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# Chromosome number and karyotype analysis of wild guava *Psidium guineense* Sw. - a new report from Tripura, India

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Abstract

The chromosome number and karyotype of *Psidium guineense* Sw. was investigated. The species had the

chromosome count of n = 22 and 2n = 44 with a karyotype formula  $2A_{sm}^{\&c}+8B_m+24C_{nm}+10D_{sm}$ . The karyotype of the species was slightly asymmetric with a little variation in chromosome length. The species revealed 4 pairs of metacentric, 12 pairs of nearly metacentric and 6 pairs of sub-metacentric chromosomes one of which also had secondary constriction. No meiotic irregularities were recorded. The chromosome constancy of the karyotype recorded in the present study justifies a new record of the present endemic threatened species growing wild in Tripura.

Keywords: Psidium guineense Sw. chromosome number, karyotype, endemic, Tripura

#### Introduction

*Psidium* L. of the family Myrtaceae, a tropical American genus with over 100 species and mostly represented by evergreen trees and shrubs with edible berries (Mabberlay, 1990). In India the genus is represented by three introduced species, among them *P. guineense* Swartz. is endemic to Tripura (Deb, 1961; Chakraborti *et al.*, 2005).

Number of potential uses of the species has been reported in the literature (Hedrick, 1972; Tanaka, 1976; Morton, 1987; Verheij and Coronel, 1992; Nazarudeen, 2001). Ethno-medicinally, young leaves and soft twigs of the species are used in the treatment of toothache and gum problem and leaves are used in gastric, cold and bronchitis problems. Locally, fruits are consumed as non-conventional minor fruit and are rich in vitamin C and sugar content (Chakraborti *et al.*, 2007).

Chromosomal studies dealina with somatic chromosome number determination and its ploidy level are of fundamental consideration for any given species in understanding the basic structure of the genetic complement. In literature, there has been no report on somatic chromosome number and karyomorphological details of *P. guineense* Sw. and in particular for this wild guava growing in this Northeastern state Tripura. Although number of cytological works are recorded in common cultivar of *Psidium guajava* L. (Atchinson, 1947; Sharma & Majumdar, 1957; D'Cruz and Rao, 1962; Raman et al., 1971; Majumdar & Mukherjee, 1971, 1972) and other related species (Atchinson, 1947; Costa & Martins, 2007).

In view of the known ethnobotanical value, a detailed cytological analysis is carried out along with karyomorphological account to understand the basic genetic structure of *P. guineense* Sw.

## Materials and Methods

Study of somatic chromosomes

Shoot tips of P. guineense Sw. were collected from the plants growing in the University experimental garden and from different population sites growing wild in West district of Tripura. Young shoot tips measuring 2 - 3 mm were pretreated with saturated para dichlorobenzene (pDB) solution for 4 hours and 45 minutes at 12°C and subsequently fixed in 1:3 acetic acid and ethyl alcohol mixture for overnight. The shoot tips were then treated with 45% acetic acid solution for 15 minutes followed by hydrolysis in 5N HCl at 12°C for 1 hour. Finally shoot tips were washed with distilled water for 7 - 8 times and treated again with 45% acetic acid solution for 10 minutes. Shoot tips were stained with 2% aceto - orcein (N) HCl (9:1) mixture for overnight at room temperature. The shoot tips were squashed in 45% acetic acid solution (Sharma & Sharma, 1980) for observation. At least 100 metaphase plates were scanned and 5 well spread metaphase cells were randomly selected and drawn for different chromosome measurements with the aid of drawing prism under compound microscope with oil immersion objective (× 1268). Microphotographs were taken with Nikon FDX - 35 microscope with photographic attachment and was suitably enlarged. In preparing the karyotype, measurements of long arm, short arm, total chromosome length and centromeric index were used. Total Forma percentage (TF%) of chromosomal complements was also calculated (Levan et al., 1964). Karvogram of the species was constructed from the microphotographs of respective metaphase plates. Meiotic chromosome study

Young flower buds of *P. guineense* was fixed in 1: 2 glacial acetic acid - ethyl alcohol mixture for 2 hours, then in 1:3 acetic - ethanol mixture for overnight and finally transferred to 70% ethanol for 3 - 4 days. Then the buds were treated with 45% acetic acid for 10 minutes, followed by warm hydrolysis in 1 N HCl for 30 minutes at 55°C. Finally after thorough washing in distilled water flower buds were stained in 2% aceto - carmine for 2 - 3

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hours and smeared in 45% acetic acid. As the cytoplasm takes colour, smearing in 45% acetic acid gives desired result. Table 1. Kanyatima and macauraments of comptine materials of promotions of Poidium

 $2\mathbb{A}_{sm}^{\$\&}\!\!+\!8\mathbb{B}_m\!\!+\!\!24\mathbb{C}_{nm}\!\!+\!\!10\mathbb{D}_{sm}$  . The average size of the

