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# CYTOTAXONOMICAL STUDIES IN THE GENUS *SETCREASEA*

SMRITIMOY BOSE*

*Cytogenetics Laboratory, Department of Botany, Calcutta University, Calcutta-19*

ABSTRACT

Cytological studies have been done in two species of *Setcreasea*. In *Setcreasea purpurea* a somatic chromosome number of 12 has been observed and in *S. brevifolia* an aneuploid number of 2n = 25 has been found. Three major types of chromosomes have been observed in the karyotypes of both taxa. The cytological situation in the two taxa has been observed to be similar to that of *Tradescantia*. Meiotic behaviour in *S. purpurea* is regular while in *S. brevifolia* it is irregular. The irregularity in the latter taxon is doubtless connected with aneuploidy and structural hybridity. The finding of diploid pollen grains in *S. purpurea* and *S. brevifolia* could have been due to the failure of the chromosomes or chromatids to go to different poles, disturbance in spindle formation, or possibly to a complete failure of cell wall development. Many cases have been found of abnormal cytokinesis in pollen grain formation. Polyploidy, structural hybridity and hybridization has been considered to be playing major role in evolutionary tendencies in *Setcreasea*.

In view of the cytological and morphological characteristics, it has been suggested that the genus is related to *Zebrina* and its relationship with *Cyanotis* is remote. Taking all these factors into consideration, it appears that *Setcreasea* will be in more natural systematic position if separated widely from *Cyanotis* and placed near *Zebrina*.

## INTRODUCTION

*Setcreasea* is a genus belonging to the family Commelinaceae. Its several species are native to Texas and Mexico. A few genera in this family have been the subject of extensive cytological studies. Special mention can be made of the genus *Tradescantia,* which is ideally suitable for the studies of structure, morphology and behaviour of chromosomes in mitosis and meiosis. In *Setcreasea* the chromosomes have been found to be similar to those of *Tradescantia,* and are few in number. Moreover, not all the recognized species in this genus have been studied cytologically and taxonomic position of the genus has also to be taken into account. For these reasons it was thought desirable to make cytotaxonomical studies of the available species.

## RESUME OF THE PREVIOUS CYTOLOGICAL WORK

The earliest report on the chromosome number in the genus *Setcreasea* is that of Darlington (1929). He reported the somatic chromosome number of *Treleasia brevifolia* to be 2n=24. and remarked that the chromosomes were similar to those of some varieties of *Tradescantia virginiana.* With regard to the karyotype, he observed three or four chromosomes with more nearly terminal constrictions in *Treleasia brevifolia* than are found in *Tradescantia virginiana.* Later on, Richardson (1935) reported the chromosomes both in diploid and tetraploid species to be large and with median or submedian primary constrictions. She also made an extensive study of meiotic behaviour of both diploid and tetraploid types. Meiosis in the diploid was found to be regular and was similar to that of another member of the tribe Tradescantieae, *Spironema fragrans.* The tetraploid type studied by Richardson on the other hand was similar to that of *Tradescantia virginiana.* The similarity was particularly evident in the size and form of metaphase configurations and the average number of quadrivalents. The tetraploid species of *Setcreasea brevifolia* revealed the presence of a higher degree of interstitial chiasmata and the quadrivalent and bivalent associations fewer in comparison to *Tradescantia virginiana.* From the study of the meiotic behaviour of the tetraploid form of *Setcreasea brevifolia,* Richardson suggested the presence of structural hybridity and from this study she brought additional evidence for the presence of polyploidy and structural hybridity in the whole tribe Tradescantieae. According to Richardson's hypothesis structural hybridity in the tetraploid species of *Setcreasea brevifolia* was shown by the association of more than four, by interstitial chiasmata and by the observation of low chiasma frequency. She also took into account the formation of trivalents and the finding of many univalents in this connection.

Anderson and Sax (1936) reported the chromosome number of another form of *Setcreasea brevifolia* from the microspore cells and found a number of 18 chromosomes to be present. They observed the morphology of the chromosomes to be like those of the Virginiana group of *Tradescantia* so far as the position of the centromere was concerned. The chromosomes of *Setcreasea brevifolia* studied by them were smaller in size. In meiosis, half of the chromosomes were paired as hexavalents and the rest were found to form bivalents and quadrivalents.

