CYTOGENETIC STUDIES OF SOME SPECIES OF TRADESCANTIA (L) AND COMMELINA (L) IN AKWA IBOM STATE, NIGERIA

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ABSTRACT

Morphological analyses of the vegetative characteristics of two species of *Tradescantia* and two species of *Commelina* grown in polythene bags in the greenhouse were done. Inter-specific variation in vegetative and floral morphology was significant ($p<0.5$). The root tips were harvested between 7:30 am and 9:00 am, pretreated in 8-hydroxyl-quinoline, and transferred into 3:1 ethanol acetic acid for 24 hours. Root tips were hydrolyzed in 10% hydrochloric acid and subsequently squashed in FLP orcein. The chromosome number was 2n = 12 in *Tradescantia spathacea* with a Karyotype formula of 10m + 2sm. The chromosome number of *Tradescantia pallida* was 2n = 24 with a Karyotype formula of 22m +2sm, while the Chromosome number was 2n = 22 in *Commelina benghalensis* with a karyotype formula of 14m+2sm + 4st. The chromosome number was 2n = 30 in *Commelina diffusa* with a karyotype formula of 28m + 2sm. The mean

chromosome lengths in the two genera ranged from 1-4µm. A secondary construction satellite was observed in the longest chromosome of *Commelina benghalensis*. Morphological and cytological data from the two genera showed considerable differences, which would be helpful to the genera's taxonomic separation.

Keyword: *Chromosome, karyotype, Tradescantia and Commelina.*

INTRODUCTION

This paper focused on the morphological and cytogenetic characteristics of some species in the genera *Commelina* and *Tradescantia* in the family Commelinaceae. The two genera belong to the class *Lipiopsida* and the order *Commelinaceae* (Faden, 1998). The family *Commelinaceae has* 41 genera and 650 species worldwide (Kubitzia, 1998).

The Tradescantia genus consists of perennial herbs with adaptable stems that can grow in various forms, such as branching, creeping, standing upright, or trailing, and are capable of developing roots at their lower segments (Mabberley, 1997; Ensemu & Faden, 1997). Research has shown that the chromosomes of these plants are generally large, with some exceptions of medium or small sizes, and have a varied number of essential chromosomes ranging from 4 to 13(Faden & Hunt, 1991). Commelina is a perennial or annual herb with fibrous or tuberous roots. It has creeping, ascending, erect, and branched stolons (Mudua, 2007). Cytological Studies have helped in understanding the different species complexes in *Commelina* and the other genera, but the data on *Murdannia and Aneilema* have not given such a clear indication regarding their delimitation and positions.

Different populations collected from different habitats indicated differences in Karyotype within members of the same species (Faden & Hunt, 1997). In Akwa Ibom State of Nigeria, little is being documented on these plant

species, although some local encounters with the rural people are experienced during cultivation. Some of the most ordinary members of the genus are *Commelina erecta, Commelina diffusa, Commelina lagosensis, and Commelina congesta of these four species. Commelina diffusa and Commelina lagosensis* are the most prevalent types found on cultivated lands, and they cause significant problems for farmers (1981).

Although the Commelinaceae family offers several medicinal and economic applications, more cytology research needs to be conducted.

This paper provides morphological and cytological data on four species of Commelinaceae (*Commelina and Tradescantia): Tradescantia spathacea* and *Tradescantia pallida, Commelina diffusa,* and *Commelina benghalensis.*

MATERIALS AND METHODS

Species of the two genera *Commelina* and *Tradescantia* were obtained from the three senatorial districts of Uyo, Eket, and Ikot Ekpene in Akwa Ibom state. Taxonomists recognized the plant samples at the University of Uyo's Department of Botany and Ecological Studies Herbarium in Akwa Ibom State, Nigeria.

The voucher specimens were deposited in the department's herbarium, and the plant samples were raised in the Akwa Ibom State Polytechnic Botanical Garden.

MORPHOLOGICAL METHOD

The vegetative parts of the plant samples were planted in polyethylene bags in the greenhouse. Four accessions of each species were replicated in a randomized complete design four times.

The planting distances were 3 m between and within rows. Manual weeding was carried out during the plant development.

