Original Article

Chromosome Numbers and Karyotype Studies of Few Members of Malvales

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ABSTRACT

Chromosome numbers and karyomorphological data are essential in selecting the suitable species for plant breeding programmes, resolving taxonomic confusions, tracing the evolutionary tendencies and evolving ploypoid varieties. In this study, we analysed the karyotype analysis of five malvales species, viz., *Sida rhombifolia*, *Sida spinosa, Sida acuta*, *Sida glutinosa* and *Sida cordata*. Somatic chromosome numbers, karyotypes, range of chromosome length, arm ratio and haploid chromatin length were studied for these species. The result of this study showed, *Sida rhombifolia* and *Sida spinosa* were found to be 2n=14, *Sida acuta* was 2n=28 and *Sida glutinosa* and *Sida cordata* were found to be 2n=32 somatic chromosome numbers. Somatic chromosome length ranges from 0.95 to 3.23 µm, arm ratio ranges from 0.22-0.91 µm where as haploid chromatin length ranges from 13.49 to 31.74 µm. Their karyotypes were commonly bi-modal, homogenous assemblage and decreasing in length from the longest to the shortest chromosomes. Experimental results have confirmed that the chromosome numbers in *Sida* are not just multiplies of a single basic number. Different basic number of x=7, 8, 9, 11 and 17 occur in the *genus*.

Keywords: Malvaceae, Mitosis, Karyotype analysis.

INTRODUCTION

Many taxa of the malvales are well known for their high economic value as they are the sources for cotton (Gossypium), jute (Corchorus), kapok (Ceiba), silk (*Bombyx mori* L.), cocoa (Theobroma), etc. Some of them also yield valuable timber (Heritiera, Tilia, Bombyx and Ochroma), gum (Sterculia) and vegetables (Hibiscus and Abelmoschus). Cytological studies on Malvales members from North[10,5,2] have revealed differences in chromosome numbers in several taxa. Previous karyomorphological reports do not includes many taxa occurring in South-India. Chromosome numbers are yet to be discovered in many taxa. "Malesian Malvaceae Revised" feels that chromosome numbers are insufficiently known in most of

the wild species[3]. In recent years, cytology has become closely associated with taxonomy and emergence of the new discipline under the name "Cytotaxonomy" is very important development in the history of both these disciplines. Cytological data in respect of chromosome number, karyomorphology, meiotic behaviour etc., have provided extremely useful information for purpose of comparison, understanding and interpretation of relationships and evolutionary trends operating within and among the taxonomic categories. In the present study an attempt have been made to study the karyotypic studies in five species of Malvales.

MATERIALS AND METHODS

For present studies, somatic preparations were made from fresh root tips were collected from young seedlings between 9.30 to 10.30 a.m. and pre-treated with 0.002 M8-hydroxyquinoline for 2-4 hours at 10-12C^{O} and then fixed in 1:3 glacial acetic acid: alcohol for minimum of 30 minutes. Hydrolysed in 1 N HCl at 60C^{o}. Then they are stained in Schiff's reagent and squashed on a clean slide using 1.5% aceto-orcein stain. Photomicrographs and drawings were made on the same day of preparation. For each species number of preparations was made to ascertain the chromosome number and their morphology. Ideograms were drawn using suitable scale. Karyotype classifications were made according to[6].

RESULTS

Details of the somatic chromosome number, range of chromosome length, karyotype formulae, arm ratio and haploid chromatin length are presented in Table 1.

Sida rhombifolia

The somatic complement of this species is revealed 2n=14 chromosomes (Fig. 1). There are medium and short chromosomes. Out of five pairs of medium chromosomes, one pair is with median primary constructions (B^{m}), three pairs are with sub median primary constructions (B^{sm}) and one pair is with sub median constructions having satellites on short arms (B^{ss}). Among the two pairs of short chromosomes, one pair has sub median primary constructions (C^{sm}) and the other pair has sub terminal primary constructions (C^{st}). The differences in the chromosome length range from 2.20 to 3.25 µm with an arm ratio ranging from 0.22 to 0.94µm. The total chromatin length of the haploid set is 18.70 µm. The karyotype formula of this species is $2n=14=2B^{m}+6B^{sm}+2B^{ss}+2C^{sm}+2C^{st}$.