Recently, Celarier (1955) in his studies on the members of the tribe Tradescantieae, reported the

* This work was carried out during the author's stay at the Blandy Experimental Farm of the University of Virginia, Boyce, Virginia, U.S.A.

chromosome number in three additional species of *Setcreasea,* and found an aneuploid number of 2n=23 in one form of *S. brevifolia.* The chromosomes were found by him to have median and submedian constrictions. From his studies on the somatic and meiotic chromosomes he concluded that the genus *Setcreasea* was in an active state of evolution and that euploidy, aneuploidy, structural hybridity and hybridization were responsible for the phenomenon. Celarier further concluded that in spite of much cytological work done in the tribe Tradescantieae, a majority of the species were still unknown. He pointed out the need for a thorough phylogenetic study of the tribe with particular reference to the morphology, cytology and geographical distribution.

More recently, Mehra *et al.* (1961) reported cytotaxonomical studies in five species of *Setcreasea.* They observed 2n=24 chromosomes in *S. purpurea* and in two unidentified species. They ascribed the irregularities observed in meiotic stages in the tetraploids of *S. brevifolia, S. purpurea* and in two unidentified species to be due to polyploidy and hybridization between species and came to the same conclusion like that of Celarier that the genus *Setcreasea* was in an active state of evolution and that euploidy, aneuploidy, structural hybridity, and hybridization between species was probably playing a major part.

In Table 1 chromosome numbers reported for *Setcreasea* are listed. A study of this table will show that out of eight species recognized by Willis (1948), chromosome numbers are known for only four species and two unidentified taxa. A review of the literature shows that in comparison with the extensive amount of work done in the genus *Tradescantia,* cytological studies in *Setcreasea* are very scanty. Moreover, as stated above, chromosome numbers are unknown for several of the species in this genus. Previous work with *Setcreasea* indicates it to be interesting material for cytological problems.

## TAXONOMIC POSITION OF THE GENUS *SETCREASEA*

In 1899, Rose established a new genus *Treleasea,* with three species. These species were formerly included under the genus *Tradescantia.* In his new classification, Rose (1899) distinguished *Treleasea* from *Tradescantia,* on the basis of corolla and stamen characters. Species transferred to *Treleasea* had petals spread only at the top but tapered into a claw to form a tube at the base, while the species of *Tradescantia* had petals broad at the base and had open flowers spreading from the base. Besides, in the species of *Treleasea,* the stamens were borne on the petals, while in the species of *Tradescantia* they were free from the petals.

Later on, Rose (1903), changed the generic name *Treleasea* to *Neotreleasea,* because the former name had previously been applied to a genus of fungi. Meanwhile, Schumann and Sydow in 1901 (Rose, 1911) changed the name *Treleasea* to *Setcreasea.* Finally, Rose recognized the name *Setcreasea* and also supported the generic characteristics assigned to it by Schumann and Sydow in 1901. Rose also included the description of two species at this time, thus bringing the total number of then recognized species to five. While discussing the taxonomic position of the new genus, Rose distinguished it from the genus *Cyanotis* by the possession of stipitate fruit and concave sepals and other characters, but thought it to be nearer to *Cyanotis* than *Tradescantia.* On the other hand, he thought the chief difference between *Treleasea* and *Zebrina* to be the mere coherence of the petals at the edge in *Treleasea* as distinguished from united petals in *Zebrina.* On this basis he suggested the new genus *Treleasea* to be nearest to *Zebrina.*

Hutchinson (1934) also suggested a classification similar to that of Rose, and placed the genus *Setcreasea* between *Cyanotis* and *Zebrina,* on the basis of the presence of petals united into a short or long tube in the flowers of the above mentioned three species. *Tradescantia* was separated from these three genera, by the same author, because of the presence of petals free up to the base in the genus *Tradescantia.* As regards the classification of the family Commelinaceae, Hutchinson considered the type and position of inflorescence to be of primary significance.

Recently, Woodson (1942) in his taxonomic treatment of the American genera of Commelinaceae, based his major subdivision of the family entirely on inflorescence structure. In this respect he criticized the former classifications of Clarke in 1881 and of Brückner in 1930 which were based upon floral structure, specially the characters of perianth and androecia. Woodson argued, that because of the deliquescent flowers present in the members of the family Commelinaceae it is difficult to make herbarium studies. Moreover classification based on floral characters could not be relied upon. In his classification, Woodson divided the family Commelinaceae into two tribes. The tribe Tradescantieae was distinguished from the tribe Commelineae by the possession of the ultimate branches of the inflorescence composed of paired sessile scorpioid cymes and also by the presence of regular corolla. He distinguished the genus *Setcreasea* from the genus *Tradescantia,* by the presence of gamopetalous corolla and by the petals united at the base in the former. In *Tradescantia,* on the other hand, the corolla was apopetalous and the petals were free to the base. The genus *Zebrina* was placed next to *Setcreasea* in the same group because of the presence of the above mentioned two characters but was separated from *Setcreasea,* as the flowers in the genus *Zebrina* had unequally

lobed, united and hyaline sepals, whereas the sepals in the genus *Setcreasea* were separate and foliaceous.