The morphological characters were measured; these include plant height, leaf width, leaf sheath, and inter-node

CYTOLOGICAL METHOD

At the planting site, the young sprouting root tips, which were about 1 cm long, were cut using sharp forceps and pre-treated in 0.002 M 8-hydroxyquinoline for 3-3.5 hours before being fixed in 3:1 ethanol acetic acid for 24 hours. The fixed root tips were transferred to a 70% ethanol solution before

squashing. When necessary, the roots were extracted from 70% ethanol, hydrolyzed in 10% HCI, and squished in a drop of FLP orcein (Osuji, 2003). Mitotic chromosomes were examined with an Optika B-1000 FL LED research microscope, and photomicrographs of five high-quality metaphase plates were taken and recorded. The long arm (L), short arm (s), and total chromosomal length (c) of each chromosome were determined. The relative lengths, arm ratios (rl/s), and centromeric index (I = s/c 100) were determined and used to classify and identify homologous chromosomes (Gomurgen et al., 2010). For karyotype description, chromosomes were grouped based on chromosome length and decreasing size. The chromosome nomenclature was based on Levan et al. (1964). The chromosomal length and chromosome arm ratio variance within the Karyotype were evaluated by computing these parameters' mean and standard deviation (SD) in Microsoft Excel 2010.

RESULTS

Table 1 presents the morphological and cytogenetic results of the Comelinaceae *(Tradescantia and Commelina)* species, while plates (1-8) show the images from the photomicrographic study.

The chromosome number of 2n = 12 was recorded for *Tradescantiaspathecea;* 2n = 24 was found in *Tradescantia pallida,* respectively. In *Commelina,* the Chromosome number of 2n = 22 was found in *Commelina benghalensis* and *Commelina diffusa. The* chromosome number was 2n = 30 (plates 1 -8) in the family of Commelinaceae. The karyotype formula was observed on the four species of Commelinaceae (plates 1-8), respectively.

Table 1: Quantitative data on vegetative traits in the four species of Commelinaceae

Species	Plant height (cm)	Leaf length (cm)	Leaf width (cm)	Leaf sheath (cm)	Inter-node (cm)
Commelina diffusa	15-36	2.0-4.8	1.8-2.3	1.8-2.0	1.2-8.6
Commelina benghalesis	32-38	6.2-10.5	1.4-2.0	2.0-2.5	3.8-11.0
Tradescantia spathacea	10-32	30.5-33.2	4.2-4.7	-	-
Tradescantia pallida	28-46	10.2-13.5	2.4-3.3	1.0-1.3	1.6-4.0

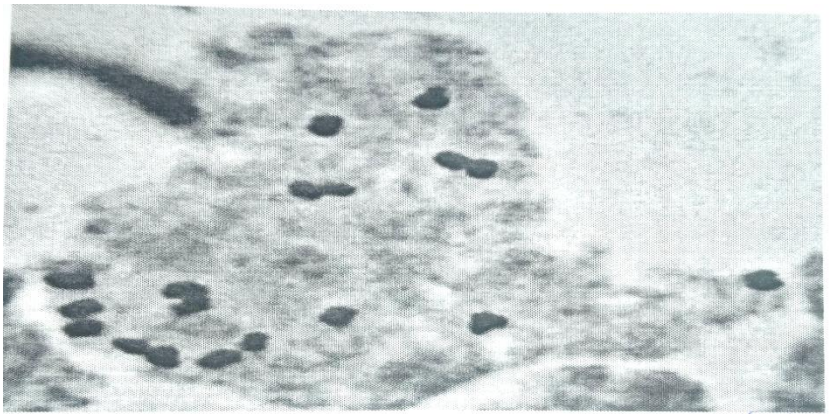

Plate 1: Chromosome spread of *T. spathacea* (2n = 12)

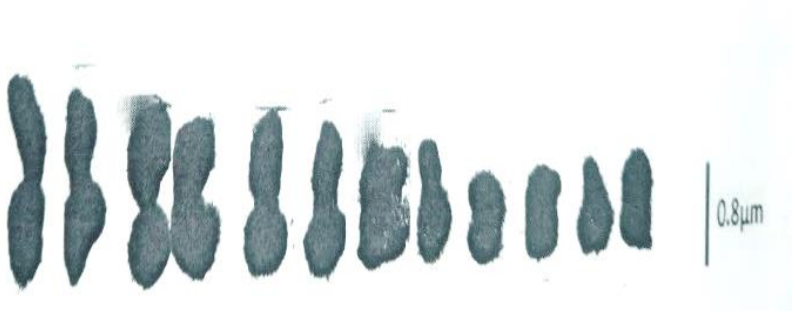

Plate 2: Karyotype of *T. spathacea* (karyotype formula = 10m + 2sm)

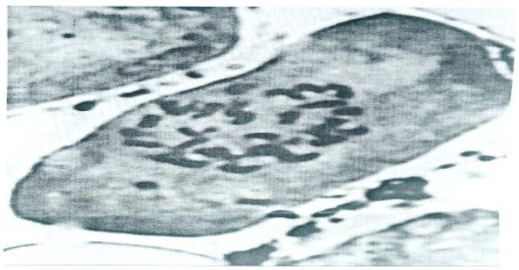

Plate 3: Chromosome spread of *Tradescantia pallida* (2n = 24)

