Systematic Studies on Ornamental Plants of the Apocynaceae Family in Kanyakumari District, Tamil Nadu, India

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Abstract
A systematic investigation was done on the Apocynaceae family that is found growing all around the Kanyakumari District in Tamil Nadu, India. We gathered and identified a total of 17 species from the 12 genera in the family Apocynaceae. A complete taxonomic account of each species has been given along with their current name, common name, brief description and phenology. Based on morphological and floral characteristics, a classification of the Apocynaceae family has been proposed.

Keywords: Apocynaceae, Kanyakumari District, Ornamental Plants, Systematic Study

INTRODUCTION
Apocynaceae is a family of angiosperms, which is known as dogbane family or oleander family. This family, which is a member of the Gentianales order, historically consists of about 155 genera and 2000 species, most of which are found in the tropics and subtropics and are only very infrequently found in temperate climates (Cronquist, 1981). The Order Gentianales, which also includes the four other families Gelsemiaceae, Gentianaceae, Loganiaceae and Rubiaceae (APG IV, 2016). The Apocynaceae family is organised into five subfamilies, 25 tribes, and 49 subtribes according to APG IV classification. Apocynoideae, Asclepiadoideae, Periplocoideae, Rauwolfioideae and Secamonoideae are the subfamilies. The largest subfamily is Asclepiadoideae, which has five tribes, fifteen subtribes and 164 genera. Rauwolfioideae is second, with eleven tribes, seventeen subtribes and 83 genera. Apocynoideae has nine tribes, seventeen subtribes and 82 genera. There are 33 genera in the Periplocoideae and 8 in the Secamonoideae (Endress et al., 2014; APG IV, 2016).

The current investigation was carried out in Tamil Nadu, Kanyakumari District, India. The southernmost point of the Indian Peninsula is the Kanyakumari District. The Kanyakumari District is located between latitudes 8°05' and 8°35' in the north and longitudes 77°05' and 77°35' in the east. The Kanyakumari district experiences a warm and humid environment. The average monthly temperature ranged from 32.6°C at its highest point in May to 22.5°C at its lowest point in December. Elevation ranges from sea level to 1829 m above sea level, and rainfall ranges from 103 cm to 310 cm. The soil is red, varying in the quantity of ferruginous element. The purpose of the current study was to catalogue the Apocynaceae family's ornamental plant flora in Kanyakumari District.

MATERIALS AND METHODS
Systematic investigation on the family Apocynaceae growing throughout the Kanyakumari District, Tamil Nadu, India was carried out during 2019–2021. A survey on the determination of the location of different species was made and a list was prepared to be acquainted with the Apocynaceae available in the selected area. All the species were noted and from periodically the areas were visited to see when they flowered. For the morphological study, different types of species were examined five to six sampling were carried out in order to
see if there was any variation or not. Samples of several plants were gathered and morphology, habitat and location details were noted. Photographs of plant samples were used to obtain and illustrate floral and vegetative characters which are necessary for more accurate identification. It was dealt with and thoroughly investigated how the differences and similarities between the actual plants in the field and the dried specimens in the herbarium.

Apocynaceae family have been reviewed based on the various informative web sites, using herbarium library materials in addition to accurate examination of the samples by dissecting microscope to get more detail properties of any parts of plant needed to be taken in consideration. The literature and herbarium material that was accessible were used to review the characteristics of each individual species. All of the collected plant specimens were stored in the herbarium at the Nesamony Memorial Christian College Marthandam. In order to identify the gathered specimens, the relevant taxonomic books and pamphlets were consulted. With the aid of [19], [20], [36], [37], the majority of the obtained items were recognised and characterised upto species.

RESULTS

Systematic investigation was done on the Apocynaceae family that is found growing all around the Kanyakumari District in Tamil Nadu, India. A total of 17 species under 12 genera of the family Apocynaceae were collected and identified. A complete taxonomic account of each species has been given along with their current name, common name, brief description and phenology. The majority of the species, including Adenium obesum, Allamanda cathartica, Catharanthus roseus, Nerium oleander, Plumeria rubra and Tabernaemontana divaricata were dispersed throughout the research region.

The classification of the Apocynaceae family has been suggested based on the current study:

In the present study, the selected 17 species belongs to 3 subfamilies, 7 tribes, 3 subtribes and 12 genera. Apocynoideae, Periplocoideae and Rauvolfioideae are the subfamilies. Apocynoideae with 3 tribes and 4 genera, Periplocoideae with one genera, Rauvolfioideae with 7 genera.

