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Cytological Investigation of Brazilian Nightshade (*Solanum Seaforthianam* Andr.)

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ABSTRACT

Solanum genus namely *Solanum seaforthianum* Andr. belongs to the Solanaceae family, and comprises only dioeciously species. These plants are distributed between 29º and 40º south. All species of this genus are diploid with chromosome numbers of 2n = 24, 28 and 30. According to literature, the basic chromosome number in this genus is x = 12, 14 and 15. *Solanum* genus with a chromosome complement of 2n = 30 has a symmetric karyotype with a median and sub median centromere position. Because ancestral species have a symmetric karyotype, it seems that x = 12 is the initial basic chromosome number in this genus and the x = 14 and x = 15 derived from x = 12. So it seems that diploid phenomena played an important role in evolution and speciation.

***Keywords*:** Cytological investigation; Brazilian night shade; *Solanum seaforthianum*; *Solanum* species; Chromosome study

1. INTRODUCTION

The genus *Solanum* L. belongs to the family solanaceae in the order Solanales. It is one plant genus of great importance for food security in most countries of the developing world. Some of its members are cultivated mostly as vegetable crops (Kochlar, 1981), while the active principles such as solinidine and other steroids extracted from the roots and leaves of some species are useful pharmaceuticals (Simmonds and Choudhury, 1976). (Purseglove 1968) noted that many *Solanum* species are used as potherbs or ornamentals in the tropics. However the lack of immediate known utilities for some members of this group has led to their neglect and subsequent genetic erosion. Rapid depletion of such potentially useful plant resource because of skewed selection pressure calls for an urgent reappraisal of germplasm exploitation and conservation in our area (Obute 2001). Despite the importance of *Solanum* species, there is still paucity of information on the karyotypes of the members of the taxa in Tamil Nadu.

Brazilian Nightshade is a flowering evergreen sprawling shrub or climber native to tropical South America. It is characterized by clusters of four to seven leaves and can climb to a height of 20 ft given enough room. Leaves are mostly pinnately cut into almost leaflets.

Leaves are ovate in outline, 4-10 cm long, 3-6 cm wide, deeply lobed, both surfaces green and smooth except for hairs on margins and veins on lower surface. Leaf-stalk is 2-4 cm long. The plant blooms in the mid to late summer with clusters of star-shaped purple

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inflorescence followed by scarlet marble-sized berries. Inflorescences are 10-50 flowered, carried on 1-6 cm long stalks. The rachis is up to 10 cm long, flower-stalks 1-1.5 cm long. Sepal tube is 1.5-2.5 mm long, sepals about 1 mm long. Corolla deeply incised, 2-3 cm across, mauve-blue. The plant is highly heat resistant, but cannot tolerate frost conditions. The plant contains modest amounts of various tropane alkaloids such as atropine, scopolamine and hyoscyamine and should be considered mildly toxic and inedible. The species has become widely naturalised outside its native range and is an invasive species in Australia, Africa, Indochina, the Pacific Islands and India, choking native vegetation and poisoning livestock.

Studies on cytogenetics, chromosome structure, behavior and manipulation in plants are well documented (Karpenchenko, 1925; Sarbhoy, 1977; Okoli and Olorode, 1983; Obute, 2001). The usefulness of information from such studies in the understanding of phylogenetic relationships, genetic mapping and breeding studies has been very significant (Okoli, 1993; Hartwell *et al.,* 2003; Kurata *et al*., 2002). Available literature on the basic and applied chromosomes features of *Solanum* species is rather scanty. This is quite precarious given the urgent need for the documentation of the basic chromosome structure and behavior of important crop species as and the initial step towards manipulating these chromosomes for specific purposes in crop improvement. It is against this realization that the present attempt at describing the chromosome features in some Nigerian species of *Solanum* L. in relation in their morphology, distribution of chromatin, karyotype features as well as targeted doubling of chromosomes for production of gages characters is embarked upon.

2. MATERIALS AND METHODS

2. 1. Collection

Fruits of *Solanum seaforthianum* were collected during field trips to different parts of southern Tamil Nadu. The root tips for mitotic studies were obtained from healthy seedlings.

2. 2. Mitotic Studies

The root tips for mitotic studies were fixed directly in 1:3 acidic ethanol at times when collected from hill stations and also pretreated in a saturated solution of PDB (Para-dichlorobenzene) for3 hours. The root tips were immediately washed with distilled water and transferred to 1:3 acetic ethanol and kept for overnight. The root tips were transferred to 70 per cent ethyl alcohol and kept at 6 °C until they were taken for squashed. The root tips were hydrolyzed in 0.1 N hydrochloric acid for 15 to 20 minutes at 6 °C after which the iron alum haematoxylin squash technique was followed.

After softening with 0.1 N hydrochloric acid, the root tips were washed with distilled water and stained with 4 per cent haematoxylin for 1 to 2 hours. After a thorough wash in distilled water the root tips were kept in 45 per cent acetic acid, one or two root tips were placed on a clean slide, squashed by using a clean cover slip and slide was sealed with nail polish. To make the slide permanent, the sealing was removed, the slide and cover slip were separated in 50 per cent ethanol and each of them was treated separately with the ethanol series (60, 70, 80, 90 and 100 percent for 2 to 3 minutes in each grade. After slight warming the slides were mounted with euparol).

