

Interspecific Morphological Variations within the Species *Adenium obesum* and *Nerium oleander*

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ABSTRACT

Adenium obesum (Forssk.) Roem. & Schult. and *Nerium oleander* L. is an ornamental plant, and it belongs to the family Apocynaceae. It produces a lot of flowers in the summer, but they can bloom throughout the year. In this study, we performed interspecific morphological characteristics of *Adenium obesum* and *Nerium oleander*. Research was conducted in Kanyakumari District, Tamil Nadu, India. *Adenium obesum* and *Nerium oleander* have lots of cultivars, but the present study we choose light pink color (3 whorls) cultivars in both species. The cultivars were selected based on similar color and number of whorls. From this study, interspecific morphological variations were observed among the species *Adenium obesum* and *Nerium oleander*. The color and quantity of floral whorls were the two most significant morphological similarities seen in both species. The results of the current investigation showed that the *Nerium oleander* has the largest leaves and the *Adenium obesum* has the smallest leaves. The species are distinguished based on both vegetative and floral morphological characteristics. It aims at utilizing the methods of classical as well as experimental taxonomy to resolve the systematic position and inter-relationship of the patterns of diversity exhibited by the species.

Keywords: *Adenium obesum*, Apocynaceae, Morphology, *Nerium oleander*, Ornamental Plants

INTRODUCTION

Morphology is the study of any visible expression in space, which is shape, size, structure, color, texture, etc. Plant morphology is useful in the visual identification of plants. A majority of taxonomic groups were recognized by the cardinal characters of floral morphology and leaf morphology. Morphological characters have long been used more often than anatomical and molecular characters because the morphological characters are easier to observe and more practical to use. Flower morphology is important marking characters in identification, it is the best explaining component in plant systematic researches and the key for creating phylogeny which broadens the understanding of evolution and other related organs.

Adenium obesum (Forssk.) Roem. & Schult. is an ornamental plant and it belongs to the family Apocynaceae, subfamily Apocynoideae and tribe Nerieae. *Adenium* latinized Arabic name, aden is used as the genus name. The specific epithet refers to the obese nature of the stem base. *Adenium obesum* is an evergreen or drought-deciduous succulent shrub or small tree that can reach heights of upto 10 feet (3 metres). It was commonly called "desert rose." It is widely known for its deep red flowers and swollen succulent stem. They are frequently used for bonsai and may be grown in a pot for many years. It produces a lot of flowers in the summer, but they can bloom throughout the year. In the colder months, they can shed their leaves.

In the modern world, it is widely cultivated in many humid and tropical nations with significant importance in the ornamental market and plays an important function as an attractive plant in dwellings, particularly in India. The flower resembles a rose but is not at all related to the other members of the rose family. The flowers of this species are tubular, and the color ranges from deep purple-red through pink and white. However, commercial cultivars have different colors, shapes, and sizes. *Adenium* varieties differ in flower color, petal doubleness, flowering duration, and branching habit compactness. Flowers may be single, double, or even triple.

Nerium oleander is an evergreen shrub or small tree, 2–5 m in height, it was cultivated worldwide as an ornamental plant. *Nerium oleander* is the only species currently classified in the genus *Nerium*. Genus name comes from the Greek word 'Neros' meaning moist, probably referring to its wild habitat. Species name comes from the Italian *oleandro* for its olive-like leaves. Oleander is found all over India, commonly seen in gardens and on road sides. It is valued for its abundant, fragrant flowers. The flowers are tubular with five lobes. It was very tolerant of heat and also of drought once they are established. The common varieties of oleander plant were white, yellow, pink and red flowers. Many cultivars are available with single or double flowers and in dwarf, medium and large plants.

Therefore, in the present research, we study the interspecific morphological variations within the species *Adenium obesum* and *Nerium oleander*. The samples were collected from different places of Kanyakumari district. In the present study, the species cultivars were selected on the basis of flower color and number of whorls.

Adenium obesum and *Nerium oleander* have lots of cultivars, but the present study we choose light pink color (3 whorls) cultivars in both species. The cultivars were selected based on similar color and number of whorls.