Sida spinosa

The somatic chromosomes of this species exhibited 2n=14 chromosomes (Fig. 2). The karyotype analysis revealed the presence of medium and short chromosomes. There are two pairs of medium chromosomes of which one pair has median primary constrictions (B^{m}) and other pair possesses sub median primary constrictions with satellites on the short arms (B^{ss}). Among short chromosomes, one pair has median primary constrictions (C^{m}) and four pairs have sub median primary constrictions (C^{sm}). The difference in the chromosome length ranges from 1.43 to 2.61 µm with an arm ratio ranging from 0.41 to 1.00 µm. The total chromatin length of haploid set is 13. 49 µm. The karyotype formula for this species is $2n=14=2B^{m}+2B^{ss}+2C^{m}+8C^{sm}$.

Sida acuta

The somatic chromosome number of this species consist of 2n=28 (Fig.3). There is only one pair of medium chromosomes with submedian primary constrictions (B^{sm}). Out of

thirteen pairs of short chromosomes, five pairs are with nearly median primary constrictions (C^{m}), six pairs are with sub median primary constrictions (C^{sm}) and two pairs are with nearly sub terminal primary constrictions (C^{st}). Thus the karyotype consists of four main types chromosomes. The longest chromosome in the complement measures 2.56 µm while the shortest is 1.61 µm with an arm ratio ranging from 0.22 to 0.91 µm. The total chromatin length of haploid set is 27.54 µm. The karyotype formula for this species is $2n=28=2B^{sm}+10C^{m}+12C^{sm}+4C^{st}$.

Sida glutinosa

The somatic chromosome number of this species consist of 2n=32 chromosomes (Fig. 4). The karyotype analysis revealed the presence of short and very short chromosomes. Among fourteen pairs of short ones five pairs with median primary constrictions (C^{m}), eight pairs with sub-median primary constrictions (C^{sm}) and the remaining pair is with submedian-subterminal median primary constrictions having satellites on the short arms (C^{ss}). There are two pairs of very short chromosomes with submedian primary constrictions (D^{sm}). Thus, the karyotype consists of four main types of chromosomes. The differences in the chromosome length range from 0.95 to 2.14 µm with an arm ratio ranging from 0.49 to 0.95 µm. The total chromatin length of haploid set is 24.53 µm. The karyotype formula for this species is $2n=32=10C^{m}+16C^{sm}+2C^{ss}+4D^{sm}$.

Sida cordata

The somatic complement of this species consist of 2n=32 chromosomes (Fig. 5) and includes medium and short chromosomes, majority of them being short. There is an only one pair of medium chromosomes with sub-median primary constrictions (B^{sm}). Among the short chromosomes, six pairs have median primary constrictions (C^{m}), seven pairs have sub median primary constrictions (C^{sm}) and two pairs of sub-medium chromosomes have satellites on the short arms (C^{ss}). Three pairs of short chromosomes are equal in their length. The longest chromosome in the complement measures 2.85 µm, while the shortest measures 1.52 µm with an arm ratio ranging from 0.41 to 0.96 µm. The total chromatin length of haploid set is 31.74 µm. The karyotype formula for this species is $2n=32=2B^{sm}+12C^{m}+14C^{sm}+4C^{ss}$.

DISCUSSION

About eight species of *Sida* occur in South India[4]. Of these, five species have been studied in the present work. *Sida spinosa* and *Sida rhombifolia* revealed 2n=14, where as *Sida acuta* revealed 2n=28 chromosomes. Altogether a different chromosome number (2n=32) were found in *S. cordata* and *S. glutinosa*. The chromosome number of *S. rhombifolia* (2n=14) is a new report from the present studies.

