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*Caralluma* R.Br. (*sensulata*) has been usually accepted to include about 120 taxa, with a wide African, Asian and southeastern European distribution (Mabberley 1993). It belongs to the subtribe Stapeliinae (tribe Ceropegiae, subfamily Asclepiadoideae and family Apocynaceae), which has its centre of origin in East Africa (Meve & Liede 2004). The genus comprises xerophytic succulent herbs, represented by 13 species and eight varieties in India. Of these, eight species and seven varieties are endemic to peninsular India (Karuppusamy et al. 2013). The genus *Caralluma* is closely allied to *Boucerosia* but differs by having flowers arising in the axils of rudimentary leaves all along the distal portion of the stem. The type species of the genus *Caralluma* is *C. adscendens* (Roxb.) Haw., a species originally described from peninsular India (Meve & Liede 2002). Among them, 13 species and five varieties are presented in India (Jagtap & Singh 1999). Recently, a few new taxa have been described from India including *Caralluma moorei* Aditya (Aditya 2011a), *C. bicolor* Ramach. et al. (Ramachandran et al. 2011), *C. sarkariae* var. *longipedicellata* Aditya (Aditya 2011b), *C. stalagmifera* var. *intermedia* Karuppusamy & Pullaiah and *C. stalagmifera* var. *longipetala* Karuppusamy & Pullaiah (Karuppusamy & Pullaiah 2007).

*Caralluma adscendens* is a first described Indian stapeliad that has found greater variations among the taxa which has attracted several taxonomists to work out the complexities of this group (Karuppusamy et al. 2013). Variability in the floral morphology of *C. adscendens* is higher than what is typically found in other widespread allied species and has, therefore, hampered a sound taxonomic treatment. The increasing availability of

## NOTES ON *CARALLUMA ADSCENDENS* (ROXB.) HAW. VAR. *ATTENUATA* (WIGHT) GRAV. & MAYUR. (APOCYNACEAE: ASCLEPIADOIDEAE)

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plant material has demonstrated intraspecific variability, where almost every population shows its own features (as the many illustrations published by Gravely & Mayuranathan (1931) show). Especially with regard to frequently occurring differences in corolla structure, size, ciliation, striation, color variation, corona structure and position of insertion of pollinarium have already been established for taxonomic and systematic significance in stapeliad species. However, several distinct tendencies that support intraspecific differentiation have to be considered for delimitation of taxonomic ranks. Inner coloration of the corolla surface is predominantly purple, but creamy yellow coloration is found in *C. adscendens* var. *gracilis*. Dense purple-red transverse stripes or streaks are found in all the six varieties of *C. adscendens* but each variety has different patterns and amount of striation (Karuppusamy & Pullaiah 2013). Many authors have already presented the variations among

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the succulent stapeliads of *Caralluma* groups in India (Plowes 1995; Aditya 2009; Plowes 2011; Karuppusamy et al. 2012). The present communication is aimed at revealing the floral variations among the *Caralluma adscendens* var. *attenuata* in Tamil Nadu State.

***Caralluma adscendens*** (Roxb.) R. Brown var. ***attenuata*** (Wight) Gravely & Mayuranathan in Bull. Madr. Govt. Mus. n.s. N.H. 4(1): 13. 1931; S.R. Srinivasan in A.N. Henry et al. Fl. Tamil Nadu Anal. 2: 81. 1987; Gilbert in Bradleya 8: 11. 1990; Plowes in Haseltonia 3: 52. 1995; Jagtap & Singh in Fasc. Fl. India 24: 194. 1999; Meve & Leide in Plant Syst. Evol. 234: 200. 2002. *C. attenuata* Wight, Ic. Pl. Ind. Orient. 4(1): 15. t. 1268. 1848. Type: tab. 1268 of protologue based on material from India; Hooker f. Fl. Brit. India 4: 76.1883; Gamble Fl. Pres. Madras 2: 861.1923.

