Karyomorphological Analysis of
Syzygium laetum (Myrtaceae):
An Endemic Species from Western Ghats of India

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Summary Syzygium laetum (Myrtaceae) is an endemic species of Western Ghats. The karyomorphology is reported for the first time with mitotic chromosome number 2n=22. The karyotype formula is 2n=22=18m+4sm. The karyotype is a 2A type of the Stebbins category.

Keywords Chromosome number, Endemic, India, Karyotype, Syzygium laetum, Western Ghats.

The genus Syzygium Gaertn. consists of about 1,200 species distributed mainly in the tropics and subtropics; from India to Pacific islands with a diverse range of habitats from sea shore to montane forest. Most Syzygium species are medium to large evergreen trees or shrubs and many of which have been used in traditional medicine. Some species have culinary uses and are commercially produced for their edible fruits (S. cumini and S. jambos). The ripened fruits are eaten fresh or used to produce jams and preserved. S. aromaticum is used as spices and flavoring agents, too. Nectariferous flowers and fleshy fruit genus exhibit high ecosystem importance as a food source for an extensive range of animals (Craven et al. 2006).

About 102 taxa of Syzygium are represented in India of which 44 are endemic to the country. The Western Ghats and North Eastern part of India are the two major centers of species diversity having the maximum number of taxa of which 20 are enlisted in the IUCN category. S. andamanicum and S. palghatense are critically endangered species, whereas S. alternifolium, S. beddomei, S. bourdillonii, S. microphyllum, S. myhendrae, S. parameswarantii and S. stocksii are enlisted in the endangered category (Shareef and Kumar 2020). The richest species diversity and endemism are seen in the Western Ghats with 54 species of which 28 are endemics to the region. The level of endemism in the Western Ghats suggests that it is one of the centers for diversification of Syzygium.

The genus is little known cytologically. Up to now only 26 species including eight Indian species have been studied cytologically with basic chromosome number x=11 (Table 1). S. laetum is distributed throughout the Western Ghats but so far it has not been studied from a cytogenetic view. Here, we have investigated the species and reported mitotic chromosomes and karyotypes for the first time.

Materials and methods

The fruits of S. laetum were collected from Ugwai sacred groove in the Kolhapur district of Maharashtra state (Fig. 1A, B). The voucher specimens of the species are deposited in the Herbarium of the Department of Botany, Shivaji University, Kolhapur (SUK, RNM-255). For the mitotic study, the seeds were germinated in coco peat in a plastic tray. Root tips of 4–8 mm in length were pretreated with 2 mM 8-hydroxyquinoline at 6±2°C for 4–5 h. The pre-treated tips were hydrolyzed in 1 N hydrochloric acid at about 60–70°C for 1 min and were squashed in 2% propionic orcein. The well-spread somatic plates were photographed with a Carl Zeiss Axio Imager. Twenty well-spread somatic chromosome plates were used for karyotype analysis and nomenclature for describing karyotype composition following Levan et al. (1964). The degree of karyotype asymmetry was determined using the categories of Stebbins (1971). Karyotype morphometric characters were evaluated by calculating haploid complement length together with intrachromosomal asymmetry index (A1) and interchromosomal asymmetry index (A2) as per Zarco (1986).

Results and discussion

Syzygium laetum showed somatic chromosome number 2n=22 (Fig. 1C). Numerical data were shown in
Table 1. Previously reported chromosome numbers for Syzygium species.