The taxonomic position of the genus *Setcreasea* as suggested by Hutchinson (1934, 1959) and Woodson is shown in Table 2.

The taxonomic position of *Setcreasea* will be considered along with the cytological data obtained from the present investigation and also from the past studies on this genus made by different workers. This combined approach of taxonomy and cytology should throw further light on the relationship of *Setcreasea* with other members of the family Commelinaceae.

## MATERIALS AND METHODS

The following species were used in the present investigation:—(1) *Setcreasea purpurea* Boom and (2) *S. brevifolia* (Torr.) Rose.

Actively growing root tips were placed in a 0.2 per cent aqueous solution of Colchicine for 4 hours. This pretreatment not only helped in scattering the chromosomes but also resulted in details of their morphology being more readily observed. Constricted regions of the chromosomes also became distinct following such treatment. Fixation was in Acetic acid: Alcohol: : 1 : 3 for 24 hours. Following fixation, root tips were rinsed and were hydrolysed in 10 per cent HCl for 12-15 minutes at 58-60°C and were then again rinsed. They were then placed in Feulgen solution and were left in this stain for from 15 minutes to half an hour. Deeply stained portions of the root tips were smeared in a drop of 45 per cent acetic acid and pressure was applied to get maximum flattening and spreading of the chromosomes. The slides were then gently heated over the flame.

In both the species included in the present study detailed analyses of the karyotypes were made and idiograms were drawn for each of them. Only cells with well spread and unbroken chromosomes permitting careful observation of details were examined.

For the meiotic study suitable anthers were smeared on the slides and a 2 per cent aceto-orcein solution added. Next the smear was covered with a cover glass and was heated.

Pollen grains were stained in a drop of 1 per cent aceto-carmine solution to score fertile and sterile pollen.

## OBSERVATIONS

**Mitosis in Setcreasea purpurea**—The somatic chromosome number in *Setcreasea purpurea* has been found to be 2n=12 (Fig. 1). The chromosomes here can be classified into the following types (Table 3).

Type A: Chromosomes with median primary constrictions.

Type B: Chromosomes with submedian primary constrictions.

Type C: Chromosomes with submedian primary constrictions satellited on the shorter arms.

Type A and B can be further subdivided into $A_1$, $A_2$, and $B_1$, $B_2$ respectively. (Table 3).

**Meiosis in Setcreasea purpurea**—It was not possible to observe the early stages of meiosis with any degree of clarity. At metaphase I, six bivalents have been observed. They form various configurations of which ring and rod shapes are common (Fig. 3). The chiasma frequency per bivalent has been found to be 2.67. Behaviour of the chromosomes is completely regular and only bivalents have been noticed (Table 5). At anaphase I, chromosomes undergo regular disjunction and six chromosomes have been found going toward each pole. Regular distribution of chromosomes has been noticed in dyad stage and six chromosomes have been observed in metaphase II. No irregularities have been noticed either in anaphase II or telophase II of meiosis. Regular tetrad formation is the result.

Six chromosomes have been observed at pollen grain mitosis (Fig. 6). Cells with five (one cell) and 12 chromosomes (one cell) have also been observed. The percentage of apparently normal pollen has been found to be quite high (90 per cent). They are all of approximately the same size.

**Mitosis in Setcreasea brevifolia**—The somatic chromosome number in the present material of *Setcreasea brevifolia* has been found to be 2n=25 (Fig. 2). Chromosomes here can be classified into the following types (Table 4).

Type A: Chromosomes with median primary constrictions.

Type B: Chromosomes with submedian primary constrictions.

Type C: Chromosomes with submedian primary constrictions satellited on the shorter arms.

Types A and B can be further subdivided into $A_1$, $A_2$, $A_3$ and $B_1$, $B_2$, $B_3$ respectively (Table 4).

The extra chromosome has been found to be one of the subtypes of type B.

**Meiosis in Setcreasea brevifolia**—At metaphase I, different forms of chromosome association have been observed. Bivalents, trivalents and quadrivalents are most common (Fig. 4). Table 5 shows the different forms of association observed in *S. brevifolia*. The chiasma frequency per chromosome have been found to be 0.93. The terminalization of chiasmata is greater here in comparison with the diploid species, *S. purpurea*. Similar observations were made by Anderson and Sax (1936) in their studies of diploid and tetraploid species of *Tradescantia*. Large numbers of multivalents have been noticed at metaphase I. The bivalents are mostly of ring type but rod type configurations are also seen. The trivalents take the form of rod, and other types. The quadrivalents take various shapes like ring, rod, open chain and like figure eight. The maximum number of bivalents observed in a cell

are nine, while not more than one trivalent has been seen in any single cell. Up to four quadrivalents have been observed in single cells (Table 5).