Common names: Kallimulaiyan, Mankulli, Iluvaan, Pulichampirandai (Tamil).

Succulent herb: vegetative stem fleshy, 60–65 cm high and 6.8cm width, highly branched with tapering end at the tip. Branches are quadrangular, angle rounded, dark green in the base and paler purplish colored at the tip, fertile apical portion very slender. Leaves caducous, reduced to conical teeth which are arranged in four ribs, 2cm at base and 2–2.5 cm apart from each other. Inflorescence is cyme. Flowers single or 2–3, axils on minute leaf axils, sides of stem; bracts minute, lanceolate, 1 or 2, pedicellate 0.3mm in length and 0.2mm in width and it is glabrous, pendulous, bisexual and complete. Calyx is divided to base 0.25x0.1 mm, ovate or lanceolate, acuminate at apex, fleshy, glabrous and brownish-green in colour. Corolla bud 1.0–1.4 cm long, tubular, constriction in above the middle with valvate aestivation. Corolla 0.9x0.3 mm in diameter, glabrous at the base and pubescent at the tip, purple in color, in the inner side of the lower portion a yellow brown ornamentation is present. Corona biseriate, ca. 1mm in long, broad at the base; inner corona 0.2mm in long, incumbent on anthers, basally united with outer corona. Anther 0.5mm long, yellowish, basally united with inner surface of the middle corona, swollen. Pollen yellow, round, waxy attached by the reddish brown caudicle. Gynostegium 1mm long; stigma cap is star pentagonal. Follicle cylindrical with tapering ends and green color with black stripes present, 8.4cm in long and 2.3cm in width (Image 1).

Habitat: Dry deciduous forests and scrub jungles. The materials for the present study were collected from various areas of Tamil Nadu state (Table 1).

Flowering & Fruiting: Throughout the year.

Distribution: Peninsular India and Sri Lanka.

Medicinal uses: Anti-hyperglycaemic herb used for the treatment of migraine, urinary trouble, chest pain and general weakness of the body. The stem is also used for preparing chutney (Reddy et al. 2010). *C. attenuata* extract prevents increase in blood glucose levels significantly after glucose administration (Kumar et al. 2011). The Paliyar tribe used *C. adscendens* as a remedy for diabetes, lung diseases, indigestion, kidney stone, epilepsy, skin diseases and so on. A paste prepared from 20g of the whole plant along with ghee and an equal quantity of black gram, coriander, pepper and cumin seeds if taken orally once a week cures vomiting, indigestion and reduces body heat (Maruthupandian & Mohan 2010). The methanol extract of *C. adscendens* var. *attenuata* shows significant anti-oxidant, anti-inflammatory, anti-diabetic and anti-microbial activities, which could be used as a potential source of pharmaceutical materials (Madhuri et al. 2010).

Variation study: The detailed morphometric and reproductive characters were observed from the field and tabulated (Table 2). The morphological variations among *C. adscendens* var. *attenuata* showed four different morphological classes which are sporadically distributed in different parts of Tamil Nadu (Table 1). Habitat is strongly attributed to its growth forms due to the availability of nutrients and light that greatly influence the growth habit of succulents. *Caralluma*

**Table 1. Localities and morphological variants of *Caralluma adscendens* var. *attenuata* (Wight) Grav. & Mayur. in Tamil Nadu.**

	Locality	GPS location	Voucher number(s)	Morphological group
1	Madhukkarai, Coimbatore District	10°90.283'N & 76°97.102'E	CMPR 7145, 7252, 7261	II
2	Palni hills, Dindigul District	10°24.425'N & 77°50.320'E	SK 2316, 2326	IV
3	Marudhamalai, Coimbatore District	11°05.420'N & 76°25.534'E	SK 1752	II
4	Kolli Hills, Namakkal District	11°02.376'N & 78°21.837'E	SK 2135, 2144	III
5	Sirumalai, Dindigul District	10°24.226'N & 78°12.930'E	SK 1643, 1651, 1655	I
6	Thirumayam, Pudukottai District	10°21.472'N & 78°75.052'E	SK 2254, 2263, 2272	III
7	Tirupattur, Sivaganga District	10°11.066'N & 78°49.210'E	SK 2178, 2183	II
8	Oddanchatram, Dindigul District	10°48.127'N & 77.75.039'E	SK 1592, 1598	I
9	Barigam, Dharmapuri District	11°93.301'N & 77.98.528'E	SK 1720	IV
10	Kolli Hills, Namakkal District	11°24.852'N & 78°33.870'E	SK 1542, 1564	II





