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Chromosome counts in two species of *Curcuma* Linnaeus (Zingiberaceae) from North-East India

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Abstract

The somatic chromosome number of two species of *Curcuma* from Northeast India has been investigated. Chromosome counts were carried out in root tip cells by squash preparation. All the root tip cells analyzed show the chromosome number of 2n = 63 in both the species *viz. C. longa* and *C. caesia*. Probable triploid nature of both the species has been indicated.

Key words: *Curcuma caesia*, *Curcuma longa*, Chromosome number, Polyploidy

INTRODUCTION

The genus *Curcuma* Linnaeus of Zingiberaceae comprises of about 100 species (Velayudhan *et al*. 1999) including some most useful and popular ones viz. *C. longa* (Sasikumar 2005). The origin and spread of the genus favoured its Indo–Malayan origin and centre of diversity theory (Harlan 1975). The genus *Curcuma* Linnaeus contains many taxa of economic, medicinal, ornamental and cultural importance (Velayudhan *et al*. 2012).

Chromosome numbers and genome size of plant species provide authentic information which is useful in systematic, evolution and conservation of plants (Bennett & Leitch 2005; Guerra 2008), especially in taxa with smaller chromosomes like *Curcuma* (Skornickova *et al*. 2007). A quick perusal of published literature reveals that somatic chromosome numbers have been investigated in various species of *Curcuma* and polyploidy has been implicated in the diversification and evolution of the species (Suigura 1931; Raghavan & Venkat 1943; Chakravorti 1948; Sato 1948; Ramachandran 1961; Prana 1977; Apavatjrut *et al.* 1996; Das *et al.* 1999; Joseph *et al.* 1999; Ardiyani 2002; Sirisawad *et al.* 2003; Islam 2004; Skornickova *et al*. 2007; Nair & Sasikumar 2009). However, there are no detailed cytologenetical reports about *Curcuma* species growing in wild and/or cultivated in northeast India. Therefore, the present investigations have been undertaken to determine the somatic chromosome number in two species belonging to the genus *Curcuma viz. C. caesia* Roxburgh and *C. longa* Linnaeus which are medicinally important species of the region.

MATERIAL AND METHODS

The rhizomes of *C. caesia* (IISR 700) and *C. longa* (IISR Pratibha) used in the present investigation were obtained from Indian Institute of Spices Research, Kozhikode, Kerala. The plants were grown and maintained in poly-house conditions at the Department of

Biotechnology and Bioinformatics, North-Eastern Hill University, Shillong. Actively growing root tip of 1 – 2 cm long were excised from field grown plants and were pretreated with saturated para-dichlorobenzene (HiMedia) for 3 hours at room temperature. The root tips after pretreatment were fixed in freshly prepared 1 : 3 acetic alcohol for a minimum period of 24 hrs and thereafter stored in 70 % ethanol till those are squashed. Root tips were hydrolysed in 1N HCl for 8 minutes at 60° C and stained in leucobasic-fuschin (HiMedia) for 45 minutes at room temperature. The stained root tips were then thoroughly washed with distilled water and finally squashed in 1 % acetocarmine (Shamurailatpam *et al*. 2012).

Photomicrographs of the metaphase plates were taken from temporary preparations using Leica DFC 310FX microscope. At least 5 well spread metaphase plates were used for the study. The voucher slides for future verification have been stored at Plant Biotechnology Laboratory, Department of Biotechnology and Bioinformatics, North-Eastern Hill University, Shillong.

RESULTS AND DISCUSSION

In the present study, the somatic chromosome numbers of *C. caesia* and *C. longa* were determined to be 2n = 63 (Figs. 1 a & b). Karyological investigation of C*urcuma* species is rather challenging and errors may easily be introduced due to relatively high number but smaller chromosomes (Ramachandran 1961; Apavatjrut 1996; Joseph *et al.* 1999; Sirisawad *et al.* 2003). Different chromosome counts for the same species have also been reported in some cases. However, in present investigations the occurrence of 2n = 63 has been clearly recorded with the help of neat, clean and unambiguous preparations in *C. longa* and *C. caesia* with no evidence of numerical variations, whatsoever. The occurrence of 2n = 63 as somatic chromosome number is in agreement with the findings of Ramachandran (1961),

Fig. 1. Mitotic complements in *Curcuma* spp. **a.** *C. caesia* (2n = 63); **b.** *C. longa* (2n = 63). Scale bar = 10 µm.

Joseph *et al* (1999) and Islam (2004). However, the somatic chromosome number in *C. caesia* has also been reported to be 2n = 22 (Das *et al*. 1999) which is quite unrelated chromosome count and thus our observations are at variance with the report of Das *et al.* (1999). On contrary, 2n = 22, 48, 62, 64 and 93 have been reported by different workers for *C. longa* (Raghavan & Venkatasubban 1943; Ramachandran 1961; Sharma & Bhattachrya

