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Flower and flower bud morphology study of selected ornamental plants of the family Apocynaceae

Rejitha S [1*], Uma Devi S [2]
[1] Department of Botany, Nesamony Memorial Christian College, Marthandam, Tamil Nadu, India
[2] Department of Botany, Sree Ayyappa College for Women, Nagercoil, Tamil Nadu, India

* Corresponding Author: **Rejitha S**

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Abstract
The present study reports the comparative morphology of flower and flower buds of 15 well known ornamental plant species of the family Apocynaceae in Kanyakumari District. The flower and flower buds of 15 species have showed large variation in shape, size and color. Flower color is the most attractive aspect of differentiation of the species.

Introduction

The small lateral or terminal protuberances on the stem of vascular plants may develop into a flower, leaf or shoot. Flower buds are modified leaves. The phase of flower development from mature bud to open flower encompasses one of the most active growth periods in the plant development. The bud development was calyx abscises, stamens extend, anthers dehisce and petals expand and re-orientate. Flower refers to a part of the plant that contains the reproductive organs. It is often surrounded by colorful petals and sepals.

Apocynaceae is the most popular family, due to the traditional use of some species as ornamental plants (e.g., *Allamanda cathartica* L., *Catharanthus roseus* (L.) G. Don, *Nerium oleander* L., *Plumeria rubra* L.). Many plants of this family have economic and medicinal values. It was a widely circumscribed family based on presence of laticifers, abundant endosperm, an often contorted corolla limb and follicular fruits. Apocynaceae is one of the largest families of angiosperms, with 360 genera and approximately 5000 species, 25 tribes, 49 subtribes and five subfamilies: Apocynoideae, Asclepiadoideae, Periplocoideae, Rauvolfioideae and Secamonoideae (Meve, 2002; Endress, 2016) [4, 3].

Morphology was traditionally most important source of information in plant taxonomy. A majority of taxonomic groups were recognized by the cardinal characters of floral morphology. Flower morphology is the best explaining component in plant systematic researches and the key for creating phylogeny which broadens the understanding of evolution. Wide range of flowering plants are identified, described and classified based on their morphology. The objective of the present investigation is to study the comparative morphology of flower and flower buds in selected ornamental plants of the family Apocynaceae.

Materials and Methods

In the present study, fresh plants in each species were collected from different localities of Kanyakumari District, Tamil Nadu, India, during the month of June–December 2021. Kanyakumari District is the Southern-most tip of Indian Peninsula is bounded between 77°05[l] and 77°35[l] of the Eastern longitude and 8°05[l] and 8°35[l] of the Northern latitude. Shoots of three plants in each species had been collected and used for flower and flower bud morphology study.

From these shoots, 20 flowers and flower buds were randomly collected and measured the characteristics of the species. A datasheet was designed and information was recorded for the flower bud shape, color, length and width (Table 1), flower shape, color, length, width, aestivation and overlapping characters (Table 2).

Result

The result obtained for all measurements of the investigated species are listed in Table 1 and Table 2. The flower and flower bud images of all species are given in figure 1. A total of 15 species were collected and studied the flower and flower bud morphology. In APG IV classification, *Adenium obesum* (Tribe Nerieae), *Nerium oleander* (Tribe Nerieae) and *Wrightia antidysenterica* (Tribe Wrightieae) positioned in the Apocynoideae subfamily. *Cryptostegia grandiflora* is placed in Periplocoideae subfamily. *Allamanda* (Tribe Plumerieae, Subtribe Allamandinae), *Alstonia scholaris* (Tribe Alstonieae), *Cascabela thevetia* (Tribe Plumerieae, Subtribe Thevetiinae), *Catharanthus roseus* (Tribe Vinceae, Subtribe Catharanthinae), *Kopsia fruticosa* (Tribe Vinceae, Subtribe Kopsiinae), *Plumeria* (Tribe Plumerieae, Subtribe Plumeriinae) and *Tabernaemontana divaricata* (Tribe Tabernaemontaneae, Subtribe Tabernaemontaninae) positioned in the Rauvolfioideae subfamily.

