

A new *Senecio* (Asteraceae) from the Anjaneri Hills of Nashik, India

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Abstract

A new species of *Senecio* L. (Asteraceae, Senecioneae), *Senecio anjanericus* is described and illustrated from the Anjaneri Hills of Nashik district, Maharashtra, India based on morphological and cytogenetical studies. The species resembles *Senecio bombayensis* but differs from it in small size of the ligules, presence of conspicuous foliose supplementary bracts and dense indumentum on stem. The somatic chromosome count was observed to be $2n=2x=20$, with all the chromosomes exhibiting median region centromeres. Detailed morphology, illustration and karyotypic features of the new species are provided.

Introduction

The genus *Senecio* L. (Senecioneae: Asteraceae) is recognized for its remarkable species richness, comprising approximately 1250 species worldwide and exhibits a nearly cosmopolitan distribution, with its primary centers of diversity found in southern Africa and south America (Pelser et al. 2007). *Senecio* exhibits a remarkable diversity in life forms ranging from annual to perennial herbs, shrubs, vines, trees or epiphytes and its ability to thrive across a wide range of habitats (aquatic to desert, from low altitudes to alpine and from arctic regions to tropical areas) (Dana et al. 2021). The genus can be identified with a set of characters such as presence of truncate style-branches with short hairs on stigma, stamens with ecaudate anther bases (obtusate or rounded) and balusterform filament collar (Nordenstam 2007).

Senecio is represented by 53 taxa (47 species and 6 varieties) in India (Karthikeyan et al. 2020). Of these, 21 taxa are endemic to the country (Singh et al. 2015). The distribution of *Senecio* species in India is predominantly confined to two major regions, the Himalayas and the Western Ghats. The Anjaneri Hills, located in the northern Western Ghats of Maharashtra, India, are known for their rich floral diversity (Auti et al. 2020). During botanical surveys conducted by the authors in the Anjaneri Hills, a previously unidentified *Senecio* species was found. The plants resembled *Senecio bombayensis* N.P. Balakr., but further examination revealed significant differences between the Anjaneri population and *S. bombayensis*. Accordingly, this population is described here as a new species. Furthermore, cytogenetical differences between the new species and *S. bombayensis* are also discussed.

Material and methods

Taxonomy: The morphological analysis and description of the newly discovered species were made through examination of live specimens on the field as well as in the laboratory. Herbarium specimens housed at BLAT, BSI, CAL and MH were studied. Also, the specimens were compared with the type specimens of closely related species in the virtual herbaria (K and E). The acronyms of the herbaria consulted is as per Index Herbariorum (<http://sweetgum.nybg.org/science/ih/>). Descriptions were made following the terminology of Hickey and King (2001).

Cytogenetics: Mitotic studies of the new species and *S. bombayensis* were conducted on the root tips obtained from germinating cypselae. Root tips were pre-treated with a saturated solution of *para*-Dichlorobenzene

(*p* DB) for 4–5 h at 7 ± 2 . The roots tips were then hydrolysed in 1N HCl and squashed in 2% propionic orcein. Suitable plates from freshly prepared slides were photographed with Leica DM 750 microscope with attached camera at 1000X magnification. Five cells with well-spread metaphase chromosomes were selected for karyotype analysis by using KaryoMeasure software (Mahmoudi and Mirzaghaderi 2021). Karyological parameters, viz. $2n$, mean chromosome length (MCL), total haploid chromosome length (THL), mean centromeric asymmetry (M_{CA}), coefficient of variation of chromosome length (CV_{CL}) and coefficient of variation of centromeric index (CV_{CI}) were used for karyotype analysis. To generate chromosomes with secondary constriction in Idiogram, single image was selected for measurement in Idiogram generation option found in the side panel of software. Voucher specimens were deposited in the Herbarium of Shivaji University, Kolhapur (SUK).

Results

Taxonomic treatment

Senecio anjanericus A.S.Jeswani, S.R.Yadav & Lekhak sp. nov. (Figs. 1–2)

Type: India, Maharashtra, Nashik district, Anjaneri hills (19°55'.139" N 73°34'.381" E), 1264 m, 8 Oct 2022, A.S.Jeswani, M.M.Lekhak and S.R.Yadav (holotype: CAL, isotypes: BSI, SUK).

Etymology: The specific epithet is derived from Anjaneri Hills, the type locality of the species.

Diagnosis: The new species is related to *S. bombayensis* but differs in the presence of dense woolly tomentose indumentum observed specifically on the peduncles (vs puberulous to pubescent peduncles in *S. bombayensis*); presence of distinct foliose supplementary bracts with white tomentum beneath and arachnoid hairs on the vein (vs absence of such bracts in *S. bombayensis*); small size of ligules ca. 3.5 x 1.5 mm (vs large ligule size ca. 11 x 3.5 mm). Other differences between the two species are provided in Table 1.