MATERIALS AND METHODS

The fresh specimens of *Adenium obesum* and *Nerium oleander* were collected from the different locations of Kanyakumari District, Tamil Nadu, India during the month of June to August 2022. Three (3) specimens of each species were used for morphological examinations. Morphological characters for all plant part were studied in the laboratory under dissecting microscope. The morphology of the specimen (leaves and floral parts) photographs were taken using Canon 550D professional Lens – 18 × 3.5 mm, Macro Lens – 20x magnification.

Following qualitative morphological traits were studied stem color, stem nature, latex color, leaf arrangement, leaf shape, leaf margin, leaf apex, leaf base. leaf color, leaf nature, venation type, petiole color, petiole nature, inflorescence type, peduncle, flower shape, flower color, pedicel color, pedicel nature, bract/bracteole, br/brl apex shape, br/brl color, br/brl nature, br/brl length, br/brl width, calyx, calyx aestivation, calyx apex shape, calyx color, calyx nature, corolla aestivation, corolla lobe shape, corolline corona, swollen corolla tube outer color, swollen corolla tube inner color, swollen corolla tube outer nature, swollen corolla tube inner nature, cylindrical corolla tube outer color, cylindrical corolla tube inner color, cylindrical corolla tube outer nature, cylindrical corolla tube inner nature, nectar guides color, androecium position, anther shape, anther color, anther nature, appendage color, filament, filament like hair color, stigma shape, stigma color, style color, ovary color, ovary nature, nectary, fruit type, fruit shape, fruit color, seed shape, seed color and coma color.

Quantitative morphological traits such as blade length, blade width, petiole length, petiole width, number of veins, br/brl length, br/brl width, flower length, flower width, pedicel length, pedicel width, sepal length, sepal width, corolla number of whorls, corolla length, corolla width, corolla tube full length, swollen corolla tube length, swollen corolla tube width, cylindrical corolla tube length, cylindrical corolla tube width, number of anthers, androecium length, anther length, anther width, appendage length, gynoecium length, stigma length, stigma width, style length, ovary length, ovary width, fruit length, fruit width, seed length, seed width, coma length, number of fruits and number of seeds.

Plate 1. Selected Species of the present study

Adenium obesum



Nerium oleander



RESULTS

The habit of both species are shown in Plate 1. The leaf of both species are shown in Plate 2. The bract and bracteole of both species are shown in Plate 3. The flower of both species are shown in Plate 4. The calyx of both species are shown in Plate 5. The corolla of both species are shown in Plate 6. The androecium of both species are shown in Plate 7. The gynoecium of both species are shown in Plate 8. The fruit of both species are shown in Plate 9. The seed of both species are shown in Plate 10.

Stem

Adenium obesum is a succulent shrub and *Nerium oleander* is a shrub or tree. Both species stem with latex, *Adenium obesum* have golden color latex and *Nerium oleander* have colorless latex.

Leaves

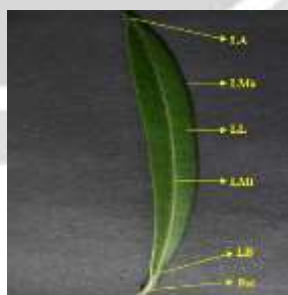
The leaf arrangement was alternate in *Adenium obesum* and whorled type in *Nerium oleander*. The shape of the leaves is linear to obovate in *Adenium obesum* and linear in *Nerium oleander*. The leaves are simple, entire, glabrous, leathery and dark green in both species. *Nerium oleander* has the largest leaves (11.7–14.5 × 1.6–2.3 cm) and *Adenium obesum* has the smallest leaves (6.2–10.4 × 1.8–3.9 cm). The petiole was glabrous in both species, it was light green in *Adenium obesum* and green in *Nerium oleander*. The leaves have the pinnate venation in both species. In *Adenium obesum* lateral veins are conspicuous only the adaxial surface of the leaves and inconspicuous in abaxial surface, but *Nerium oleander* lateral veins are conspicuous in both surface.