Plate 4: Karyotype of *Tradescantia pallida* (Kyryotype formula = 22m + 2sm)

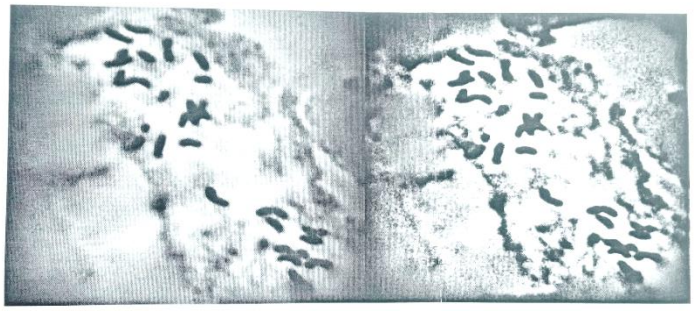

Plate 5: Chromosome spread of *Commelina benghalensis* (2n = 22)

Plate 6: Karyotype of *Commelina benghalensis* (Karyotype formula = 16m + 2sm +4st)

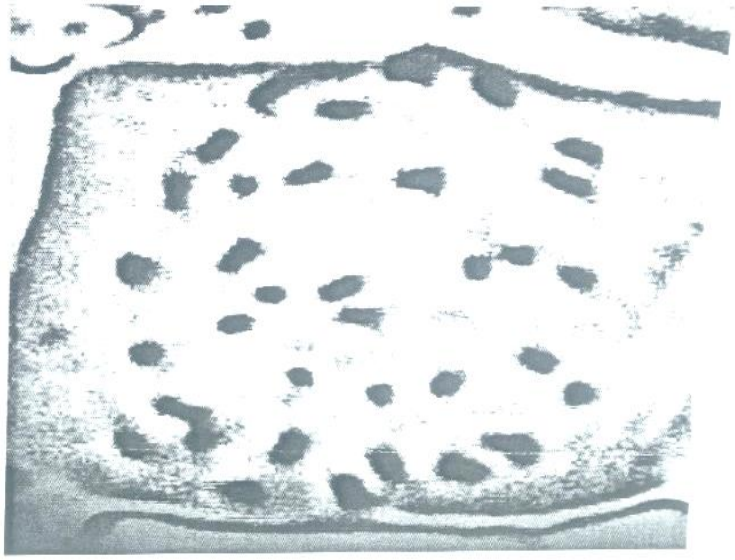

Plate 7: chromosome spread of *Commelina diffusa* (2n = 30)

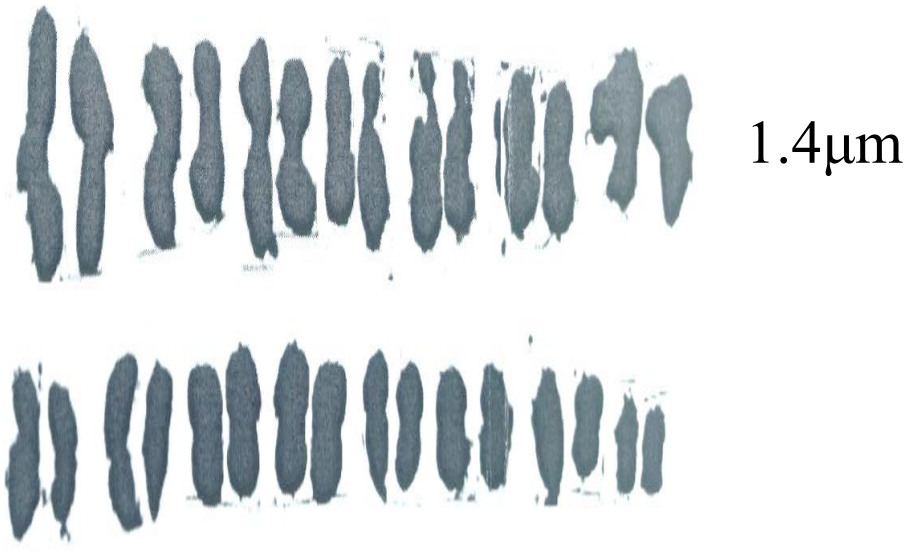

Plate 8: Karyotype of *Commelina diffusa*
(Karyotype formula = 28m + 2sm)