S. cordata is at variance with the previous reports except that of[5]. Thus *S. cordata* has 2n=28[9] and 2n=34[1].

Similar variation is also seen in *S. acuta*. Present work and previous work of[7] and[5] revealed 2n=28, while the diploid chromosome number of 2n=14 is reported by[8]. On the other hand a different base number n=18 is found by[9]. Thus this species has 7 and 9 has base numbers.

Sida spinosa reveals the chromosome number of 2n=14 in the present study, while[11] and[1] have reported the number of 2n=28 in this species, which is apparently at the tetraploid level with 7 as the basic number. These findings are highly suggestive that polyploids have played a major role in the evolution of *Sida.* Further, the chromosome number in *Sida* are not just multiplies of a single basic number, but are multiplies of different basic numbers of x=7, 8, 9, 11, and

17. The basic numbers x=7 appears to be predominant in the *genus*. In addition to the chromosome numbers, detailed karyotypic analysis has been done in all the five species here, in which the karyotypes of *S. rhombifolia* and *S. spinosa* have been newly reported in the present studies. Generally chromosomes are comparatively short. The category of long chromosomes are prominently absent in all of them. Majority of the chromosomes have sumedian primary constrictions. The differences in the chromosome size within the respective complements do not appear to be very significant. Although gross similarities among the karyotypes suggest their homogenous assemblage, yet each species showed certain chromosomal differences from the others retaining their individual pattern. SAT-chromosomes have not been observed in *Sida acuta* where as *Sida spinosa*, *S. glutinosa* and *S. rhombifolia* have revealed the presence of one pair of SAT- chromosomes in each and two pairs in *S. cordata.* It is an interesting that certain marked differences were noticed in the karyotype of *Sida acuta* analysed in the present studies as compared to those of previous workers. Presence of secondary constrictions[5] has not been observed in the present studies.

CONCLUSION

Based on our observations, we therefore concluded that, the basic chromosome number x=7 appears to be dominant in the *genus* and the other numbers appear to have been derived through uneuploid alterations, secondary polyploidy, hybridization and doubling of chromosomes played a major role in the evolution of the *genus*.

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Table 1. Karyotype analysis in *Sida rhombifolia, Sida spinosa, Sida acuta, Sida glutinosa* and *Sida cordata*

No. of species	2n chromosome number	Karyotype formulae	Chromosome size range (µm)	Arm ratio (µm)	Haploid chromatin Length (µm)
Sida rhombifolia	2n=14	$2n=14=2B^{m}+6B^{sm}+2B^{ss}+2C^{sm}+2C^{st}$	2.20-3.25	0.22-0.94	18.70
Sida spinosa	2n=14	$2n=14=2B^{m}+2B^{ss}+2C^{m}+8C^{sm}$	1.43-2.61	0.41-1.00	13.49
Sida acuta	2n=28	$2n=28=2B^{sm}+10C^{m}+12C^{sm}+4C^{st}$	1.61-2.56	0.22-0.91	27.54
Sida glutinosa	2n=32	$2n=32=10C^{m}+16C^{sm}+2C^{ss}+4D^{sm}$	0.95-2.14	0.49-0.95	24.53
Sida cordata	2n=32	$2n=32=2B^{sm}+12C^{m}+14C^{sm}+4C^{ss}$	1.52-2.85	041-0.96	31.74