Plate 2. Leaves

Adenium obesum



Nerium oleander



Inflorescence

The inflorescence was corymb in *Adenium obesum* and terminal cyme in *Nerium oleander*. *Nerium oleander* have the peduncle, it was striate, light green color with red branches, glabrous, 11–18 cm length and 0.3–

0.4 cm width. The peduncle was absent in *Adenium obesum*. The bracteoles are present in *Adenium obesum* and bracts are present in *Nerium oleander*.

Plate 3. Bract and Bracteole
Adenium obesum Bracteole *Nerium oleander* Bract



Flowers

The flowers are bisexual, complete, actinomorphic, light pink color and 3 whorls in both species. It was trumpet shaped in *Adenium obesum* and salverform in *Nerium oleander*. *Adenium obesum* have the largest flower (8–9.9 × 7.1–9.7 cm) and *Nerium oleander* have the smallest flower (5.1–5.8 × 6.5–7.6 cm). The flower bud was conical shape and light pink in *Adenium obesum*, ovate shaped and pink color in *Nerium oleander*.

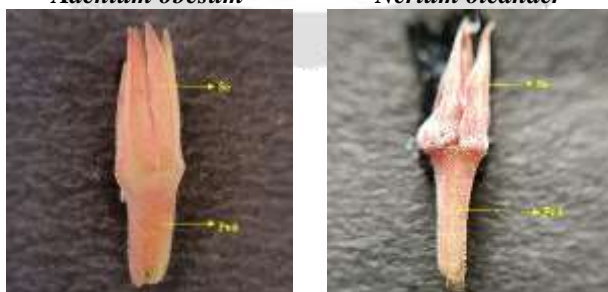
Plate 4. Flower
Adenium obesum *Nerium oleander*



Calyx

The calyx consists of five free sepals and has quincuncial aestivation in both species. The sepals are red, acute apex and pubescent in both species. Comparatively *Adenium obesum* have the largest sepals (1.1–1.3 × 0.3–0.5 cm) and *Nerium oleander* have the smallest sepals (0.4–0.6 × 0.2 cm).

Plate 5. Calyx
Adenium obesum *Nerium oleander*

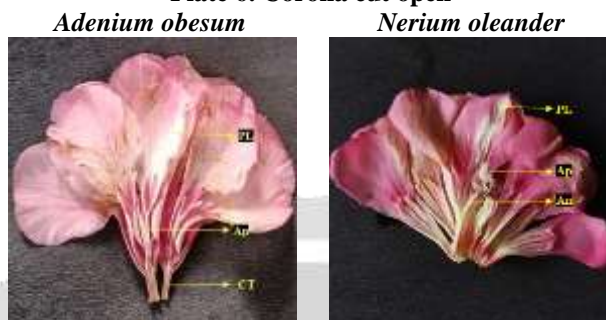


Corolla

The corolla consists of 3–4 whorls of petals in *Adenium obesum* and 2–3 whorls of petals in *Nerium oleander*. Each whorl of petals has 5 petal lobes in both species, it was opposite to each other in *Adenium obesum* and irregularly arranged in *Nerium oleander*. The lobes are cuspidate in *Adenium obesum*, but obtuse in *Nerium*

oleander. The corolla has twisted aestivation and overlapping to the right side (clockwise) in both species. The outer two whorls of petals are sympetalous and inner whorl of petals are polypetalous in *Adenium obesum*, but outer two whorls are polypetalous and inner whorl was sympetalous in *Nerium oleander*. The three whorls are joined at the throat of the cylindrical corolla tube in both species. In *Adenium obesum* each whorl of corolla lobes is almost similar size, but *Nerium oleander* inner whorl of the corolla lobes are larger than the other whorls.

Plate 6. Corolla cut open



Adenium obesum have both swollen and cylindrical corolla tubes, but *Nerium oleander* only have the cylindrical corolla tube. The cylindrical corolla tube outer was light pink in both species, but interior was light pink in *Adenium obesum*, white and pink in *Nerium oleander*. It interior was glabrous in both species, but outer was pubescent in *Adenium obesum* and glabrous on *Nerium oleander*. *Nerium oleander* has the largest cylindrical corolla tube (0.8–1.9 × 0.4–0.7 cm) and *Adenium obesum* have the smallest cylindrical corolla tube (0.9–1.2 × 0.3–0.4 cm).