3. RESULT AND DISCUSSION

3. 1. Chromosome size

In general, the chromosomes are medium (4.0 to 5.0 μm), short (2.0 to 3.9 μm) and shorter (1.0 to 1.9 μm) in size in most of the species. This situation has been observed among the genera *Brugmansia*, *Solanum, Withania, Cestrum, Lycium,* and *Datura* the chromosomes are the largest (more than 10.0 μm) larger (8.0 to 10.0 μm) and medium sized.

Most of the species of Solanaceae studied so for (Purseglove 1968) and are diploids (2n = 24 chromosomes) developed from the derived basic chromosome number that is n = 12. The species with 2n = 16 chromosomes should have been developed from the primary basic chromosome number n = 8. The species having 2n =14 chromosomes should have arisen by reduction of one bivalent from n = 8 that is the presence of n =7. Similarly, the species having 2n = 22 chromosomes should have come about by reduction of one bivalent from n = 12 chromosomes, that is the presence of n = 11 chromosomes. Therefore, reduction of one chromosome from both primary basic chromosome number and derived basic chromosome number. In the present study, a similar process of chromosomal reduction might have been in operation among the species of Solanaceae so that a basic number n = 12 might have got reduced to n = 11 and n = 8 to n = 7 by unequal translocation involving concurrent loss of inert heterochromatin parts of the chromosomes.

Of the diploid chromosome numbers, 2n = 24 and 2n = 40 represented the highest frequency among the species of Solanaceae so for cytological studied (Okoli, 1983 and taxon up to 1992. The present study, shows that the 12 species studied 10 species possess 2n = 24 chromosomes. Therefore, it is assumed that the original primary basic number may be 10 which should have given rise to the derived primary basic numbers 12, 13, 14, 15, 19 and 20. (Sarbhoy 1977) is also of the opinion that the deep seated numbers 19, 20 and 21 might have possibly derived from X = 10 and its derivatives by hybridization and the chromosomal cytotypes have been reported in nearly all of them but the aneuploid and polyploidy numbers are mostly derivatives of the basic sets.

By various karyological mechanisms either an increase or decrease in chromosome numbers may be brought about. It has been suggested that an increase in the basic number can be brought about without much changes in the chromatic content as by misdivision of the centromere, whereby unpaired chromosomes, at the first meiotic division, break across into two halves which go to opposite poles, each arm forming a new independent chromosome with a terminal kinetochore (Okoli and Olorode 1983).

But, according to (Hartwell 2000), this has been observed only under experimental conditions. A more frequent method of an increase in chromosome numbers appears to be through polyploidy by appropriate longitudinal division and unequal apportionment of the chromosomal halves between daughter cell. Aneuploid increase of chromosome numbers may also be due to the non-disjunction of chromosomes of bivalents during the first meiotic division resulting in an increase in the chromosome numbers, above the primary basic chromosome number and this has been reported among the various species studied. Therefore, it is conduced that along with euploidy and aneuploidy, karyotype alterations of chromosomes also play an important role in the origin and evolution of the species of Solanaceae. Although increase in chromosome number are more easily assimilated by the plants than decrease with may lead to environmental, nutritional and even disorders, mechanisms are known, however, by which decrease of chromosome number may also arise. A commen method of chromosome decrease is through unequal translocation between chromosomes (Kurata *et al.,* 2002).

It is concluded that aneuploidy with an increase or decrease of one chromosome over the basic chromosome number as well as euploidy (Tetraploid) play an important role in the origin and evolution of the species of Solanaceae studied.



Fig. 1. *Solanum seaforthianum* Andr. Metaphase of Mitosis, 2n = 30 chromosomes.

Table 1.

Chromosome		**Long arm in µm (L)**	**Short arm in µm (S)**	**Satellite (S)**	**Total length in µm (L+S+S)**	**L/S Ratio**	**Relative length in µm**	**Constrictions**
Type	Number							
S	4	1.4	0.8	0.2	2.4	1.7	8.5	2 Constriction
J	4	1.4	1.0	-	2.4	1.4	8.5	Sub-median
J	4	1.3	1.0	-	2.3	1.3	8.2	Sub-median
V	4	1.1	1.1	-	2.2	1.0	7.8	Median
V	2	0.9	0.9	-	1.8	1.0	6.4	Median
I	8	1.2	0.2	-	1.4	6.0	5.0	Sub-median
I	4	0.8	0.2	-	1.0	4.0	3.5	Sub-terminal

Total chromosome length = 56.0 µm
Absolute chromosome length = 28.0 µm
Average chromosome length = 1.86 µm
Karyotype formula: S_4 = 2.4 µm + J_4 = 2.4 µm + J_4 = 2.3 µm + V_4 = 2.2 µm + V_2 = 1.8 µm + I_8 = 1.4 µm + I_4 = 1.0 µm.

4. CONCLUSION

The chromosomes are short and shorter, ranging in size from 1.0 m to 2.4 µm. All the four types of chromosomes are present in this species. Mitotic chromosome counts showed that the 2n = 30 was the diploid number for *Solanum seaforthianum* Andr.

The chromosomes were generally small in size. Secondary constriction was observed these chromosomes.

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