Description : Annual herbs up to 35 cm tall. *Stems* erect, striate with dense indumentum of arachnoid hairs, much branched apically. *Leaves* alternate, gradually smaller and sessile apically otherwise petiolate, ovate to rhomboid, 1.2–4.5 x 0.5–3.5 cm, apex acute, base decurrent, margin irregularly dentate with acute teeth adaxial surface scaberrulous, abaxial surface densely white tomentose between the veins, arachnoid hair on the veins, reticulately veined; petioles 1–4 cm long, often auriculate at the base. *Capitulescence* terminal, panicleiform, axes densely woolly white-tomentose. *Capitula* radiate, pedunculate; peduncles 1–5 cm long, densely white arachnoid-tomentose, ebracteolate. *Foliose supplementary bracts* ca. 5–10, lanceolate, 0.5–1.7 x 0.2–0.5 cm, puberulous above, woolly tomentose beneath, central vein with a row of hairs. *Involucre* campanulate, 0.5–1.2 cm in diameter; phyllaries ca. 20–22, linear-lanceolate, 0.5–0.7 cm x 0.2–0.4 mm with narrow scarious margins, apex caudate-acuminate, abaxial surface with a row of hairs on central vein; receptacles alveolate and glabrous. *Ray florets* 10–13, usually sterile; corolla yellow, limb somewhat oblong, 3.5–4 x 1.5 mm, 3–4 veined, 2–3 denticulate, tube ca. 1 mm long, hairy at mouth. *Disc florets* 70–100 in number, ca. 5 mm long, hermaphrodite, corolla yellow, tubular, 5-lobed, glabrous, tube ca. 1.2 mm long, limb campanulate, only slightly broader than tube, throat ca. 1.3 mm long, lobes broadly triangular, bulging outside at tip, 0.5–1 mm long, base ca. 0.2 mm wide; anther 1 mm x 0.2 mm, ecaudate, connective appendage oblong; style ca. 3 mm long, stylopodium slightly swollen, glabrous, style branches 0.5 mm long, truncate, fringed with short papillae. *Cypselae* ca. 3.5 mm long, 10-costate, setose; setae emerging from costae; pappus ca. 4 mm long, bristles many, unequal, scabrid, paleaceous, copious in disc florets, absent in ray florets.

Phenology: Flowering season is from August to September; fruiting October.

Distribution: To date, *S. anjanericus* is only known from the type locality; Anjaneri Hills, Nashik district in northern Western Ghats of Maharashtra.

Habitat: It grows on the slopes and tops of hills. Common associates are *Pinda concanensis* (Dalzell) P.K.Mukh. & Constance, *Pogostemon deccanensis* (Panigrahi) Press and *Smithia purpurea* Hook.

Conservation status: *S. anjanericus* was found in Anjaneri hills, Maharashtra, India. The Anjaneri Hill is designated as a Reserved Forest (RF), and a conservation committee has been established to protect endemic plants on the plateau (Auti et al. 2020). The presence of this conservation committee has prevented any disruption from human activities and currently appears to be growing well. The precise count and dimensions of the populations are not adequately determined. However, according to our observation, the population is within very small geographical range. We currently classify this new species as DD (Data Deficient) based on the IUCN Red List classifications (IUCN 2012).

Cytogenetical analysis

S. anjanericus and *S. bombayensis* exhibited the somatic count of $2n = 20$ chromosomes. The former species had chromosomes with median region centromeres (10m) whereas in the latter nine pair had median region centromeres (9m) and one pair a sub-median centromere region (1sm). The karyotype was bimodal in both the species. Of the 10 pairs, two pairs were conspicuously larger than the remaining eight pairs. The first pair was characterized by the presence of a secondary constriction (Figs. 3–4). In *S. anjanericus* the secondary constriction was on the short arm whereas in *S. bombayensis* it was on the long arm. Comparative karyotypes of both the species are given in Table 2.

