.16	2.49	0.03	0.06	0.03	0.02	0.02

*Sp 1- *Curcuma. decipiens*, Sp 2– *C. pseudomontana*, Sp 3– *C. zedoaria*,

**__Traits__ – 1– Rhizome length, 2– Rhizome width, 3– Plant height, 4– Sheath length, 5– Petiole length, 6– Leaf length, 7– Leaf width, 8– Leaf area index, 9– Total no. of leaves, 10– Flower length, 11- Calyx length, 12- Calyx width, 13- Corolla length, 14- Corolla width, 15- Lip length, 16- Lip width.

Conclusion:

Present study revealed that generally genotypes of *Curcuma* appeared to have narrow genetic base which have to undergone high level of genetic erosion and selection pressure. Thus, the investigation on agronomic traits of *Curcuma* related wild species provided useful information regarding their horticultural use. The given data can be helpful to select wild parents in order to widen indigenous gene pool of turmeric for future breeding programms.

References:

Aoi, K. (1992). The characteristics and cultivation methods of medicinal plants *Curcuma domestic. Agric. Hort.,* 67:401-406.

Apavatjrut, P., Anantalabhochai, S., Sirirugsa, P. and Alisi, C. (1999). Molecular markers in the identification of some early flowering *Curcuma* (Zingiberaceae) species. *Ann. Bot.,* (84):529-534.

Brown, A.D.H. (1989). The use of plant genetic resources. New York: Cambridge.

Chaveerach, A., Sudmoon, R., Tance, T., Mokkamul, P., Sattayasai, N. and Sattaysai, J. (2008). Two new species of *Curcuma* (Zingiberaceae) used as cobra-bite antidotes. *J. Syst. Evol.,* 46:80-88.

Hikmat, J., Malik, A.R. and Khan, S. (2012). Estimation of genetic variability in Turmeric (*Curcuma longa* L.) germplasm using agro-morphological traits.*Pak. J. Bot.,* (44): 231-238.

Kumar, K.M., Thomas, V.P., Prasanth, A.V. and Sabu. M. (2008). Conservation of selected wild potential ornamental gingers in India: Domestication and Cultural practice. *Biodiversity Assessment and Conservation,* 391-395.

Mangaly , J. and Sabu, M. (1993). A taxonomic revision of the South Indian species of *Curcuma* Linn. (Zingiberaceae). *Rheedea*, 3(2): 139-171.

Preter, K.V. (2001). Handbook of herbs and spices. 1:298.

Rattan, **R.S., Korla. B.N. and Dohroo, N.P. (1998).** Performance of ginger variety under Solan conditions of Himachal Pradesh. In Proceedings of National Seminar on Chilies, Ginger and Turmeric, Hyderabad (Eds.): Styanarayanan, G., Reddy, M.S., Rao, M.R., Azam, K.M. and Naidu, R. Spices board, Cochin and Andhra Pradesh Agricultural University, Hyderabad, 71-73.

Reed, B.M., Engelmann, F., Dullo, M.E. and Engels, J.M.M. (2004). Technical guidelines for the management of field and in vitro germplasm collections.*IPGRI Handbook for Genebanks* No 7. Rome: IPGHI.

Schonbeck, J. and Frey, R.J. (2005). Turmeric. In : Longe JL (Ed.), The Encyclopedia of Alternative Medicine. Farmington Hills, Mich: Thomson/ Gale.

Škorničková, **J. (2007).** Taxonomic studies in Indian *Curcuma* L. Dissertation, Charles University, Prague, Czech Republic.

Škorničková, J., Rehse, T. & Sabu, M. 2007. Other economically important *Curcuma* species. 451–467 in: Ravindran, P.N. (ed.), Turmeric: The genus *Curcuma*. Florida : CRC Press.

Škorničková, J., Šída, O., Jarolimova, V., Sabu, M., Fer, T., Travnicek, P. and Suda, J. (2007). Chromosome numbers and genome size variation in Indian species of *Curcuma* (Zingiberaceae). *Annals of Botany*, 1-22.

Westwood, M.N. (1989). Maintenance and storage: clonal germplasm. Plant Breeding Review, (7):111-128.

Yadav, D.S. and Singh, R. (1996). Studies on genetic variability in turmeric (*Curcuma longa*). *J. Hill Res.*, 9:33-36.

Záveská, E., Fer, T., Šída, O., Krak, K., Marhold, K. and Leong-Škorničková, J. (2012). Phylogeny of *Curcuma* (Zingiberaceae) based on plastid and nuclear sequences: Proposal of the new subgenus *Ecomata*. *Taxon* 61(4), 747-763.

Záveská, E., Fér, T., Šída, O., Leong-Škorničková, J., Sabu, M. & Marhold, K. (2011). Genetic diversity patterns in *Curcuma* reflect differences in genome size. *Bot. J. Linn.* Soc. 165: 388.