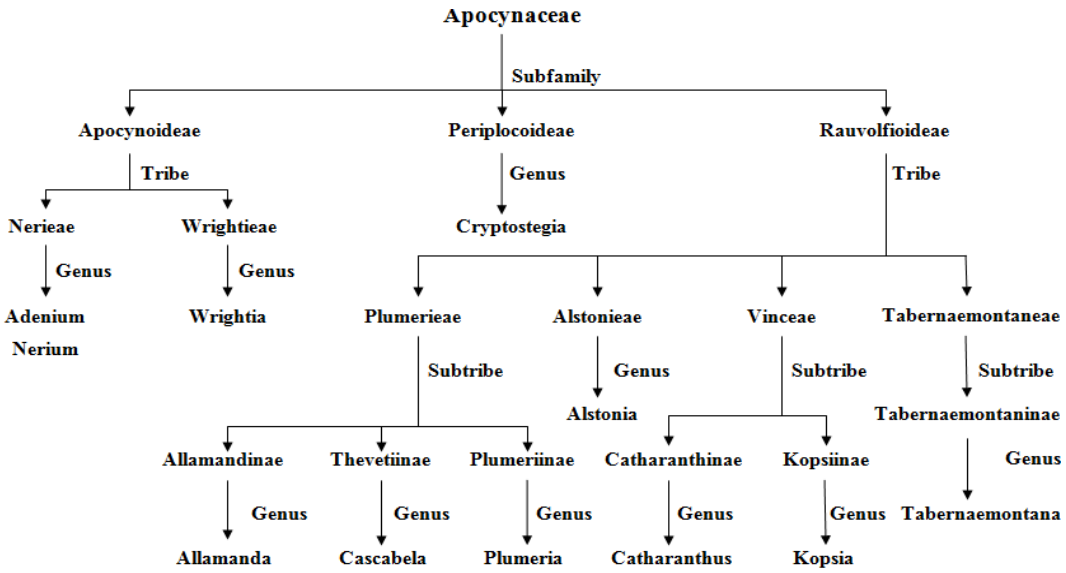

Fig 1

Table 1: Flower bud Morphological Traits of the selected species

Sl. No.	Botanical Name	Flower bud Shape	Flower Bud Color	Flower Bud Length	Flower Bud Width	Corolla Tube Shape
1	*Adenium obesum* (Forssk.) Roem. & Schult.	Conical	Red	4.8–5.9	1.1–1.5	Cylindrical, Swollen
2	*Allamanda blanchetii* A.DC.	Conical	Reddish Lavender	8.1–10.2	1.9–2.4	Cylindrical, Swollen
3	*Allamanda cathartica* L.	Conical	Brownish Yellow	7.4–8.3	1.6–1.8	Cylindrical, Swollen
4	*Allamanda schottii* Pohl	Conical	Brownish Yellow	4.6–6.1	0.9–1.5	Cylindrical, Swollen
5	*Alstonia scholaris* (L.) R. Br.	Cylindrical	Green	1.4–1.5	0.3	Cylindrical
6	*Cascabela thevetia* (L.) Lippold	Conical	Light Green	5.1–7.7	0.9–1.3	Cylindrical, Swollen
7	*Catharanthus roseus* (L.) G.Don	Cylindrical	Pinkish White	3.4–4.1	0.4–0.5	Cylindrical
8	*Cryptostegia grandiflora* Roxb. ex R.Br.	Ovate	Violet	3.9–5.6	1.1–1.5	Cylindrical, Swollen
9	*Kopsia fruticosa* (Roxb.) A.DC.	Cylindrical	Pink	3.1–5.7	0.3–0.6	Cylindrical
10	*Nerium oleander* L.	Conical	Pink	3.7–4.6	0.8–0.9	Cylindrical, Swollen
11	*Plumeria obtusa* L.	Tubular	White	5.6–7.3	0.6–1	Cylindrical
12	*Plumeria pudica* Jacq.	Tubular	White	5.8–7.5	0.7	Cylindrical
13	*Plumeria rubra* L.	Tubular	Reddish Pink	5.2–6	0.7–1	Cylindrical
14	*Tabernaemontana divaricata* (L.) R.Br. ex Roem. & Schult.	Ovate	White	2.8–3	0.3–0.4	Cylindrical
15	*Wrightia antidysenterica* (L.) R.Br.	Ovate	White	3–3.4	0.6–0.7	Cylindrical

Note: Length and width were measured in centimeter

Table 2: Floral Morphological Traits of selected species

Sl. No.	Botanical Name	Flower Shape	Flower Color	Flower Length	Flower Width	Aestivation	Overlapping Character
1	*Adenium obesum* (Forssk.) Roem. & Schult.	Funnel	Reddish Pink	7.2–7.9	3.9–4.9	Twisted	Right
2	*Allamanda blanchetii* A.DC.	Trumpet	Yellowish Pink	10.6–12.8	9.1–11.4	Twisted	Left
3	*Allamanda cathartica* L.	Trumpet	Yellow	9.1–10.3	4.7–6.1	Twisted	Left
4	*Allamanda schottii* Pohl	Trumpet	Yellow	6.2–7.8	2.8–4.4	Twisted	Left
5	*Alstonia scholaris* (L.) R. Br.	Salverform	Light Green	1.4–1.7	0.8–1.2	Twisted	Left
6	*Cascabela thevetia* (L.) Lippold	Funnel	Yellow	9.1–10.4	5.1–5.6	Twisted	Left
7	*Catharanthus roseus* (L.) G.Don	Salverform	Dark Pink	4.5–5.2	3.7–5.5	Twisted	Right
8	*Cryptostegia grandiflora* Roxb. ex R.Br.	Salverform	Violet	5.9–6.7	6.1–6.7	Twisted	Right