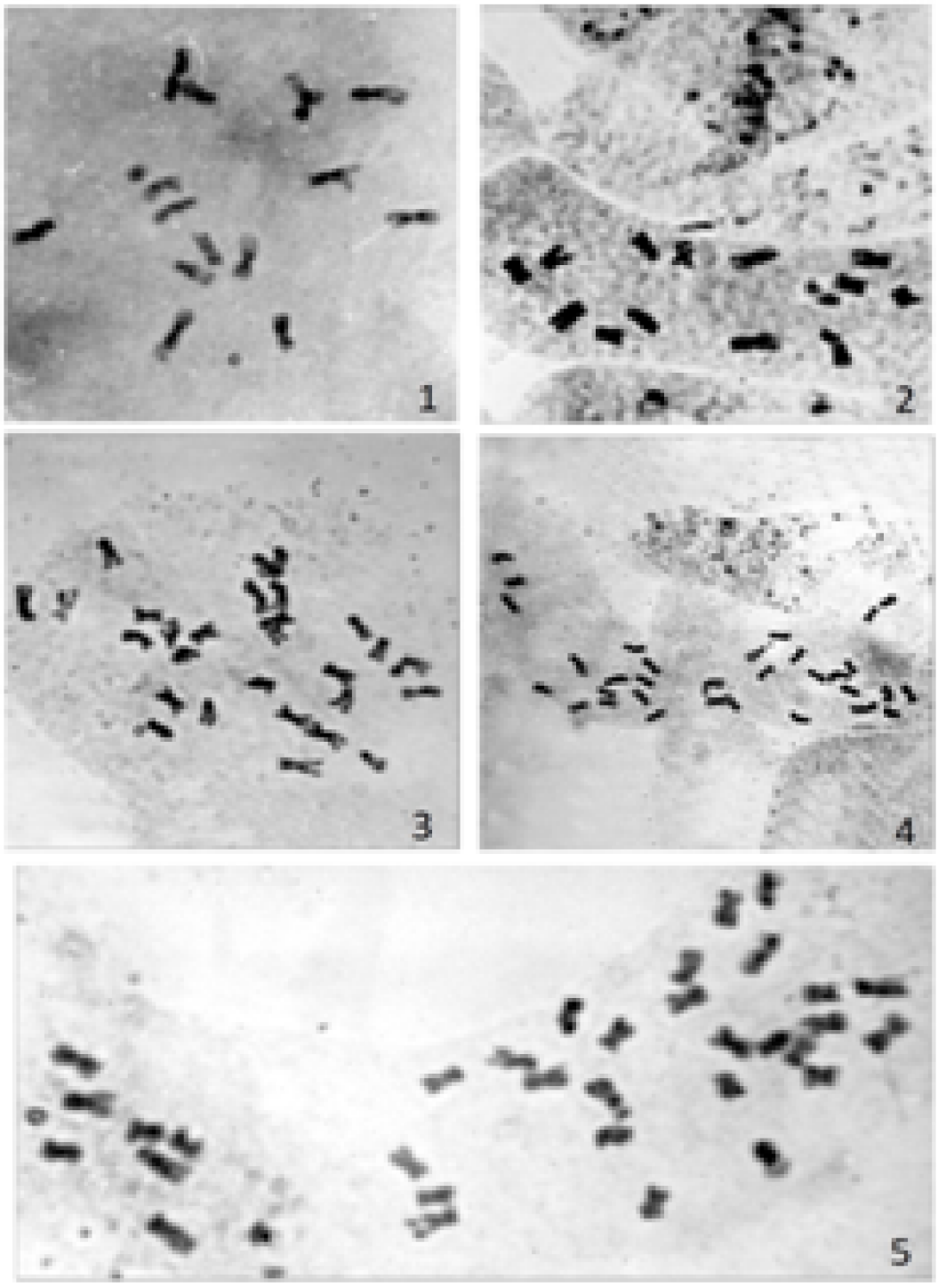

Figure: 1, 2, 3, 4 & 5, Somatic chromosomes of *Sida rhombifolia* (2n=14), *Sida spinosa* (2n=14), *Sida acuta* (2n=28), *Sida glutinosa* (2n=32) and *Sida cordata* (2n=32) respectively