The Apocynaceae Family: A Key

1a- The leaf arrangement was whorled type with 5 leaves …… Allamanda schottii
1b- The leaf arrangement was whorled type with 7 leaves …… Alstonia scholaris
2a- The leaf has revolute and undulate margin ………………… Allamanda cathartica
2b- The leaf has entire and undulate margin …………………… Tabernaemontana divaricata
3a- The inflorescence type is corymb ………………………… Adenium obesum
3b- The inflorescence type is solitary or dichasial cyme ……… Catharanthus roseus
4a- The bract was truncate shape and black color ……………… Plumeria obtusa
4b- The bract was acute shape and brown color ……………… Plumeria pudica
5a- The flowers are trumpet shape and calyx apex is acute to subacute
................................................................. *Allamanda blanchetii*

5b- The flowers are salverform and calyx apex is rounded .... *Kopsia fruticosa*

6a- The corolla lobe was truncate to obtuse and overlapping to the left side
................................................................. *Cascabela thevetia*

6b- The corolla lobe was obtuse to rounded and overlapping to the right side
................................................................. (10)

7a- The outer of the cylindrical corolla tube is violet color ...... *Cryptostegia grandiflora*

7b- The outer of the cylindrical corolla tube is white color ...... *Wrightia antidysenterica*

8a- The appendages are glabrous and twirled together ........ *Pentalinon luteum*

8b- The appendages are pubescent and twirled together ........ *Nerium oleander*

9a- The fruit was linear to ellipsoid shape ..................... *Plumeria rubra*

9b- The fruit was boat shape .................................... *Tabernaemontana alternifolia*

By examining the plant materials collected from the study area using the identification methods, systematic information was accumulated and described below.


    Deciduous succulent shrub with golden color latex; alternate type of leaf arrangement. Leaves are subsessile, green to dark green, pubescent or glabrous; linear, obovate, oblong or obcordate shape, pinnate venation. Inflorescence was corymb; flowers funnel or trumpet shape, white, pink and red color, 6.4–10.7 × 3.8–9.8 cm. The bracteole present and bract absent. Calyx 5, polysepalous and quincuncial aestivation. Corolla twisted aestivation, 1–4 whorls of petal lobes. Androecium placed at the base of the swollen corolla tube; anther 1–10, sagittate with apical appendage; stigma dumb-bell shape, superior ovary; follicle fruits and cylindrical seeds. Phenology: Throughout the year.

2. *Allamanda blanchetii* A.DC. Common Name: Cherry Allamanda, Purple Allamanda

    Climber with milky latex; stem violet to green color and pubescent; leaf arrangement was whorled type with 3–4 leaves; green to dark green, pubescent, ovate or lanceolate shape, entire margin, pinnate venation. Inflorescence was terminal cyme; flowers funnel or trumpet shape, light pink to red color, 8.1–13.8 × 5–12.6 cm. Bract present and bracteole absent. Calyx 5, polysepalous and quincuncial aestivation; corolla 5 obtuse petal lobes with corolla tube, twisted aestivation. Androecium placed at the base of the swollen corolla tube; anthers 5, sagittate; stigma drum shape, superior ovary with nectary disc. Phenology: Throughout the year.


    Climbing shrub, green to violet color stem with milky latex; whorled or opposite type of leaf arrangement; leaves glabrous or pubescent, dark green, elliptic or lanceolate shape, revolute, entire or undulate margin, pinnate venation. Inflorescence terminal cyme or dichasial cyme, peduncle with bracts. Flower trumpet shape, yellow color, 9.1–14.5 × 4.7–12.1 cm; calyx 5, polysepalous and quincuncial aestivation; corolla 1–3 whorls of petal lobes, rounded or obtuse lobes and twisted aestivation. Androecium placed at the base of the swollen corolla tube; anther 1–5, sagittate; stigma drum shape; superior ovary with nectary disc. Phenology: Throughout the year.

<table>
<thead>
<tr>
<th>Adenium obesum</th>
<th>Allamanda blanchetii</th>
<th>Allamanda cathartica</th>
<th>Allamanda schottii</th>
</tr>
</thead>
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Shrub, brownish green stem with milky latex; whorled type of leaf arrangement; leaves are dark green, pubescent, elliptic to obovate shape, entire margin, pinnate venation. Inflorescence cymose panicle, peduncle with bracts; flower trumpet shape, yellow color, 6.2–7.8 × 2.8–4.4 cm; calyx 5, polysepalous and quincuncial aestivation; corolla single whorl, 5 orbicular shaped petal lobes and twisted aestivation. Androecium placed at the base of the swollen corolla tube; anthers 5, sagittate; stigma drum shape; superior ovary with nectary disc; capsule fruits, globose shape and spherical shaped seeds. Phenology: Throughout the year.