9	*Kopsia fruticosa* (Roxb.) A.DC.	Salverform	Whitish Pink	5.1–6.7	3.8–5.8	Twisted	Right
10	*Nerium oleander* L.	Funnel	Light Pink	4.2–5.6	3.6–4.6	Twisted	Right
11	*Plumeria obtusa* L.	Salverform	White	8.1–9.2	7.9–8.9	Twisted	Left
12	*Plumeria pudica* Jacq.	Salverform	White	7.8–10.2	6.9–9.9	Twisted	Left
13	*Plumeria rubra* L.	Salverform	Reddish Pink	6.2–2.9	3.8–4.6	Twisted	Left
14	*Tabernaemontana divaricata* (L.) R.Br. ex Roem. & Schult.	Fan	White	3.8–4.5	1.9–2.7	Twisted	Left
15	*Wrightia antidysenterica* (L.) R.Br.	star	White	3.4–4	1.9–2.8	Twisted	Right

Note: Length and width were measured in centimeter

In the flower bud variability of the selected species, *Adenium obesum*, *Allamanda blanchetii*, *Allamanda cathartica*, *Allamanda schottii*, *Cascabela thevetia* and *Nerium oleander* have conical shaped flower buds. *Alstonia scholaris*, *Catharanthus roseus* and *Kopsia fruticosa* have cylindrical shaped flower buds. *Plumeria obtusa*, *Plumeria pudica* and *Plumeria rubra* have tubular shaped flower buds. *Cryptostegia grandiflora*, *Tabernaemontana divaricata* and *Wrightia antidysenterica* have ovate shaped flower buds (Table 1).

In flower buds, 8 species have the cylindrical corolla tube and other 7 species have two types of corolla tubes, ie. swollen corolla tube and cylindrical corolla tube. The flower bud colors are varying from white (4 species), brownish yellow (2 species), pink (2 species), red (*Adenium obesum*), reddish lavender (*Allamanda blanchetii*), green (*Alstonia scholaris*), light green (*Cascabela thevetia*), pinkish white (*Catharanthus roseus*), violet (*Cryptostegia grandiflora*) and reddish pink (*Plumeria rubra*). Based on the length and width *Allamanda blanchetii* have the largest flower bud (8.1–10.2 × 1.9–2.4 cm) and *Alstonia scholaris* have the smallest flower bud (1.4–1.5 × 0.3 cm) (Table 1).

The comparative study of flowers, all the species have twisted aestivation. The overlapping characters of the flowers are 9 species overlapping to the left side and 6 species overlapping to the right side. Based on the length and width *Allamanda blanchetii* have the largest flowers (10.6–12.8 × 9.1–11.4 cm) and *Alstonia scholaris* with smallest flowers (1.4–1.7 × 0.8–1.2 cm). The shape of the flowers is salverform (7 species), funnel (3 species), trumpet (3 species), fan (*Tabernaemontana divaricata*) and star shape (*Wrightia antidysenterica*). The flower color is white (4 species), yellow (3 species), reddish pink (2 species), yellowish pink (*Allamanda blanchetii*), light green (*Alstonia scholaris*), dark pink (*Catharanthus roseus*), violet (*Cryptostegia grandiflora*), whitish pink (*Kopsia fruticosa*) and light pink (*Nerium oleander*) (Table 2).

Flower and Flower Bud Color Variability within the Species

1. *Adenium obesum* have red color flower bud and reddish pink color flower.
2. *Allamanda blanchetii* have reddish lavender color flower bud and yellowish pink color flower.
3. *Allamanda cathartica* have brownish yellow color flower bud and yellow color flower.
4. *Allamanda schottii* have brownish yellow color flower bud and yellow color flower.
5. *Alstonia scholaris* have green color flower bud and light green color flower.
6. *Cascabela thevetia* have light green color flower bud and yellow color flower.
7. *Catharanthus roseus* have pinkish white color flower bud and dark pink color flower.
8. *Kopsia fruticosa* have pink color flower bud and whitish pink color flower.
9. *Nerium oleander* has pink color flower bud and light pink color flower.
10. *Cryptostegia grandiflora* have violet color flower bud and flower.
11. *Plumeria obtusa* have white color flower bud and flower.
12. *Plumeria pudica* have white color flower bud and flower.
13. *Plumeria rubra* have reddish pink color flower bud and flower.
14. *Tabernaemontana divaricata* have white color flower bud and flower.
15. *Wrightia antidysenterica* have white color flower bud and flower.