In anaphase I, disjunction of the bivalents is regular. Multivalents like trivalents and quadrivalents interfere with the disjunction of the chromosomes at anaphase I. Lagging chromosomes have been observed as a result of this and they are noticed at various positions in the cell. The univalents show different behaviour. Those which are not included in either of the polar groups are seen at the equator and are split longitudinally. In other cases, the split halves go to the same pole and are included in the daughter nuclei. Those which fail to go to any pole are lost in the cytoplasm.

In majority of the cases behaviour of the multivalents is regular and there is regular disjunction of chromosomes to the poles. In case of the trivalents regular disjunction allows two chromosomes to go to one pole and a single one to the other pole. This causes unequal distribution of the chromosomes in the subsequent cell generations. In anaphase I, 12:13 distribution is common while in some cases 11:14 and 10:13 distribution have been noticed (Table 6). At interphase I, the univalents form micronuclei. Micronuclei are also seen in the second division. Univalents entering telophase I do not behave normally and lagging or failure of division results in the formation of micronuclei.

Another type of irregularity has been observed i.e., the finding of chromatin bridges and of fragments at anaphase I. Such bridges and fragments have been noticed in nearly 8 per cent of the cells studied in anaphase I. In some cases a bridge is accompanied by a fragment (Fig. 5). In others they are without a fragment. Such bridges have also been noticed in anaphase II.

**Pollen grain mitosis**— Cells with different chromosome numbers have been observed here. Usually 12 (Fig. 8) and 13 (Fig. 9) chromosomes have been noticed. In some cases 11 (Fig. 7), 14 and 18 (Fig. 10) chromosomes have been seen. The most notable has been the finding of pollen grains with 25 chromosomes (Fig. 11). Table 7 shows the distribution of chromosome numbers in the pollen grain studied. Many cases are found of abnormal cytokinesis in pollen grain formation. In other cases the formation of cell wall has been found to be incomplete between two pollen grains (Fig. 12). The pollen grains vary markedly in size. The percentages of normal appearing pollen is lower here (77 per cent) than in *Setcreasea purpurea*.

## DISCUSSION

In *Setcreasea purpurea* a 2n number of 12 chromosomes is found in the root tip cells (Fig. 1). The finding of this diploid number (12 chromosomes) and the finding of tetraploid plant by Mehra et al (1961) indicate the presence of a polyploid series in *S. purpurea*.

With regard to the karyotype, the presence of a submedianly constricted chromosome with satellite on the shorter arm is a new type of chromosome found for the genus (Fig. 1). This is the type which has been designated as C here. While this type of chromosome has not been reported before in *Setcreasea* a similar type has been observed in the allied genera *Tradescantia* and *Cyanotis*.