Tree, greenish black with milky latex; whorled type of leaf arrangement; leaves are dark green, glabrous, elliptic to oblanceolate shape, entire margin, pinnate venation. Inflorescence umbellate cyme, peduncle with bracts; flowers numerous, salverform, single whorl, pubescent, light green, 1.4–1.7 × 0.8–1.2 cm; calyx 5, synsepalous and quincuncial aestivation; corolla has 5 rounded lobes and twisted aestivation. Androecium placed near the corolla tube throat; anthers 5, ovate shape; stigma conical shape; superior ovary; fruit pairs of follicles; seeds cylindrical with coma at both ends. Phenology: November–December; Fruiting: December–February.


Shrub or tree, green stem with milky latex; alternate type of leaf arrangement; leaves are dark green, glabrous, linear shape, entire margin, pinnate venation. Inflorescence terminal cyme, peduncle with bracts; flower funnel shape, yellow color, 9.1–10.4 × 5.1–5.6 cm; calyx 5 polysepalous and quincuncial aestivation; corolla 5 petal lobes, twisted aestivation, truncate to obtuse lobes. Androecium placed at the base of the swollen corolla tube; anthers 5, ovoid shape; stigma conical shape; superior ovary with nectary disc; fruit drupe, subglobose to pear shaped and spherical shaped seeds. Phenology: Throughout the year.


Herbaceous plant, light green or pink color stem; leaf arrangement opposite decussate; leaves are petiolar, dark green, glabrous, oval to obovate shape, entire margin, pinnate venation. Inflorescence solitary or dichasial cyme; flower salverform, ebracteate, ebracteolate; lavender, light pink and white color, 4.5–5.9 × 3.7–5.5 cm; calyx 5, polysepalous quincuncial aestivation; corolla 5 cupulate petal lobes with cylindrical corolla tube and twisted aestivation. Androecium placed just below the corolla tube throat; anthers 5, sagittate; stigma drum shape; superior ovary with scaly nectary; fruit are paired follicle with oblong seeds. Phenology: Throughout the year.

<table>
<thead>
<tr>
<th>Alstonia scholaris</th>
<th>Cascabela thevetia</th>
<th>Catharanthus roseus</th>
<th>Cryptostegia grandiflora</th>
</tr>
</thead>
</table>

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Climber, green color stem with milky Latex; Leaf arrangement opposite decussate; leaves are elliptic to ovate shape, dark green color, entire margin, glabrous, pinnate venation. Inflorescence terminal cyme, peduncle with bracts; Flowers salverform, violet color, 5.9–6.7 × 6.1–6.7 cm; calyx 5, quincuncial aestivation; corolla twisted aestivation, 5 obtuse petal lobes; androecium placed at the base of the swollen corolla tube, anthers 5, ovoid shape; stigma conical shape; superior ovary. Phenology: Throughout the year, but mainly June to August.


Shrub, green and glabrous with milky latex; leaf arrangement opposite decussate; leaves are green, glabrous, elliptic shape, entire margin, pinnate venation; inflorescence terminal cyme, with bract and bracteole. Flowers salverform, single whorl, light pink color, 5.1–6.7 × 3.8–5.8 cm; calyx 5, synsepalous and quincuncial aestivation; corolla 5 rounded petal lobes with cylindrical corolla tube and twisted aestivation. Androecium placed near the corolla tube throat; anthers 5, ovate shape; stigma drum shape; superior ovary. Phenology: Throughout the year.


Shrub or tree, green and glabrous stem with colorless latex; whorled type of leaf arrangement; leaves are dark green, glabrous, linear shape, entire margin, pinnate venation. Inflorescence terminal cyme, peduncle with bracts; flowers funnel and salverform, pink, white and yellow color, 3.8–5.8 × 3.6–7.6 cm; calyx 5, polysepalous and quincuncial aestivation; corolla 1–3 whors, twisted aestivation, lobe rounded, obtuse or emarginate shape, corolla with corolline corona. Androecium placed at the base of the swollen corolla tube; anther 1–5, sagittate with apical appendage; stigma shape: dumb-bell; superior ovary; follicle fruits, cylindrical seeds with coma. Phenology: Throughout the year.