 ISSN 2321 – 2748

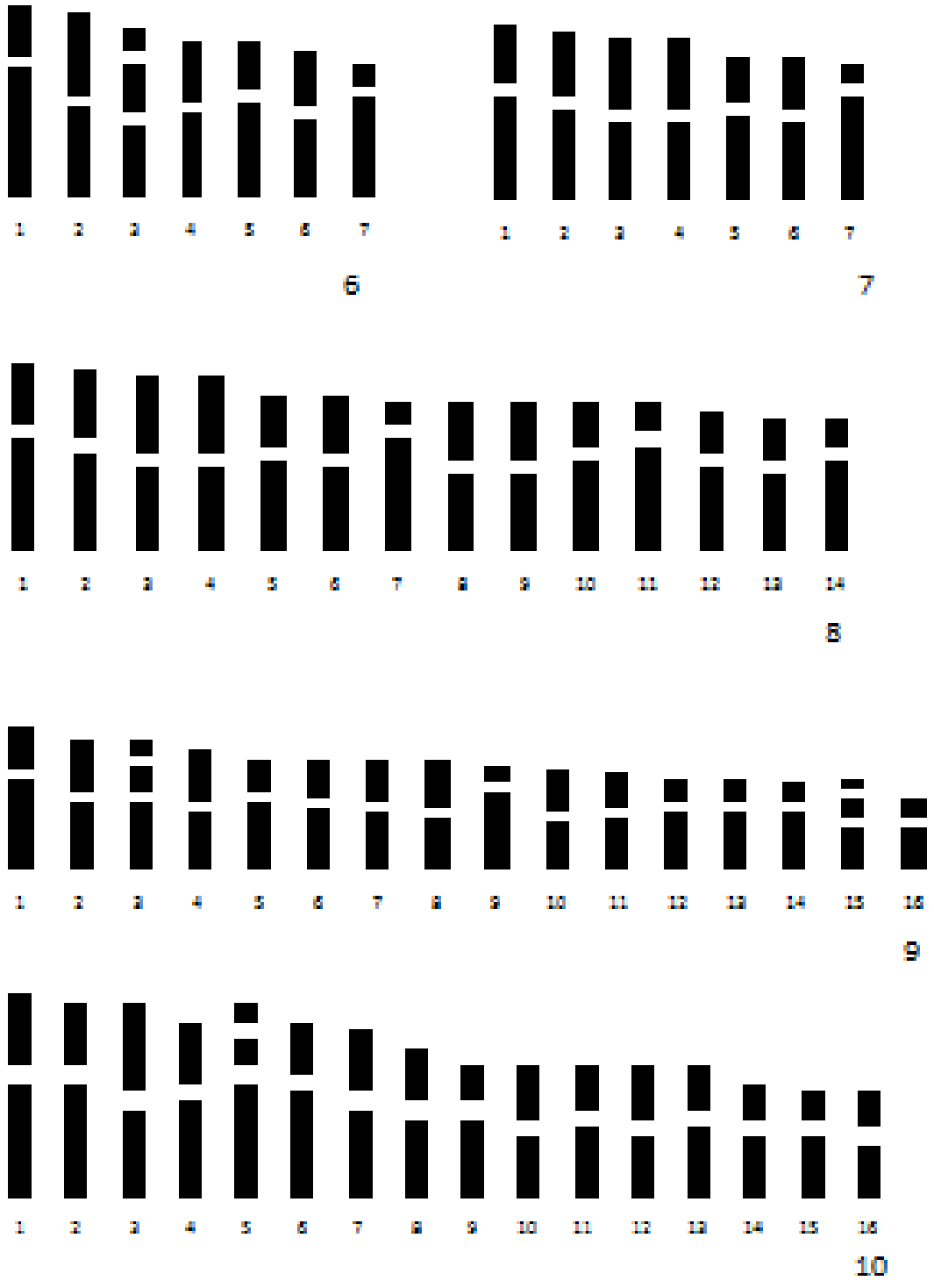

Figure: 6, 7, 8, 9 & 10, Ideograms of *Sida rhombifolia, Sida spinosa, Sida acuta, Sida glutinosa* and *Sida cordata* respectively