Adenium obesum	***Allamanda blanchetii***	***Allamanda cathartica***
		
		
Allamanda schottii	***Alstonia scholaris***	***Cascabela thevetia***

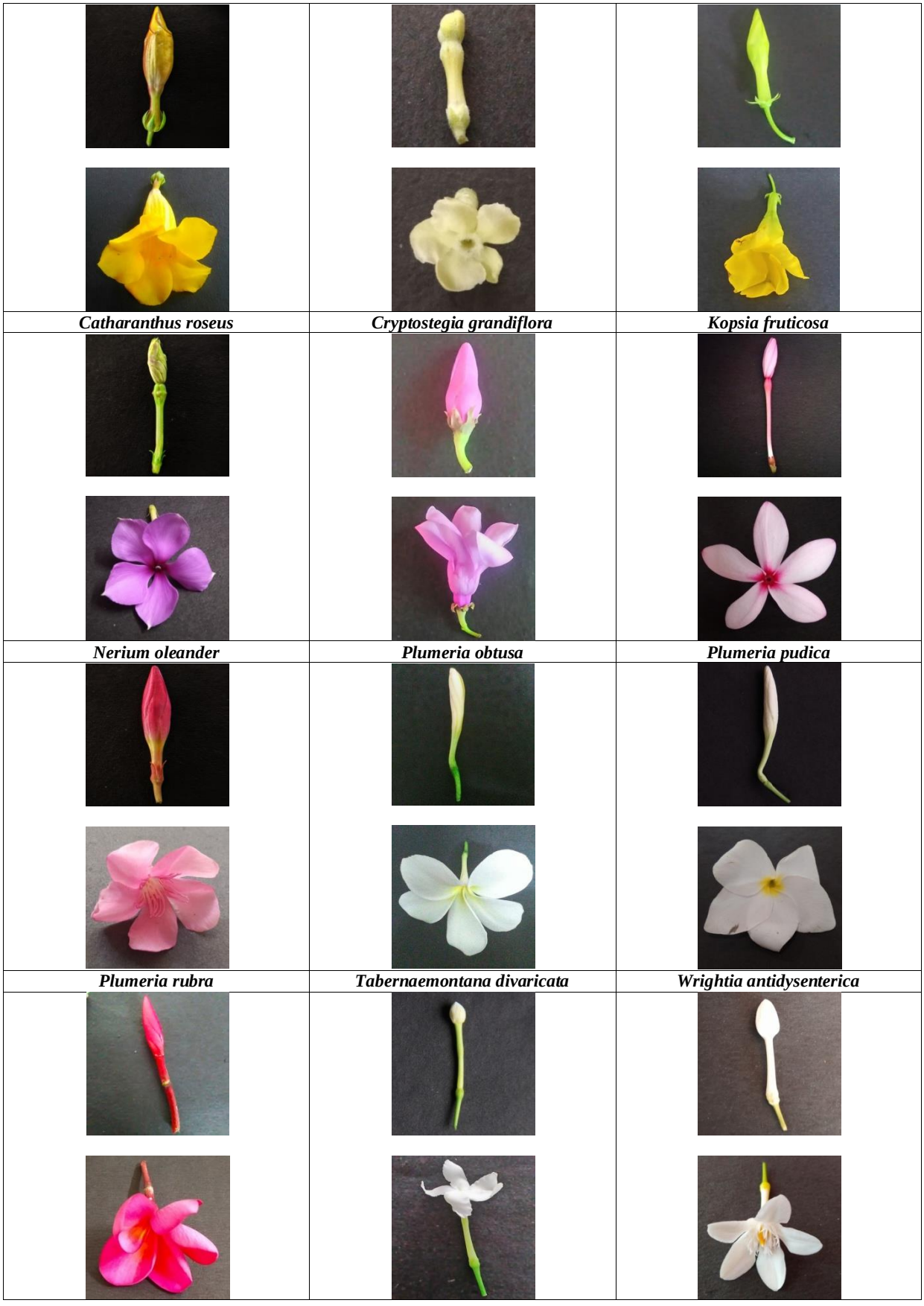

Fig 1: Flower Buds and flowers of the Selected Species

Discussion

Chun-hao *et al*. (2018) [1] studied the flower bud morphology of the species Dahua Pear (*Pyrus communis*). Colombo *et al*. (2018) [2] studied the floral morphology of *Adenium obesum*, these studies are similar to the present study.

Conclusion

Study of the external structure helps to identify and distinguish the species. The flower and flower buds of 15 species studied here showed large variation in shape, size and color. Flower color is the most attractive aspect of

differentiation of the species. Based on these findings, the species are distinguished from one another as certain features. The overlapping similarities as well as distinguishing characteristics are observed among the species.

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