Climber, green and glabrous stem with milky latex; leaf arrangement opposite decussate; leaves are dark green, glabrous, oval shape, entire margin, pinnate venation. Inflorescence terminal cyme, peduncle with bracts; flower funnel shape, yellow, 6.1–7.1 × 3.9–4.6 cm. Calyx 5, synsepalous and quincuncial aestivation; corolla 5 obtuse petal lobes, corolla tube with nectar guides and twisted aestivation. Androecium placed at the base of the swollen corolla tube; anthers 5, sagittate with apical appendage; stigma round cap shape; superior ovary with nectary disc. Phenology: Throughout the year.


Tree, green to dark green stem with milky latex; alternate type of leaf arrangement; leaves are dark green, glabrous, obovate to oblong shape, entire margin, pinnate venation. Inflorescence terminal cyme, peduncle with bracts; flower salverform, light pink and white color, 5.1–9.2 × 4.6–8.9 cm; calyx 5, synsepalous
and quincuncial aestivation; corolla twisted aestivation, single whorl, 5 obtuse petal lobes with twisted corolla tube. Androecium placed at the base of the corolla tube; anther 5, ovate shape; stigma bottle shaped and half inferior ovary. Phenology: July to September.

### Kopsia fruticosa

Shrub, dark green and glabrous stem with milky latex; alternate type of leaf arrangement; leaves are dark green, glabrous, spoon shape, undulate margin, pinnate venation. Inflorescence terminal cyme, peduncle with bracts; flower salverform, white color, 7.8–10.2 × 6.9–9.9 cm; calyx 5, synsepalous and quincuncial aestivation; corolla twisted aestivation, 5 rounded petal lobes with twisted corolla tube. Androecium placed at the base of the corolla tube; anthers 5, ovate shape; stigma bottle shaped; half inferior ovary. Phenology: Throughout the year.

### Nerium oleander

Common Name: Bridal Bouquet Tree, Everlasting Love, Fiddle Leaf Plumeria, Gilded Spoon, Golden Arrow, Wild Plumeria.

Shrub, dark green and glabrous stem with milky latex; alternate type of leaf arrangement; leaves are dark green, glabrous, spoon shape, undulate margin, pinnate venation. Inflorescence terminal cyme, peduncle with bracts; flower salverform, pink, red, white or yellow color, 5.8–8.6 × 3.8–8.4 cm; calyx 5, synsepalous and quincuncial aestivation; corolla twisted aestivation, 5 rounded or cuspidate petal lobes with twisted corolla tube. Androecium placed at the base of the corolla tube; anthers 5, ovate shape; stigma capitate shape; superior ovary; fruit follicle and boat shape; seed elliptical shape. Phenology: Flowering March to June and fruiting May to September.

### Pentalinon luteum

Tree, dark green and glabrous stem with milky latex; alternate type of leaf arrangement; leaves are green to grey and glabrous stem with milky latex; alternate type of leaf arrangement; leaves are green to dark green, glabrous, obovate, elliptic or lanceolate shape, entire margin, pinnate venation. Inflorescence terminal cyme, peduncle with bracts; flowers salverform, white color, 7.8–10.2 × 6.9–9.9 cm; calyx 5, synsepalous and quincuncial aestivation; corolla twisted aestivation, 5 rounded petal lobes with twisted corolla tube. Androecium placed at the base of the corolla tube; anthers 5, ovate shape; stigma bottle shaped; half inferior ovary. Phenology: Throughout the year.
DISCUSSION

Apocynaceae family generally has lots of ornamental plants. In the current study, the distribution of plants from the Apocynaceae family in the Kanyakumari District was examined. The distribution and taxonomy of Apocynaceae species have been documented by several authors [19], [20], [36], [37]. There were a total of 17 species recorded in the current study, of which 6 were new. None of the floras in the study area had previously been documented. However, it is a quite widespread species in Kanyakumari District. It was recorded almost throughout the Kanyakumari District.

After a proposed key has been established, a focused, detailed and accurate study of the Apocynaceae specimens has been conducted in order to be used for the identification of the various Apocynaceae species, notably in Kanyakumari District, Tamil Nadu, India. This work will focus on the Apocynaceae family, which has not yet been taken into account in the region. The provided species identification key should prompt additional research on other broad Apocynaceae genera and other plant families. This will help to establish the district's new flora, which does not yet exist. As a result, this research and future works will surely fill in some of the gaps in the taxonomic and systemic studies of the flora in this region of the world.

CONCLUSION
Systematic investigation was done on the Apocynaceae family that is found growing all around the Kanyakumari District in Tamil Nadu, India. We gathered and identified a total of 17 species from 12 genera in the family Apocynaceae. On the basis of the morphological and floral characteristics of the current study, a classification of the Apocynaceae family has been suggested.

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