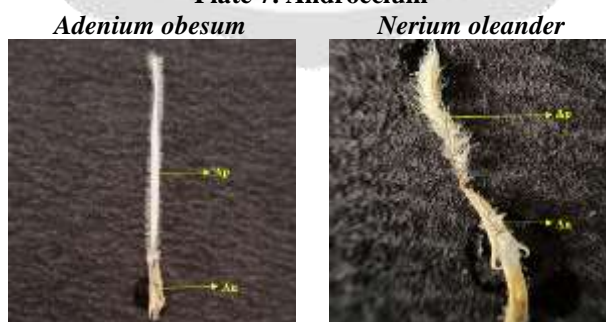
At the throat of the corolla tube coralline corona was present only the *Nerium oleander*, it was pink color and 0.5–0.9 cm length. The nectar guides are absent in *Adenium obesum* and present in *Nerium oleander*.

Androecium

The androecium consists of 5 anthers in *Nerium oleander*, but *Adenium obesum* 1–5 anthers and some flowers doesn't have any anthers, it has extra whorl of petals. The androecium situated near the base of the swollen corolla tube in *Adenium obesum* and just below the corolla tube base in *Nerium oleander*. The anthers form a cone and cover the stigma in both species. The anther was sagittate and pubescent in both species. It was pinkish white in *Adenium obesum* and white in *Nerium oleander*. *Adenium obesum* was recorded longest anthers (0.5–0.7 cm) and *Nerium oleander* was recorded shortest anthers (0.4–0.5 cm).

In both species, filament is absent, anthers are directly fixed to the corolla tube but base of the each anther has filament like hairs. It was pink color in *Adenium obesum* and white color in *Nerium oleander*. Each anther has long and hairy apical appendages, it was twirled to each other in *Nerium oleander* and free in *Adenium obesum*, it was pinkish white color in *Adenium obesum* and white in *Nerium oleander*. The longest appendage was recorded in *Adenium obesum* (1.1–1.9 cm) and shortest was recorded in *Nerium oleander* (0.8–1.2 cm).

Plate 7. Androecium

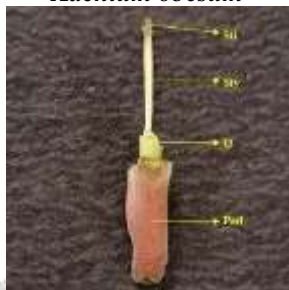
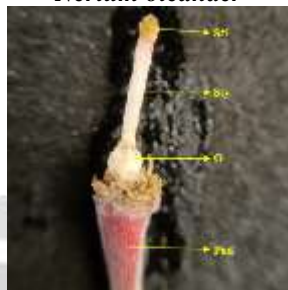


Gynoecium

The gynoecium consists of 2 free carpels but united by the style. The stigma was drum shaped in both species. It was light green in *Adenium obesum* and light yellow in *Nerium oleander*. The style was slender, light

green and white in *Adenium obesum*, white in *Nerium oleander*. The longest style was recorded by *Adenium obesum* (0.8–1.3 cm) and shortest was recorded by *Nerium oleander* (0.7–1.1 cm). The ovary was superior, light green in *Adenium obesum* and light yellow in *Nerium oleander*. It was glabrous in *Adenium obesum* and pubescent in *Nerium oleander*.

Plate 8. Gynoecium

Adenium obesum*Nerium oleander*

Fruit

The fruit was follicle in both species, it was linear to oblong in *Adenium obesum* and linear in *Nerium oleander*. Which split along one side to release the fluffy seeds. It was red color in both species. *Nerium oleander* was recorded largest fruit (18–19 × 1–1.2 cm) and *Nerium oleander* was recorded smallest fruit (12.5–13 × 0.8–1.1 cm).