DISCUSSION

Floral traits are more reliable for taxonomic identification and classification than other vegetative traits (Faden, 2000). The striking difference between the four species was in the involucres of bracteoles. This agrees with Clark *et al.'s* (1993) findings that the range of floral traits in Commelinaceae is entirely different from those in two genera, such as Tradescantia and *Commelina.*

The mitotic studies on different species of *T. pallida* collected from Akwa Ibom State presented the chromosome number of 2n = 24. Also, earlier researchers reported 2n =24 (Tanaka & Maekawa, 1983; Alam & Sharma, 1984; Weryszko-Chmielewska, 1989; Sakurai & Ichikawa, 2001; Chen *et al.*,2003) and slight variation in the chromosome number as 2n = 18 and 24 (Garcia- Velazquez, 1998), 2n = 12 and 24 (Handlos, 1970) as well as 2n=12 (Heitz, 1967).

The chromosome number recorded in *T. pallida* in this study is in agreement with that of the majority of previous studies, except for a few differences, such as 2n = 12 and 18 reported by Garcia-Velazquez (1998) and Handlos (1970). This, however, suggests that *T. pallida* has three cytotypes.

Commelina has several basic chromosome numbers, including x = 7 and 11 to 15 (Jones & Jopling, 1972), with 14 and 15 being the most prevalent. Commelina species' polyploid components are connected with distinct habitats than diploids. Polyploids in C. diffusa and C. benghalensis are found in hilly or mountainous environments with considerable rainfall (Morton, 1967).

We, however, recorded the chromosome number of 2n = 22 in *C. benghalensis*. This chromosome number has been the most prevalent within members of this species (Moore, 1973; Fedorov, 1974; Goldblatt & Johnson, 2000; Yang and Kang, 2004, Kaul *et al.*, 2007; Grabiele *et al.*, 2009).

Though *C. benghalensis* var. hirsute has been reported as exclusively polyploidy with a chromosome number of 2n = 44 and 66 (Jones & Jopling, 1972; Fedorov, 1974; Moore, 1977; Faden, 2005), *C. benghalensis* is predominantly diploids. Furthermore, studies from Japan, India, Pakistan, Taiwan, and Southeast Asia of the species *C.*

benghalensis opined that the constancy of ploidy of 2n = 22, Malik, 1961; Alam and Sharma, 1981; Bhattacharya, 1975; Fujishima, 2007a). However, chromosomal counts and ploidy levels differ among African species populations, with 2n = 22, 44, 56, and 66 observed (Lewis & TaddesseEba, 1967). In Ethiopia, diploid and tetraploid races have been reported (Lewis & TaddesseEba, 1964). C. benghalensis from California was similarly approximately hexaploid (2n = 66) (Faden, 2007). Singebu and Kobori (1997) highlighted the diversity of chromosomal number and satellite size as indicators of species invasion into new habitats.

C. diffusa Burn F. recorded a chromosome number of 2n = 30 in this study. Previous cytological reports on this species have shown different chromosome numbers and cytotypes. Among these cytotypes, 2n = 2x 30 constitutes 70%. The result of this research is in agreement with the work of Romeupitrez *et al.* (2001), which stated that this species has diverse chromosome numbers and at least 11 cytotypes and could be diploids, tetraploids, hexaploids and octoploids, with x = 15 chromosomes.

The 16m + 2sm + 4st karyotype formula was observed in *C. benghalensis*. This information disagrees with the previous reports of 8m + 10sm + 4th with no satellites, observed in *C. benghalensis* recorded in Nigeria (Matthew & Peter, 2013) and Argentina (Grabiele *et al.,* 2009), 18sm + 4th from India (Kaul *et al.*, 2007) and China (Wang *et al.*,1994) and 12m+8sm + 2nd from China (Yang & Kang, 2004).

The variation in the karyotype formula within members of the same species in the genus *Commelina* has also been reported as usual by Fujishima *et al*. (2004). Among the Nigerian species of *Commelina*, Matthew and Peter (2013) noted that the chromosomes of *C. benghalensis* are mostly median and sub-median, while the chromosomes of *C. forkalani* are mostly median and sub-terminal chromosomes. In contrast, the species of *C. benghalensis* in the study had more metacentric chromosomes and were closer to those reported in China with a karyotype formula of 12m+8sm +2st (Yang & Kang, 2004). Most

karyotype studies in the genus *Commelina* reported more median and sub-median chromosomes but few sub-terminal chromosomes (Fujishima *et al.*,2004; Grabiele *et al.*, 2009) who similarly reported that the chromosomes of *C. benghalensis* from China and Argentina are mainly medium-sized. The medium-sized chromosomes of *C. benghalensis* are pretty different from the small-sized chromosomes observed in *C. forskalaei*. Bhattacharya (1975) reported that the chromosomes of the genus *Commelina* range from medium-sized to small-sized.