1959; Sato 1960; Scornickova *et al.* 2007). The present authors opine that these unrelated chromosome numbers might be due to ambiguity in cytological preparations and/or technical difficulties in obtaining quality preparations. There has been continued disparity and controversy concerning the basic chromosome number of the genus *Curcuma* (Scornickova *et al.* 2007). Three basic numbers of x = 7, 16, 21 have been proposed for the genus *Curcuma* by various cytogeneticists (Raghavan & Venkatasubban 1943; Ramachandran 1961; Sharma & Bhattachrya 1959; Sato 1960; Scornickova *et al.* 2007). However, our study indicates that the basic chromosome number could be x = 21 in conformity with the reports of Ramachandran (1961), Prana (1978), Ardhiyani (2002) and Islam (2004) which is a widely accepted basic chromosome number. Therefore, based on our study, *C. caesia* and *C. longa* could be regarded as possible triploid (3x) species. Chromosome counts provide indispensable information on genetic discontinuities within and among the species and they contribute to our understanding of phylogenetic relationships at all taxonomic levels (Semple *et al.* 1989). However, it is untenable to depend only on chromosome counts to resolve the basic chromosome number in *Curcuma*. Therefore, further cytogenetical investigations related to meiotic analysis should be carried to ascertain the basic chromosome number in *Curcuma* and determine the type of polyploidy (3x) which is recorded here in *C. caesia* and *C. longa.*

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LITERATURE CITED

Apavatjrut, P.; Sirisawad, T.; Sirirugsa. P.; Voraurai, P. & Suwanthada, C. 1996. Studies on chromosome number of seventeen Thai *Curcuma* species. *Proceed. 2nd Nat. Conf. Flwr. Ornam. Pl.* 2: 86 – 99.

Ardiyani, M. 2002. *Systematic study of Curcuma L.: turmeric and its allies*. PhD thesis, University of Edinburgh, Scotland.

Bennett, M.D. & Leitch, I.J. 2005. Nuclear DNA amounts in angiosperms: progress, problems, and prospects. *Ann. Bot*. 95: 45 – 90.

Chakravorti, A.K. 1948. Multiplication of chromosome numbers in relation to speciation in Zingiberaceae. *Sci. Cult*. 14: 137 – 140.

Das, A.B.; Rai, S. & Das, P. 1999. Karyotype analysis and cytophotometric estimation of nuclear DNA content in some members of the Zingiberaceae. *Cytobios* 97: 23 – 33.

Guerra, M. 2008. Chromosome numbers in plant cytotaxonomy: Concepts and implications. *Cytogen. Genome Res.* 120: 339 – 350.

Harlan, J.R. 1975. *Crops and Man*. American Society of Agronomy, Madison, Wisconsin, USA. 295 pp.

Islam, M.A. 2004. *Genetic diversity of the genus Curcuma in Bangladesh and further biotechnological approaches for in vitro regeneration and long-term conservation of C. longa germplasm*. PhD thesis, University of Hannover, Germany.

Joseph, R; Joseph. T. & Joseph, J. 1999. Karyomorphological studies in the genus *Curcuma* Linn. *Cytologia* 64: 313 – 317.

Nair, R.R. & Sasikumar, B. 2009. Chromosome number variation among germplasm collections and seedling progenies in turmeric, *Curcuma longa* L. *Cytologia* 74(2): 153 – 157.

Prana, M.S. 1977. *Studies on some Indonesian Curcuma species*. PhD thesis, University of Birmingham, England.

Raghavan, T.S. & Venkatasubban, K.R. 1943. Cytological studies in the family Zingiberaceae with special reference to chromosome number and cyto-taxonomy. *Proceed. Indian Acad. Sci.*, Series B 17: 118 – 132.

Ramachandran, K. 1961. Chromosome numbers in the genus *Curcuma* Linn. Curr. Sci. 30: 194 – 196.

Sasikumar, B. 2005. Genetic resources of *Curcuma*: diversity, characterization and utilization. *Pl. Genet. Resor*. 3: 230 – 251.

Sato, D. 1948. Karyotype and systematics of Zingiberales. *Jap. J. Genet*. 23: 44 – 45.

Sato, D. 1960. The karyotype analysis in Zingiberales with special reference to the protokaryotype and stable karyotype. *Scientific Papers of the College of General Education*, University of Tokyo 10: 225 – 243.

Semple, J.C.; Chmielewski, J.G. & Windham, M.D. 1989. Chromosome number determination in fam. Compositae, tribe Astereae. III. Additional counts and comments on generic limits and ancestral base number. *Rhodora* 91: 296 – 314.

Shamurailatpam , A.; Madhavan, L.; Yadav, S.R.; Bhat, K.V. & Rao, S.R. 2012. Chromosome diversity analysis in various species of *Vigna* Savi from India. *Nucleus* 55(2):107 – 114.

Sharma, A.K. & Bhattacharya, N.K. 1959. Cytology of several members of Zingiberaceae. *La Cellule* 59: 297 – 346.

Sirisawad, T.; Sirirugsa, P.; Suwanthada, C. & Apavtjrut, P. 2003. Investigation of chromosome numbers in 20 taxa of *Curcuma*. In: Chantaranothai P, Larsen K, Sirirugsa P, Simpson D, (eds.). *Proceedings of the 3rd Symposium on the family Zingiberaceae*. Khon Kaen: Applied Taxonomic Research Centre, Khon Kaen University, Pp. 54 – 62.

Skornickova, J.; Sída, O.; Jarolimova, V.; Sabu, M. & Suda, J. 2007. Chromosome numbers and genome size variation in Indian species of *Curcuma* (Zingiberaceae). *Ann. Bot*. 100: 505 – 526.

Velayudhan, K.C.; Dikshit, N. & Nizar, M.A. 2012. Ethnobotany of turmeric (*Curcuma longa* L.). *Indian J. Trad. Knowl*. 11(4): 607 – 614.

Velayudhan, K.C.; Muralidharan, V.K.; Amalraj, V.A.; Gautam, P.L.; Mandal, S. & Dinesh, K. 1999. *Curcuma Genetic Resources*. Scientific Monograph No. 4. New Delhi: National Bureau of Plant Genetic Resources.