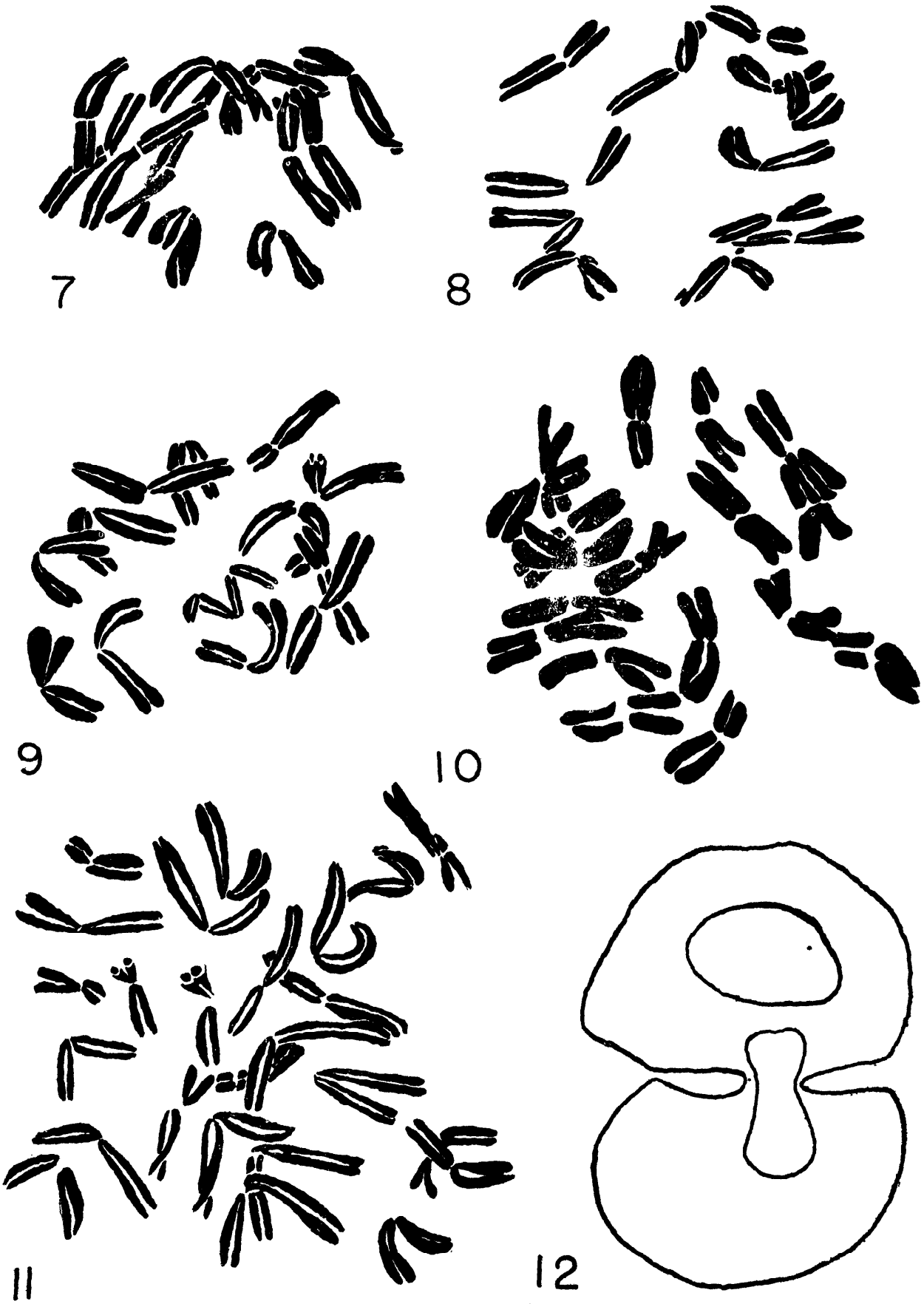
In metaphase I of meiosis, there is always the formation of six bivalents (Fig. 3), and all the I and II division stages are regular. In pollen grain mitosis six chromosomes are seen except the finding of cells with five (one cell) and 12 chromosomes (one cell).

The somatic number of 25 chromosomes observed for *S. brevifolia* is a new number in the polyploid series of this species (Table I, Fig. 2). Table 1 shows that there exists an euploid series in *S. brevifolia* with somatic numbers of 12, 24 and 36 chromosomes. Occasionally, however, plants with aneuploid numbers are observed such as 2n=23 and 2n=25 chromosomes. Celarier (1955) found one entry in *S. brevifolia* to have a 2n number of 23 chromosomes, which he suggested to be a 4n=1 plant. Our plant, however, has a 4n+1 constitution.

One interesting fact observed in the present material was the finding of chromatic bridges and fragments (Fig. 5). Bridges were also found without fragments. As regards the origin of the chromatin bridge and fragment it can be presumed that this is due to the presence of structural changes within chromosomes and that crossing over must have occurred within inverted segments. Celarier also found bridges and fragments in anaphase I and telophase I of the aneuploid (4n-1) form of *S. brevifolia* plants studied by him. This phenomenon of structural hybridity is widespread in the tribe Tradescantieae. As mentioned earlier, some members of the tribe have been extremely suitable for studies of this and other types of abnormalities. The very limited cytological studies carried out with this genus by different workers so far, bear testimony to this fact. Anderson and Sax (1936) in their studies in the family Commelinaceae, commented that structural changes were responsible for the differentiation of the genera in this family. Sharma (1955) also took this phenomenon into account in speciation in Commelinaceae. In the plant kingdom the importance of this type of behaviour has been emphasized by Darlington (1937), Stebbins (1950) and many other workers.

The finding of bridges without fragments could be taken as originating from meiotic irregularities. While in some cases these bridges without fragments come about by sticking of chromosome ends, in other cases they must be due to different causes. Thus McClintock (1941) and also Darlington and Upcott (1941) have shown that dicentric bridges


Fig. 1. *Setcreasea purpurea*, somatic metaphase 2n = 12. × Ca. 2300. Fig. 2. *S. brevifolia*, somatic metaphase 2n = 25. × Ca. 2300. Fig. 3. Six bivalents at metaphase I in *S. purpurea*. × Ca. 2300. Fig. 4. Bivalents, one trivalent and one quadrivalent in metaphase I of *S. brevifolia*. × Ca. 2300. Fig. 5. Bridge and fragment in anaphase I of *S.brevifo lia*. × Ca. 2300. Fig. 6. Pollen grain mitosis in *S. purpurea*, n = 6. × Ca. 2300.