Discussion

Taxonomy: The new species shares similarities with those classified under the genus *Madaractis* DC. Candolle (1838) initially identified four species (*M. glabra* DC., *M. pinnatifida* DC., *M. polycephala* DC., *M. scabra* DC.) in this genus. Clarke (1876) considered it as a subgenus and included a total of 17 species. Among them, *S. bombayensis* (Syn. *S. reticulatus* C.B.Clarke) was the only species included under subsection *Sub-paleata* of section 1 (members of peninsular India). The subsection is characterised by the presence of sub-paleaceous nature of pappus which was also observed in *S. anjanericus*. Other members of the section found in Maharashtra are *S. belgaumensis* (Wight) C.B.Clarke, *S. dalzellii* C.B.Clarke and *S. edgeworthii* Hook.f. (Syn. *S. tomentosus* (Wight) C.B.Clarke). These members are further characterized by lax corymbs, uniseriate involucre, ray florets epappose, cypselae of ray florets sometimes abortive, anthers ecaudate, and pappus rigid and scabrid. Hooker (1881) mentioned two more species (both occurring in Maharashtra), *S. hewrensis* (Dalzell) Hook.f. and *S. gibsonii* Hook.f. under section *Madaractis*. *S. anjanericus* falls under this section; however, none of the above-mentioned species show supplementary bracts in addition to uniseriate involucre that sets *S. anjanericus* apart from the other species of the group.

Cytogenetics: Cytological information for *Senecio* is very scarce in India, covering about 40% of the total species. Within the section *Madaractis* (DC.) Hook.f., four species have had their chromosome numbers identified previously: *S. bombayensis* (Syn. *S. grahamii* Hook.f.), *S. hewrensis* and *S. wightii* (DC.) Benth. ex C.B.Clarke (Syn. *S. saxatilis* Wall.) have a common chromosome number $2n = 20$ (Gupta and Gill 1979, Gosavi et al. 2020) while *S. dalzellii* with $n = 20$ (Matthew and Matthew 1988). Additionally, the karyotypic formula for *S. hewrensis* is reported as 10m (Gosavi et al. 2020) and for *S. wightii*, it is 9m+1sm (Matthew and Matthew 1988). Based on the available information, it is observed that the species of the section have a base number $x = 10$. *S. anjanericus*, with a chromosome number of $2n = 20$ and a karyotype formula of 10m, appears to have a close relationship with the other members of group.

Karyotype of *S. bombayensis* was more asymmetric than *S. anjanericus*. Also, bimodality was more conspicuous in *S. bombayensis* with the value of ratio of the longest to shortest chromosome of a complement (R) 2.46 in contrast to 1.74 in *S. anjanericus*. The higher values of M_{CA} (10.43) and CV_{CL} (31.94) in *S. bombayensis* indicated variation in chromosome type and heterogeneity in chromosome length of the complement. This is also reflected in the karyotype formula of the species, i.e. 9m+1sm and the range in chromosome length, 3.42 – 1.39 μm . High CV_{CI} (12.60) in *S. bombayensis* than *S. anjanericus* (2.75) reflects the shift of centromere from median to sub-median position. Additionally, the secondary constriction in *S. anjanericus* was located on the short arm whereas in *S. bombayensis* it was on the long arm.

Conflict of interest: The authors declare that they have no conflict of interest.

Significance statement: The significance of this study lies in expanding our understanding of genus *Senecio* in Maharashtra and its position. The detailed morphological and cytogenetic analyses provide essential data for further research on the evolutionary relationships and ecological roles of *Senecio* species in the Western Ghats, emphasizing the importance of the Anjaneri Hills as a rich biodiversity hotspot.

Data archiving statement: The data associated with this study, the type and voucher specimens have been deposited in the Herbarium of Shivaji University, Kolhapur (SUK). Access to this archived data can be facilitated through appropriate channels, and researchers interested in further examination or validation of the findings can contact the corresponding author for access to the materials at SUK.

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Legends

Figure 1. Illustration of *S. anjanericus* A. habit, B. capitulum, C. & D., involucre bracts, E. ray floret, F. disc floret, G. stamen, H. style, I. cypsel

Figure 2. Morphology of *S. anjanericus* and *S. bombayensis* A. habitat, B. habit, C. capitulescence, D. capitulum top view, E. capitulum back view showing foliose supplementary bracts, I. ray floret, K. disc floret, M. cypsel. *S. bombayensis* F. capitulescence, G. capitulum top view, H. capitulum back view, J. ray floret, L. disc floret, N. cypsel

Figure 3. Mitotic metaphase chromosomes of *Senecio* species A. *S. anjanericus* B. *S. bombayensis*. Scale bars = 5 μ m.

Figure 4. Idiograms of *Senecio* species. A. *S. anjanericus* B. *S. bombayensis* . Scale bars = 1 μ m.

Table 1. Comparison of morphological features of *S. anjanericus* and *S. bombayensis* .

Table 2. Comparative karyotypes of *Senecio anjanericus* and *S. bombayensis* (THL = Total haploid length, MCL = Mean chromosome length, M_{CA} = Mean centromeric asymmetry, CV_{CL} = Coefficient of variation of chromosome length, R = ratio of the longest to shortest chromosome of a complement, CV_{CI} = Coefficient of Variation of Centromeric Index).

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