| Sr. No | Species                          | 2n   | Reference            |
|-------|---------------------------------|------|----------------------|
| 1     | *S. agastya malayanum M.B. Viswan. and Manik. | 22   | Darlington (1955)    |
| 2     | *S. aqueum (Burman.) Alston     | 22   | Darlington (1955)    |
| 3     | *S. aromaticum (L.) Merr. and L. M. Perry | 22, 44 | Vijayakumar and Subramanian (1985), Oginuma et al. (1994) |
| 4     | *S. calophyllifolium (Wight) Walp. | 22   | Vijayakumar and Subramanian (1985) |
| 5     | *S. claviflorum (Roxb.) Wall. ex A. M. Cowan and Cowan | 22   | Mehra and Khosla (1969, 1972) |
| 6     | *S. cumini (L.) Skeels          | 22   | Ohi et al. (2004)    |
| 7     | *S. formosum (Wall.) Masam.     | 22   | Mehra and Khosla (1969, 1972) |
| 8     | *S. fruticosum DC.              | 22   | Mehra and Khosla (1969, 1972) |
| 9     | *S. grande (Wight) Walp.        | 22   | Mehra and Khosla (1969, 1972) |
| 10    | *S. jambos (L.) Alston          | 44   | Pedrosa (1999)       |
| 11    | *S. khasianum (Duthie) N. P. Balakr. | 22   | Mehra and Khosla (1969, 1972) |
| 12    | *S. kurzii (Duthie) N. P. Balakr. | 66   | Mehra and Khosla (1969, 1972) |
| 13    | *S. maire (A. Cunn.) Sykes and G. Jones | 22   | Dawson (1987)       |
| 14    | *S. malaccense (L.) Merr. and L. M. Perry | 22   | Pedrosa (1999)       |
| 15    | *S. micranthum Thwaites         | 44   | Gill (1974)          |
| 16    | *S. nervosum A. Cunn. ex DC.    | 22   | Gill et al. (1980)   |
| 17    | *S. oblatum (Roxb.) Wall. ex A. M. Cowan and Cowan | 22   | Mehra and Khosla (1969, 1972) |
| 18    | *S. ramosissimum (Blume) N. P. Balakr. | 22   | Mehra and Khosla (1969, 1972) |
| 19    | *S. reticulatum (Wight) Walp.   | 22   | Mehra and Khosla (1969, 1972) |
| 20    | *S. revolutum (Wight) Walp.     | 22   | Goldblatt (1981)     |
| 21    | *S. samarangense (Blume) Merr. and L. M. Perry | 22, 33, 44, 55 | Roy and Jha (1962) |
| 22    | *S. sandwicense (A. Gray) M. Stuttg. | 22   | Goldblatt (1981)     |
| 23    | *S. smithii (Poir.) Nied.       | 44   | Darlington (1955)    |
| 24    | *S. staudtii (Engl.) Mildbr.    | 22   | Vijayakumar and Subramanian (1985) |
| 25    | *S. tetragramum (Wight) Wall. ex Walp. | 22   | Mehra and Khosla (1972) |
| 26    | *S. venosum DC.                 | 66   | Mehra (1972)         |

*Indian species

Table 2. Karyotype analysis of Syzygium laetum.

| Chromosome no | Long arm (l) | Short arm (s) | c=l+s | d=l-s | r=l/s | i=s/c×100 | Centromeric position |
|---------------|--------------|--------------|------|-------|-------|----------|---------------------|
| 1             | 1.36±0.07    | 0.74±0.04    | 2.10±0.11 | 0.62  | 1.84  | 35.19    | sm                  |
| 2             | 1.24±0.06    | 0.78±0.06    | 2.02±0.12 | 0.46  | 1.59  | 38.59    | m                   |
| 3             | 1.18±0.06    | 0.73±0.07    | 1.90±0.10 | 0.45  | 1.63  | 38.12    | m                   |
| 4             | 1.09±0.10    | 0.64±0.06    | 1.72±0.10 | 0.45  | 1.72  | 36.98    | sm                  |
| 5             | 0.99±0.10    | 0.67±0.08    | 1.65±0.18 | 0.32  | 1.48  | 40.28    | m                   |
| 6             | 0.93±0.06    | 0.65±0.07    | 1.58±0.13 | 0.28  | 1.44  | 41.06    | m                   |
| 7             | 0.88±0.06    | 0.67±0.04    | 1.56±0.08 | 0.21  | 1.32  | 43.23    | m                   |
| 8             | 0.83±0.04    | 0.65±0.06    | 1.47±0.08 | 0.18  | 1.29  | 43.70    | m                   |
| 9             | 0.79±0.03    | 0.60±0.03    | 1.39±0.06 | 0.19  | 1.32  | 43.03    | m                   |
| 10            | 0.74±0.04    | 0.57±0.03    | 1.31±0.06 | 0.17  | 1.29  | 43.65    | m                   |
| 11            | 0.66±0.04    | 0.52±0.06    | 1.18±0.09 | 0.14  | 1.28  | 43.97    | m                   |

Table 1. The mean chromosome length was 1.63±0.29 µm and the total chromosome length of the haploid complement was 17.89 µm. The shortest chromosome measured 1.18±0.09 µm and the longest 2.10±0.11 µm. The total form percentage was 40.27. The symmetric index was 67.44 and the gradient index was 56.01. The coefficient of variation of chromosome lengths and coefficient of variation of the centromeric index were observed to be 17.96 and 7.60, respectively. The A1 is to be observed at 0.30 while A2 is 0.18. The karyotype formula was determined as 2n=22=18m+4sm belonging to the 2A asymmetric category of Stebbins (1971) and the karyogram is illustrated in Fig. 1D.