Figs. 7-11. Pollen grain mitosis in several cells of *S. brevifolia*. Fig.. 7. = 11. ×Ca 2500. Fig. 8. n = 12. ×Ca. 2500. Fig. 9. n =13. × Ca. 2500. Fig. 10. n = 18. × Ca. 2500. Fig. 11. n = 25×Ca. 2500. Fig. 12. Two cells in pollen grain mitosis of *S. brevifolia* showing incomplete cell wall formation. × Ca. 1600.

without fragments could originate through fusion of broken ends. Darlington and Upcott further emphasize that the bridges without fragments observed in meiotic stages in *Tradescantia* are probably due to sister reunion of true ends and not due to the phenomenon of inversion crossing over. This same suggestion can be made in the present observations in *Setcreasea brevifolia*. Recently, Rees and Thompson (1955) expressed the opinion that the occurrence of bridges without accompanying fragments both in anaphase I and II of meiosis resulted from splitting errors.

The occurrence of pollen grains with different chromosome numbers (Table 7) such as n=11 (Fig. 7) and 14 is the result of the meiotic irregularities in I and II divisions. The finding of a majority of pollen grains with either n=12 (Fig. 8) or 13 (Fig. 9) chromosomes (Table 7) on the other hand indicates the high degree of normal behaviour of the chromosomes during different stages of meiosis. Failure of previous divisions, formation of restitution nuclei, spindle abnormalities preventing anaphasic separation and the effects of temperature could be taken as the possible cause for the observation of pollen grain with 12 chromosomes in *S. purpurea* and 25 chromosomes (Fig. 11) in *S. brevifolia*. Ellison (1937) found diploid and other higher polyploid gamete development from pollen mother cells to occur through failure of cell wall formation and "fusion of two second metaphase plates". In the present material of *S. brevifolia* incomplete cell wall formation was noticed only in pollen grain divisions (Fig. 12). Abnormal cytokinesis in pollen grain formation could be taken as responsible for this. Occurrence and persistence of dicentric bridges between two poles during anaphase of meiosis could also result in the formation of incomplete cell walls (Swanson, 1957). The presence in pollen grain mitosis of cells with 12 chromosomes (*S. purpurea*) and 25 chromosomes in *S. brevifolia* (Fig. 11) is important from an evolutionary point of view. Fertilization by unreduced gametes could give rise to plants with new chromosome numbers. In nature the occurence of such a phenomenon could be possible.

In regard to the nature of polyploidy in 2n=25 chromosome plant of *Setcreasea brevifolia* included in the present study, aneuploidy has already been mentioned. Irregularities in cell division could easily give rise to plants with such chromosome numbers.

Both auto, allo and aneuploidy might be responsible for the evolution of chromosome number and speciation in *Setcreasea*. In the allied genus *Tradescantia* diploid and tetraploid forms have been found to exist side by side by Anderson and Sax (1936). They commented that autopolyploidy was responsible for the evolutionary tendencies in *Tradescantia*. Stebbins (1947) while discussing the nature of polyploidy in *Tradescantia*, commented that apart from the occurrence of autotetraploids in this genus, allopolyploidy may also be present. He further emphasized the disputed nature of many widely distributed tetraploid Tradescantias. The hybridization experiments of Giles (1941) and Skrim (1942) in *Tradescantia* were taken into account by the author. In another genus of this family, *Cuthbertia graminea*, Giles (1942) found the existence of intraspecific autopolyploidy. Here diploid, tetraploid and hexaploid forms were found. In the tetraploid 4n+1, and in the hexaploid 6n+2 plants were discovered. In the present observation on the meiotic chromosomes of *S. brevifolia* it has been seen that quadrivalent formation, which is characteristic of autotetraploids, is extremely low. The greater tendency is towards bivalent formation, a condition which is not characteristic of autotetraploids. The interesting observations of Gilles and Randolph (1951) in autotetraploid Maize where they found increase in the formation of bivalents and decrease in quadrivalent frequency during the course of ten years can be taken into account here. But if the views expressed by Stebbins (1950) are considered then it seems probable that the original pure autotetraploid in *S. brevifolia* with frequent multivalent formation has shifted to more bivalent formation through structural changes in the chromosomes. The reported occurrence of segmental interchange in certain tetraploid species of *Tradescantia* is significant in this regard. In another member of Commelinaceae, *Zebrina pendula*, Sharma (1955) observed a ring or chain of four chromosomes in meiosis which he interpreted as due to the structural changes of chromosomes. The above discussion and the works of Darlington (1929), Richardson (1935), Anderson and Sax (1936), Celarier (1955), Mehra et al (1961) and the present work show that irregularity in meiotic stages, lower number of quadrivalent formation, occurrence of chromosome bridges and fragments in the tetraploid species of *Setcreasea* suggest segmental allopolyploid nature of these tetraploids. The finding of 2n=23 and 2n=25 chromosomes in *S. brevifolia* clearly indicates the role of aneuploidy in the evolution of chromosome numbers in this genus. In addition to this the part played by hybridization cannot also be ignored. Recently, Sharma and Sharma (1958) have stressed the role of allopolyploidy and aneuploidy in speciation in Commelinaceae.