	Таріе Т. Кагуотуре анс	Theasurements of son	lauc metaphase chit	phosomes of Psid	ium guineense s	W.
No. of chromosome complements	Length of whole chromosome (μm) *Mean ± SD	Length of short arm (µm) *Mean ± SD	F% *Mean ± SD	Nature of Primary constriction	Chromosome Types	Remark
2	1.80± 0.57	0.55 ±0.19	30.56±2.12	sm	A	Chromosome
		0.39±0.00	19.07±1.00	sm		with secondary
	4.40.0.04	0.70.0.10	F0 00 0 00			construction
4	1.46±0.24	0.73±0.12	50.00±0.00	m		
2	1.46±0.16	0.73±0.08	50.00±0.00	m	В	
2	1.10±0.16	0.55±0.08	50.00±0.00	m		
2	1.83±0.22	0.75±0.07	40.98±1.57	nm		
2	1.61±0.23	0.62±0.14	38.51±1.98	nm		
2	1.58±0.11	0.66±0.15	41.77±2.35	nm		
2	1.57±0.02	0.59±0.01	37.58±0.17	nm		
2	1.51±0.21	0.58±0.16	38.41±2.67	nm		
2	1.50±0.24	0.64±0.08	42.67±2.19	nm		
2	1.44±0.19	0.57±0.09	39.58±1.71	nm		
2	1.41±0.13	0.57±0.09	40.43±4.61	nm		
2	1.39±0.11	0.57±0.09	41.07±4.46	nm	]	
2	1.30±0.15	0.50±0.09	38.46±2.87	nm		
2	1.20±0.25	0.59±0.06	49.17±1.60	nm	J	
2	1.19±0.20	0.46±0.09	38.66±2.55	nm		
2	1.88±0.46	0.65±0.21	34.57±1.94	sm	J	
2	1.74±0.31	0.61±0.13	35.06±2.80	sm		
2	1.48±0.15	0.46±0.13	31.08±2.12	sm	D	
2	1.42±0.07	0.53±0.15	37.32±1.17	sm		
2	1.25±0.37	0.32±0.10	25.60±2.51	sm		

\* Mean of 5 measurements. m = median, nm = nearly median, sm = sub-median

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## Results

The metaphase cells of P. guineense Sw. revealed 2n = 44 somatic chromosomes in all the metaphase cells (Fig. 1) which is a new record of the species. No numerical variation in somatic chromosome number was recorded. The chromosomes were small sized and mostly represented by median types of chromosomes. There were 4 pairs of median (m), 12 pairs of nearly-median (nm) and 6 pairs of sub-median (sm) chromosomes in which one pair had secondary constriction (Fig. 2). On the basis of primary constrictions and size of chromosomal complements the chromosomes were grouped into four morphological types:

- **Type A** Small chromosomes (1.80  $\pm$  0.57  $\mu$ m) bearing two constrictions, primary and secondary; both were sub-median in position.
- Type B Chromosomes were short sized measuring from 1.46  $\pm$  0.24  $\mu m$  to 1.10  $\pm$  0.16  $\mu m$  and with median primary constriction.
- Type C Shot sized chromosomes with nearly median primary constrictions and were measured from 1.80 ±  $0.22 \ \mu m$  to  $1.19 \pm 0.20 \ \mu m$ .
- Type D Chromosomes with sub median primary constriction and size range was 1.88 ± 0.46 µm to 1.25 ± 0.37 µm.

Minute details of the chromosomal complements was characterized bv having karyotype formula

Research article ©Indian Society for Education and Environment (iSee) chromosomal complements was 1.48 µm with a size range of 1.10 µm - 1.88 µm (Table 1) and with a TF value

Fig. 1. Somatic metaphase plate of P. guineense Sw. (2n = 44) [Bar: 4.78µm]. 2. Karyogram of the species. 3A. Meiotic metaphase - I of P. guineense showing n = 22 bivalents [Bar: 4.78 μm], 3B. Camera lucida drawing of the same [Bar: 7.89 µm].



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40.07%. Meiotic analysis of pollen mother cells of *P. guineense* revealed 22 normal bivalents (Figs. 3 A - B). No meiotic irregularities like secondary association were recorded in their meiotic cells. Anaphase distribution of bivalent chromosomes was normal.

## Discussion

Analysis of detailed chromosome morphology in P. guineense has enabled to disclose a clear picture of a standard karyotype. Previous cytological records on different species of *Psidium* suggests the existence of ploidy series with a basic chromosome number x = 11 (Atchinson, 1947; Costa and Martins, 2007). Variation in ploidy was also reported in many cultivars of P. guajava L., (Kumar and Ranade, 1952; Naithani and Srivastava, 1966) in spite of diploid somatic chromosome number 2n = 2x = 22 (D'Cruz and Rao, 1962; Roy and Jha, 1962b). However, somatic chromosome number recorded in the present species clearly suggests the multiple of basic chromosome number x = 11indicating polyploidy in nature. This finding on *P. guineense* could be attributed due to cytological diploidization in course of evolution and behaves like normal diploid species as recorded in many other taxa (Dana and Datta, 1961; Baguar and Akhtar, 1968; Bairiganjan and Patnaik, 1989). Although such type of variation in somatic chromosome number may occur, but only those survives and gives rise to new form which maintain the basic essential characteristics required by the particular group for its survival. Chromosome number and karyotype constancy recorded in the present study justifies a stable genotypic nature of the species.

The size variation of somatic chromosomal complements of P. guineense reveals a tendency to asymmetry. According to Stebbins (1971) the karyotype of this species belongs to the category 2A and the accumulation of relative size differences between the chromosomes of the complement suggests its karyotype to be considered as slightly asymmetric (Table 2). Moderate degree of symmetry in Psidium and other members of Myrtaceae were also reported by Vijavakumar and Subramanian (1985). Therefore, the chromosome constancy recorded by us clearly reveals a new record of the wild guava (P. *quineense* Sw.) of somatic chromosome number 2n = 44. Acknowledament

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Table 2. Stebbins categorization of the karyotype of P. guineense Sw.

gameenee em										
	Proportion of the chromosome with arm ratio < 2 : 1									
Ratio largest/smallest	0.00	0.01 - 0.50	0.51- 0.90	1.00						
	1A	2A	3A	4A						
< 2 : 1		<i>P. guineense</i> 2A								

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