In family Myrtaceae, the diploid chromosome number 2n=2x=22 is the most common, although variations of ploidy level occur, with some triploid (2n=3x=33) and tetraploid (2n=4x=44) records. Karyotype details in this group are scarce because the chromosomes are small (<2 µm) (Costa and Forni-Martins 2007). In the previous study 26 species were studied and reported 2n=22, 33, 44, 55, and 66 (Table 1). Recently, Costa and Forni-Martins (2006a, b, 2007) reported chromosome counts in c. 50 species of Myrteae belonging to different subtribes (Eugeniinae, Myrciinae, and Myrtinae), finding a predominance of 2n=22. The basic chromosome number x=11 for Myrteae, previously proposed by Atchinson...
(1947) and Raven (1975) has been confirmed. The genus Syzygium remains very poorly known cytologically. For understanding the interrelationship amongst different Syzygium species cytogenetical studies are needed.

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References

Atchinson, E. 1947. Chromosome numbers in the Myrtaceae. Am. J. Bot. 34: 159–164.
Craven, L. A., Biffin, E. and Ashton, P. S. 2006. Acmena, Acmenosperma,
Cleistocalyx, Piliocalyx and Waterhousea formally transferred to Syzygium (Myrtaceae). Blumea 51: 131–142.

Costa, I. R. and Forni-Martins, E. R. 2006a. Chromosome studies in Brazilian species of Campomanesia Ruiz and Pávon and Psidium L. (Myrtaceae Juss.). Caryologia 59: 7–13.

Costa, I. R. and Forni-Martins, E. R. 2006b. Chromosome studies in species of Eugenia, Myricaria and Plinia (Myrtaceae) from south-eastern Brazil. Aust. J. Bot. 54: 409–415.

Costa, I. R. and Forni-Martins, E. R. 2007. Chromosome studies in Gomidesia, Marlierea, Myrceugenia and Myrcia (Myrtaceae, subtribe Myricinae). Kew Bull. 62: 113–118.

Darlington, C. D. and Wylie, A. P. 1955. Chromosome Atlas of Flowering Plants. George Allen and Unwin Ltd., London.

Dawson, M. I. 1987. Contributions to a chromosome atlas of the New Zealand flora-29 Myrtaceae. N.Z. J. Bot. 25: 367–369.

Goldblatt, P. 1981. Index to Plant Chromosome Numbers 1975–1978. Missouri Botanical Garden, St. Louis., pp. 553.

Levan, A., Fredga, K. and Sandberg, A. A. 1964. Nomenclature for centromeric position on chromosomes. Hereditas 52: 201–220.

Mehra, P. N. 1972. Cytogenetical evolution of hardwoods. Nucleus 15: 64–83.

Mehra, P. N. and Khosla, P. K. 1969 In: Marhold, K. and Kucera, J. (eds.). IAPT chromosome data 20. Taxon 18: 213–221.

Mehra, P. N. and Khosla, P. K. 1972. Cytogenetical studies of East Himalayan Hamamelidaceae, Combretaceae and Myrtaceae. Silvae Genet. 21: 186–190.

Ohri, D., Bhargava, A. and Chatterjee, A. 2004. Nuclear DNA amounts in 112 species of tropical hardwoods—New estimates. Plant Biol. 6: 555–561.

Ohri, D., Bhargava, A. and Chatterjee, A. 2004. Nuclear DNA amounts in 112 species of tropical hardwoods—New estimates. Plant Biol. 6: 555–561.

Pedrosa, A., Gitai, J., Silva, A. E. B., Felix, L. P. and Guerra, M. 1999. Citogenética de angiospermas coletadas em Pernambuco–V. Acta Bot Brasil 13: 49–60.

Raven, P. H. 1975. The bases of angiosperm phylogeny: Cytology. Ann. Mo. Bot. Gard. 62: 724–764.

Sharma, S. M. and Santhosh, E. S. K. 2020. Census of Syzygium (Myrtaceae) in India. Abrahamia 6: 50–50.

Stebbins, G. L. 1971. Chromosomal Evolution in Higher Plants. Edward Arnold Ltd., London.

Vijayakumar, N. and Subramanian, D. 1985. Cytotaxonomical studies in south Indian Myrtaceae. Cytologia 50: 513–520.

Zarco, R. C. 1986. A new method for estimating karyotype asymmetry. Taxon 35: 526–530.