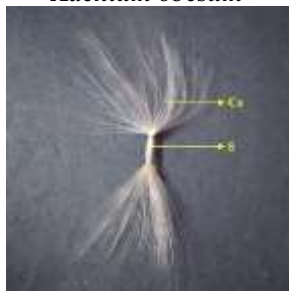
Plate 9. Fruit

Adenium obesum*Nerium oleander*

Seed

The seeds are cylindrical shape in both species. It has tufts of long hairs at both ends in *Adenium obesum* and plume of hairs at one end in *Nerium oleander*. Which help to the dispersion by wind. The longest seed was recorded in *Adenium obesum* (0.8–1.1 × 0.2–0.3 cm) and smallest seed was recorded in *Nerium oleander* (0.5–0.7 × 0.1 cm). An average of each fruit contains 50–55 seeds in *Adenium obesum* and 100–120 seeds in *Nerium oleander*. The seeds are glabrous in *Adenium obesum* and pubescent in *Nerium oleander*.

Plate 10. Seed

Adenium obesum*Nerium oleander*

Qualitative Morphological Traits for *Adenium obesum* and *Nerium oleander*

Morphological Traits	<i>Adenium obesum</i>	<i>Nerium oleander</i>
Stem Color	Greenish Grey	Brown
Stem Nature	Glabrous	Glabrous
Latex Color	Golden	Colorless
Leaf Arrangement	Alternate	Whorled
Leaf Shape	Linear to Obovate	Linear
Leaf Margin	Entire	Entire
Leaf Apex	Cuspidate	Acute
Leaf Base	Cuneate	Acute
Leaf Color	Dark Green	Dark Green
Leaf Nature	Glabrous	Glabrous
Venation Type	Pinnate	Pinnate
Petiole Color	Light Green	Green
Petiole Nature	Glabrous	Glabrous
Inflorescence Type	Corymb	Terminal Cyme
Peduncle	Absent	Present
Flower Shape	Trumpet	Salverform
Flower Color	Light Pink	Light Pink
Pedicel Color	Light Pink	Greenish Red
Pedicel Nature	Pubescent	Pubescent
Bract/Bracteole	Bracteole	Bract
Br/Brl Apex Shape	Acute	Acute
Br/Brl Color	Red and Green	Light Green
Br/Brl Nature	Pubescent	Pubescent
Br/Brl Length	0.6–0.9	0.6–0.7
Br/Brl Width	0.2–0.3	0.1–0.2
Calyx	Polysepalous	Polysepalous
Calyx Aestivation	Quincuncial	Quincuncial
Calyx Apex Shape	Acute	Acute
Calyx Color	Red or Light Green	Red
Calyx Nature	Pubescent	Pubescent
Corolla Aestivation	Twisted	Twisted
Corolla Lobe Shape	Cuspidate	Obtuse
Corolline corona	Absent	Present
Swollen Corolla Tube Outer Color	Light Pink	Absent
Swollen Corolla Tube Inner Color	Dark Pink and Violet	Absent
Swollen Corolla Tube Outer Nature	Pubescent	Absent
Swollen Corolla Tube Inner Nature	Pubescent	Absent
Cylindrical Corolla Tube Outer Color	Light Pink	Light Pink
Cylindrical Corolla Tube Inner Color	Light Pink	White and Pink
Cylindrical Corolla Tube Outer Nature	Pubescent	Glabrous
Cylindrical Corolla Tube Inner Nature	Glabrous	Glabrous
Nectar Guides Color	Absent	Red
Androecium Position	Base of the Swollen Corolla Tube	Just Above The Corolla Tube Base
Anther Shape	Sagittate	Sagittate
Anther Color	Pinkish White	White
Anther Nature	Pubescent	Pubescent
Appendage Color	Pinkish White	White
Filament	Absent	Absent
Filament Like Hair Color	Light Pink	White
Stigma Shape	Dumb-bell	Dumb-bell

Stigma Color	Light Green	Light Yellow
Style Color	Light Green	White
Ovary Color	Light Green	Light Yellow
Ovary Nature	Glabrous	Pubescent
Nectary	Absent	Absent
Fruit Type	Follicle	Follicle
Fruit Shape	Linear to oblong	Linear
Fruit Color	Red	Red
Seed Shape	Cylindrical	Cylindrical
Seed Color	Yellowish Brown	Light Brown
Coma Color	Light Brown	Light Brown