**Image 1.** *Caralluma adscendens* (Roxb.) Haw. var. *attenuata* (Wight) Grav. & Mayur. A - habit; B - close up of flower; C - corona-surface view; D - corona-side view; E - calyx; F - calyx lobe; G - corolla lobe; H - outer corona; I - pollinium; J - follicle (© K.M. Prabhu).

depends on the substratum and also its associates for their usual growth (Images 2 A–D). Mostly they grow on open rocky or soil substratum but in many places they are associated with thorny bushes like *Prosopis juliflora* (Sw.) DC., *Catunaregam spinosa* (Thunb.)

Tirveng., *Canthium coromandelicum* (Burm. f.) Alston, *Euphorbia antiquorum* L., *Commiphora berryi* (Arn.) Engl., *Dichrostachys cinerea* (L.) Wight & Arn., *Barleria buxifolia* L., *B. noctiflora* L.f. etc. The succulent quadrangular stem of the taxon may differ in round angle and acute

Table 2. Vegetative and reproductive variations in *Caralluma adscendens* var. *attenuata* (Wight) Grav. & Mayur. in Tamil Nadu

Characters	Group- I	Group- II	Group- III	Group- IV
Habitat	open bush	on rocky substratum	shaded under thorny bushes	road sides
Acuteness of stem angle	rounded	slightly sharp angles	slightly elevated	acute angles
Inflorescence	terminally branched	unbranched	unbranched	unbranched
Number of flowers in axils	single	single	single or biflowered	two or three
Size of corolla	0.8x0.7 mm dia.	0.5x0.3 mm dia.	0.9x0.6 mm dia.	0.8x0.6 mm dia.
Hairiness of corolla margin	purplish red, dense	purplish, sparse	purplish-yellow, very sparse	absent
Striation on corolla lobe	above half dark purple	above half pale purplish	above half purplish dotted	pale pinkish
Shape of outer corona	recurved	slightly recurved	semi-erect tips	recurved tips
Colour of outer corona	dark purplish	reddish-purple	pale pinkish	pale yellowish
Colour of inner corona	dark purplish	purple	pinkish	yellowish
Colour of pollinaria	orange reddish	yellowish	pale yellowish	pale yellowish
Rate of fruit set	15%	12%	16%	12%
Length of follicles	10cm long	8.2cm	7.4cm	8.5cm
Colour of the follicle	purplish streaks	purple blotches	whitish molten	creamy
Length of seed hairs	3.5cm	3.2cm	2.5cm	2.9cm
Colour of the seed hairs	cottony white	creamy white	pale yellowish	pale yellowish
Number of seeds in mature pod	52	39	46	41

angle in that most of the var. *attenuata* have a round angle, but a few populations were observed to have acute angle stems in the foothills of Palni and Barigam of Dharmapuri District. The colour of the stem is also varied in different populations, usually purple streaks on the stem and it is more concentrated during summer seasons. In many populations of this taxon there are dense purple blotches near the leaf protuberance and less in internodal regions. Floral variations are common among the succulent Apocynaceae in respect of their color, hairiness, striation pattern on corolla lobes, position of insertion of pollinarium, colour of pollen masses, coronal pattern, follicle morphology, rate of fruit setting, number of seeds per pods, seed morphology, seed hair color etc. (Karuppusamy et al. 2013).