The morphological and cytological situation in *Setcreasea* has been found to be similar to that occurring in *Tradescantia*. But in comparison with the extensive work done in *Tradescantia* from both morphological and cytogenetical point of view, studies in *Setcreasea* are very meagre. Nevertheless, work done up to the present time has shown it to be in an active state of evolution where euploidy, aneuploidy, structural hybridity and hybridization have been chiefly responsible for the evolutionary tendencies (Celarier, 1955). Extensive work in the

fields of morphology, geographic distribution and cytogenetics for the different species of *Setcreasea* is necessary in order to understand the nature of evolution and polyploidy in this genus.

## INTERRELATIONSHIPS OF *SETCREASEA, ZEBRINA, CYANOTIS* AND *TRADESCANTIA*

The taxonomic position of *Setcreasea* discussed earlier shows that the genus has been placed close to the genera *Cyanotis* and *Zebrina* by different taxonomists. *Tradescantia* has been separated from the above three genera because of certain differences in external morphological characters.

The only basic number found so far in *Setcreasea* and *Zebrina* is n=6, while in *Tradescantia*, in addition to n=6, n=8, 12, 13, 15 and 18 have been reported by different workers (Darlington and Wylie, 1955). The genus *Cyanotis* on the other hand shows entirely different basic numbers of n=10, 12 and 14 chromosomes (Darlington and Wylie l.c.).

The chromosome morphology in all the above-mentioned genera show a basic similarity. They are generally of the median, submedian and subterminally constricted types. There are, of course, discrepancies in the description of chromosome morphology by different workers. For instance, Darlington (1929) found median, submedian and terminally constricted chromosomes in *Zebrina pendula*, while Anderson and Sax (1936) noticed only median and submedianly constricted chromosomes in the same species. Sharma (1955) also did not find any terminally constricted chromosomes in *Zebrina pendula*. He observed the presence of chromosomes with extremely submedian primary constrictions, satellited on the shorter arm. In both *Setcreasea purpurea* and *S. brevifolia* studied by the present author, this type of chromosome (Type C) is present. This type of chromosome has also been reported by Sharma (1955) from observations on the somatic chromosomes of *Cyanotis axillaris* and *Cyanotis cristata*. Anderson and Sax (1936), however, found only median and subterminally constricted chromosomes in the pollen grain mitosis of *Cyanotis somaliensis*. In the species of *Zebrina* and *Cyanotis* studied by him, Sharma (1955) found another type of chromosome with submedian or subterminal primary constrictions and secondary constrictions on the shorter arm. This type of chromosome has not been reported by any other worker in any species of *Setcreasea, Zebrina, Cyanotis* or *Tradescantia*. Darlington (1929) recorded the somatic chromosome morphology of the tetraploid *Setcreasea brevifolia*, similar to that of the Virginiana group of *Tradescantia*, but noticed a few of the chromosomes to be nearly terminal in *S. brevifolia*. Other workers like Richardson (1935) and Celarier (1955), observed only median and submedian chromosomes in diploid and tetraploid species of *S. brevifolia*. The observations of the latter workers agree with the present author's description of the chromosome morphology in the genus *Setcreasea*. Chromosomes with submedian primary constrictions and trabants in their arms were reported by Darlington (1929) in *Tradescantia virginiana*. As mentioned above, such chromosomes (Type C) have been noticed in both the species of *Setcreasea* included in the present study.

The meiotic behaviour in the genus *Setcreasea* is similar to that which Darlington (1929), Anderson and Sax (1936) and Richardson (1935) observed in *Tradescantia*. The same phenomenon of polyploidy, structural hybridity and hybridization have been found to be playing a part in the evolution of both genera.