Br: Bract; Brl: Bracteole

Quantitative Morphological Traits for *Adenium obesum* and *Nerium oleander*

Quantitative Traits	<i>Adenium obesum</i>	<i>Nerium oleander</i>
Blade Length	6.1–10.2	11.1–13.8
Blade Width	1.8–3.9	1.6–2.3
Petiole Length	0.1–0.2	0.6–0.7
Petiole Width	0.2–0.3	0.2–0.3
Number of Veins	9–12	111–138
Br/Brl Length	0.6–0.9	0.6–0.7
Br/Brl Width	0.2–0.3	0.1–0.2
Flower Length	8–9.9	5.1–5.8
Flower Width	7.1–9.7	6.5–7.6
Pedicle Length	0.9–1.4	0.8–1
Pedicle Width	0.3	0.1–0.2
Sepal Length	1.1–1.3	0.4–0.6
Sepal Width	0.3–0.5	0.2
Corolla Number of Whorls	3–4	2–3
Corolla Length	7–8.8	4.2–4.8
Corolla Width	7.1–9.7	6.5–7.6
Corolla Tube Full Length	3.3–4	0.8–1.9
Cylindrical Corolla Tube Length	0.9–1.2	0.8–1.9
Cylindrical Corolla Tube Width	0.3–0.4	0.4–0.7
Number of Anthers	1–5	5
Androecium Length	1.7–2.6	1.2–1.7
Anther Length	0.5–0.7	0.4–0.5
Anther Width	0.1	0.1
Appendage Length	1.1–1.9	0.8–1.2
Gynoecium Length	1.1–1.6	1–1.4
Stigma Length	0.1–0.2	0.1
Stigma Width	0.1	0.1
Style Length	0.8–1.3	0.7–1.1
Ovary Length	0.2–0.3	0.1–0.2
Ovary Width	0.1–0.2	0.1–0.2
Fruit Length	12.5–13	18–10
Fruit Width	0.8–1.1	1–1.2
Seed Length	0.8–1.1	0.5–0.7
Seed Width	0.2–0.3	0.1
Coma Length	4.3–4.5	1–2.3
Number of Fruits	2	2
Number of Seeds	50–55	100–120

Note: Length and width were measured in centimeter.

Similarities

The similarities between the species are leaf nature, margin, venation type, flower shape, calyx apex shape, calyx aestivation, polysepalous, corolla aestivation, sympetalous, corolla overlapping position, anther shape, anther nature, apical appendage, filament absent, filament like hairs, stigma shape, superior ovary, fruit type, fruit shape and seed shape.

Dissimilarities

The contrast features of the species are latex color, leaf arrangement, inflorescence type, flower bud shape, corolline corona, nectar guides, androecium position, anther color, appendage type, ovary nature.

DISCUSSION

In this research, the morphological characteristics of *Adenium obesum* and *Nerium oleander* studied showed a significant morphological difference. In a remark similar to the one made in the present study, Dimmitt *et al.* (2009) observed that the stigma of *Adenium obesum* is hidden inside the cone formed by the anthers. *Adenium obesum* cultivars leaf and flower lengths were researched by Hastuti *et al.* (2009) for 6 cultivars, while this study focused on the morphology of 7 cultivars. *Adenium obesum* fruit and seed morphology was investigated by Colombo *et al.* (2015). According to Colombo *et al.* (2018), *Adenium obesum* fruit length varied from 15.1–25.1 cm, which was comparable, while the fruits breadth was 11.1–15.5 cm, which was different from the current study.

CONCLUSION

From this study, interspecific morphological variations were observed among the species *Adenium obesum* and *Nerium oleander*. The similarities between the species are leaf venation type, flower shape, calyx aestivation, corolla aestivation, sympetalous, corolla overlapping position, anther shape, apical appendage, filament absent, filament like hairs, stigma shape, superior ovary and fruit shape. The color and quantity of floral whorls were the two most significant morphological similarities seen in both species. The species are distinguished based on both vegetative and floral morphological characteristics.

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