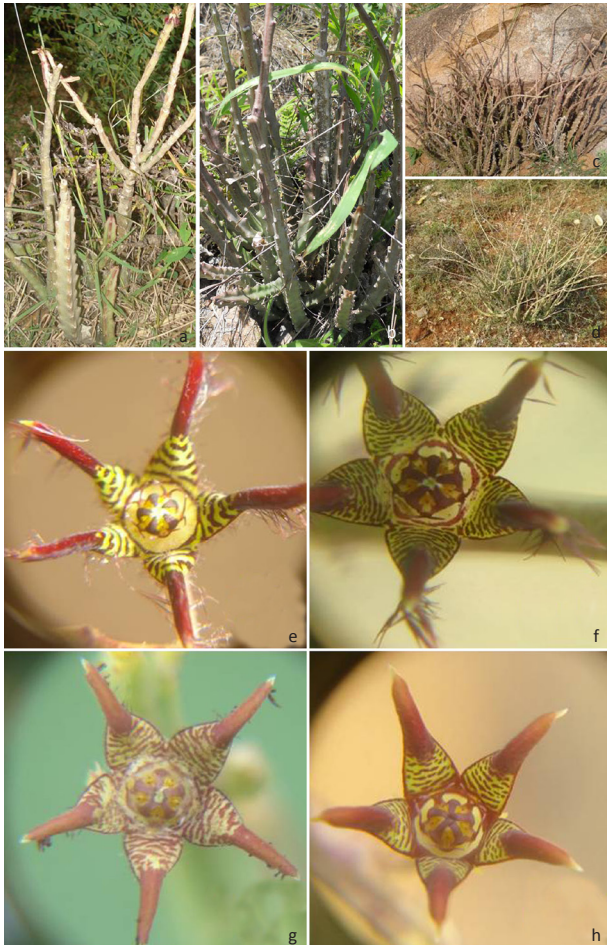
A range of floral variations has been observed in the *C. adscendens* var. *attenuata* in Tamil Nadu State alone in the present study (Table 2). Bruyns (1989) has drawn attention to the very great similarity among these varieties - *fimbriata* from India, *Caralluma subulata* from Arabia and *Caralluma dalzielii* from West Africa. This could be taken to indicate that the two groups such as round and acute angle varieties merit formal recognition at least as subspecies. The status of the varieties within *C. adscendens* seems more questionable as Gravely and Mayuranathan indicated that intermediates are apparently common (Gilbert 1990). The present

accounts indicate that *C. adscendens* var. *attenuata* is a variable and widely distributed species, with at least four distinct morphoforms being recognized. Gravely & Mayuranathan (1931) have suggested the use of classification of varieties under *C. adscendens* partly in flower morphology and partly in stem morphology. But these varieties are unable to be held as herbarium specimens, because these are succulent genera. There is considerable floral (but also vegetative) variability in *C. adscendens* var. *attenuata*, quite often even between plants of single populations, but almost always between different populations. These circumstances have stimulated many taxonomists and regional florists to describe morphotypes, ecotypes or varieties or forms. Even though in many places overlapping populations are exhibited among the taxon and also with other varieties of the species, Karuppusamy et al. (2013) suggested that the variable forms of Indian *Caralluma* with the complex taxonomy still needs to be answered because this complexity has never been explored as a whole (Images 2 & 3).

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**Image 2. Variation in *Caralluma adscendens* var. *attenuata* (Wight) Grav. & Mayur.**

**A** - habitat with thorny associates; **B** - habitat on road sides; **C** - habitat on rocky substratum; **D** - open bush; **E-H** - floral variations (© S. Karuppusamy & K.M. Prabhu).

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**Image 3. Variation in *Caralluma adscendens* (Roxb.) Haw. var. *attenuata* (Wight) Grav. & Mayur.**

**A–D** - flower colour variation; **E–F** - variation in ornamentation in lower side of corolla lobes; **G–H** - variation in branching pattern of inflorescence (© K.M. Prabhu).

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