The 16m + 2sm + 4st karyotype formula was observed in *C. benghalensis*. This information disagrees with the previous reports of 8m + 10sm + 4th with no satellites, observed in *C. benghalensis* recorded in Nigeria (Matthew & Peter, 2013) and Argentina (Grabiele *et al.*, 2009), 18sm + 4th from India (Kaul *et al.*, 2007) and China (Wang *et al.*,1994) and 12m+8sm + 2nd
from China (Yang & Kang, 2004). The variation in the karyotype formula within members of the same species in the genus *Commelina* has also been reported as usual by Fujishima *et al*. (2004). In*Tradescantineae*, based on the position of the primary constriction and chromosome size, four chromosome numbers with diversified karyotypes, with three in aneuploid series, are known (Fujishima, 2007).

Cytological research in Tradescantia revealed that the genus has at least four basic numbers and five karyotypes (Celarier, 2000). Morphologically, the chromosomes of Tradescantia species in the United States are significant, uniform, and have a median or sub-median central constriction. For example, Tradescantia zebrine possesses 2n = 23 and 2n = 24 chromosomes (Zhang, 1989; Sakurai & Ichikawa, 2001). The 24 chromosomes are divided into four median, eight sub-terminal, and twelve terminal chromosomal kinds.
(i.e. 4m 8st + 12t). In this study, we reported a chromosome formula of 22m + 2sm for *T. pallida* and
10m + 2sm for *T. spathacea*. These formulas are in contrast with the existing report on the members of the genus. There was no record of satellite in the two species of

Tradescantia studied. The combined effect of cellular, molecular, and evolutionary factors may limit species to a given average chromosome length (Li et al., 2011). Chromosomal structure and size differences indicate genetic heterogeneity among plant species (Arabbeigi et al., 2011). In general, there is an inverse relationship between chromosomal number and size (Verna & Agarwal, 2005).

The change in the absolute length of a particular chromosome in a species or genera can be attributed to a variety of factors, the most important of which is the stage of mitosis at the time of fixation (Dietrich, 1986) because chromosome length is determined by the degree of condensation during mitosis.
According to Stebbins (1971), variation in absolute chromosome size between related species or genera may indicate varying amounts of gene duplication, whereas segmental interchange, which involves the translocation of unequal chromosomal segments, results in a difference in relative chromosome size.

CONCLUSION

Morphological and cytogenetic studies of *Tradescantia pallida* and *Tradescantia spathecea*, *Commelina benghalensis*, and *Commelina diffusa* are significant studies that every geneticist should undergo in their localities. Some States in Nigeria have no or scanty record of this species. The plant samples obtained from the three senatorial districts of Akwa Ibom State, Nigeria has given and validated the chromosomal number, ploidy level, karyotype, and epidermal characteristics of the four species studied, which provide morphological and cytological data for the four species of Commelinaceae (*Commelina* and *Tradescantia*) namely *Tradescantia spathacea*, and *Tradescantia pallida*; *Commelina diffusa* and *Commelina benghalensis*.

Consequently, this study showed and confirmed the primary chromosome number for the four species of *Tradescantia pallida* and *Tradescantia spathecea*, *Commelina benghalensis* and *Commelina diffusa* 2n = 24, 2n = 12 and 2n = 30, respectively. The outcomes and findings were consistent with other reports. However, the primary chromosome

number for T. pallida, 2n = 24, differed from prior reports of 2n = 12 and 18, suggesting that the species may have another cytotype. The karyotype formula varied between Tradescantia pallida and Tradescantia spathecea, Commelina benghalensis, and Commelina diffusa.

RECOMMENDATIONS

Based on a detailed examination of the morphological and chromosomal analysis of the four species of Commelinaceae gathered from Akwa Ibom State, Nigeria, the following aspects warrant further consideration:

1. Detailed chromosome research on structural rearrangements is required for species found under the genera *Commelina* and *Tradescantia*, Which Cover a wide geographical dispersion across the country, to better confirm and understand their karyotypes.

2. As most Commelinaceae species reproduce vegetatively, any adaptive karyotypes could be kept in the zone of reproduction and spread to neighboring areas. Therefore, more investigation of the link between cytological features and geographical distribution is essential, especially for morphological vegetative reproduced species.

3. Since polyploidy appears to be frequent among Tradescantia and Commelina species, meiotic studies involving more species should be conducted to demonstrate the behavior of chromosomes at various stages and corroborate their ploidy levels and type (allo- or autopolyploid).

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