The above discussion shows that the inclusion of *Setcreasea* within the tribe Tradescantieae by Woodson (1942) has been justified. Cytologically there is remarkable similarity between *Tradescantia* and *Setcreasea* in basic chromosome number, morphology and behaviour of chromosomes. Nevertheless, though *Setcreasea* is more related to *Cyanotis* and *Zebrina* than to *Tradescantia* from the taxonomic point of view, cytologically *Cyanotis* is far apart from *Setcreasea*. In *Cyanotis*, the basic numbers are n=10, 12 and 14, but in *Setcreasea* it is n=6, whereas in *Zebrina* too the basic number is n=6. The differences in chromosome morphology between *Cyanotis* (Sharma 1955) and *Setcreasea* are also remarkable. External morphology too shows wide differences. The similarity in chromosome characteristics between *Setcreasea* and *Zebrina* as well as their similarities specially in vegetative characters seem worth noting.

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TABLE 1

*Chromosome numbers in Setcreasea*

| Species | 2n | Author |
|---|---|---|
| *brevifolia* | 12 | Richardson, 1935 |
| | 23 | Celarier, 1955 |
| | 24 | Darlington, 1929 |
| | 25 | Bose, 1958 |
| | 36 | Anderson and Sax, 1936 |
| *pallida* | 12 | Celarier, 1955 |
| | 36 | Celarier, 1955 |
| *purpurea* | 12 | Bose, 1958 |
| | 24 | Mehra et al. 1961 |
| *tumida* | 24 | Celarier, 1955 |
| *Setcreasea* sp. I | 24 | Mehra et al. 1961 |
| *Setcreasea* sp. II | 24 | Mehra et al. 1961 |

TABLE 2

*Taxonomic position of Setcreasea*

| Hutchinson (1934, 1959) | Woodson (1942) |
|---|---|
| Family Commelinaceae | Family Commelinaceae |
| *Sauvallea* | Tribe 2. Tradescantieae |
| *Tradescantia* | *Tripogandra* |
| *Commelina* | *Callisia* |
| *Cyanotis* | *Campelia* |
| *Setcreasea* (*Treleasia ; Neotreleasia*) | *Rhoeo* |
| *Zebrina* | *Tradescantia* |
| *Commelina* | *Setcreasea* |
| *Polyspatha* | *Zebrina* |
| *Athyrocarpus* | *Weldendia* |

TABLE 3

*Numbers of chromosomes with lengths and arm ratios of each of the types encountered in Setcreasea purpurea* (2n = 12)

| Types | Numbers of each type | Total length in microns | Ratio = Short arm / Total length |
|---|---|---|---|
| $A_1$ | 4 | 11.1 | .50 |
| $A_2$ | 2 | 10.3 | .50 |
| $B_1$ | 2 | 9.6 | .42 |
| $B_2$ | 2 | 9.2 | .40 |
| C | 2 | 9.6* | .42 |

* excluding satellite

TABLE 4

*Numbers of chromosomes with lengths and arm ratios of each of the types encountered in Setcreasea brevifolia* (2n = 25)

| Types | Numbers of each type | Total length in microns | Ratio = Short arm / Total length |
|---|---|---|---|
| $A_1$ | 4 | 9.6 | .50 |
| $A_2$ | 4 | 8.8 | .50 |
| $A_3$ | 2 | 8.1 | .50 |
| $B_1$ | 4 | 8.8 | .45 |
| $B_2$ | 4 | 8.1 | .40 |
| $B_3$ | 5 | 7.7 | .36 |
| C | 2 | 8.1* | .40 |

* excluding satellite

TABLE 5

*Types of associations at metaphase I in species of Setcreasea*

| Species | Numbers of cells observed | I | II | III | IV |
|---|---|---|---|---|---|
| *purpurea* 2n = 12 | 27 | 0 | 6 | 0 | 0 |
| *brevifolia* 2n = 25 | 21 | 0 | 9 | 1 | 1 |
| | 13 | 0 | 7 | 1 | 2 |
| | 9 | 1 | 6 | 0 | 3 |
| | 5 | 1 | 4 | 0 | 4 |

TABLE 6

*Distribution of chromosomes in anaphase I in Setcreasea brevifolia*

| Distribution | Number of times observed |
|---|---|
| 12 : 13 | 35 |
| 11 : 14 | 3 |
| 10 : 13 | 1 |

TABLE 7

*Data on distribution of chromosome numbers in mitotic stages of different pollen grains in Setcreasea brevifolia*

| n | Number of times observed |
|---|---|
| 11 | 4 |
| 12 | 17 |
| 13 | 23 |
| 14 | 1 |
| 18 | 2 |
| 25 | 7 |

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