IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 8 Issue 5, May 2021
ISSN (Online) 2348 – 7968 | Impact Factor (2020) – 6.72
www.ijiset.com

Morphological Characterization Of Leaf And Flower Traits Of The *Plumeria* Species In Kanyakumari District, Tamil Nadu, India

Rejitha. S[1], Uma Devi. S[2] AND Johnsi Christobel. G[1]

[1]Ph. D Research Scholar, Reg. No. 19213112262049, Department of Botany, Nesamony Memorial Christian College, Marthandam, Affiliated to Manonmanium Sundaranar University Abishekapatti, Tirunelveli- 627012, Tamil Nadu, India. E-mail: rejithastalin14@gmail.com

[2]Asst. Prof. Department of Botany, Sree Ayyappa College for Women, Nagercoil, Affiliated to Manonmanium Sundaranar University Abishekapatti, Tirunelveli- 627012, Tamil Nadu, India. E-mail: umapradeep80@gmail.com

[1]Asst. Prof and Head, Department of Botany, Nesamony Memorial Christian College, Marthandam, Affiliated to Manonmanium Sundaranar University Abishekapatti, Tirunelveli- 627012, Tamil Nadu, India.

ABSTRACT

To study the morphological variation of leaf and flower traits in *Plumeria obtusa, Plumeria pudica, Plumeria rubra I X p subsessilis* and *Plumeria rubra.* It belongs to the Family Apocynaceae (Oleander family). The present paper highlights the leaf and floral traits (Quantitative and Qualitative) of four *Plumeria* species. In the present study the four *Plumeria* species have some similar morphological leaf traits such as spiral arrangement of leaves, presence of white milky latex, long petiole, exstipulate, and smooth leaf surface. Flowers of four species studied here showed a large color variation in the different parts. Petal color is the most attractive aspect of differentiation of *Plumeria* species, varying from white and yellow in *P. obtusa* and *P. pudica* to pink and yellow in *P. rubra subsessilis* and *P. rubra*. Stamens were longer in *P. obtusa* (0.4 cm) than in other species (0.3 cm). These findings are valuable in botanical identification of plant species.

Keywords: Apocynaceae, floral traits, leaf traits, *Plumeria*.

INTRODUCTION

Genus *Plumeria* belongs to the Family Apocynaceae and is native to the new world. The plants from this genus are widely cultivated in the tropical and subtropical regions throughout the world. *Plumeria* L. is indigenous to tropical America and is found from Southern Mexico to Northern South America and also most abundant in India. *Plumeria* species are characterized by the presence of tissues containing laticifers and sap (usually milky) and radially symmetrical

flowers with five connate petals and connivent stamens forming a ring that encloses the stylar head. The fruit consists of two terete follicles or berries (Judd et al., 2002). However, due to its ease of propagation through cuttings, many species and hybrids of *Plumeria* are now widely cultivated and distributed in the warmer regions of the world. They are recognized as excellent ornamental plants and often seen in the graveyards. *Plumeria* plants are famous for their attractiveness and fragrant flowers. Ornamental plants are grown usually for the purpose of beauty, for their fascinating foliage, flowers and their pleasant smell. They plays an important role in environmental planning of urban and rural areas for abatement of pollution, social and rural forestry, wasteland development, aforestation and landscaping of outdoor and indoor spaces (Kapoor and Sharga, 1993).

Gardening is the resource management activities employed by the people of Kanyakumari district who are well acquainted with the importance of the plants growing in their surroundings (Kingston et al., 2006). While studying the taxonomy of *Plumeria* in Kanyakumari District, India, it has been found that the some of the floral characters have greater taxonomic significance. These floral characters along with other vegetative characters can be used in distinguishing the *Plumeria* species. Morphological characters are the outer appearance of plants. These characters provide characteristics which can easily be used for identification or supposition of the phylogenic relationship. 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. Morphology is considered to be old fashioned but it is still the basis for the solution of taxonomical problems.

According to World Health Organization (WHO) the macroscopic and microscopic description of a medicinal plant is the first step towards establishing its identity and purity and should be carried out before any tests are undertaken. Although studies conducted on morphology of the plants have proved valuable in the identification of the plants, some morphological characters of the *Plumeria* species were already reported elsewhere, present work re-investigate some of them and reported different other necessary parameters of leaves and flowers.

Proper recording of the morphological characters helps in easy identification and distinction of ornamental shrub species as well as utilization in the suitable designs. The study is planned to characterize four ornamental plants of the *Plumeria* genus based on the qualitative as well as quantitative characters.

MATERIALS AND METHODS

Study Area

In the present study, 4 taxa of *Plumeria* were collected from different localities of Kanyakumari District, Tamil Nadu, India (Table 1). Kanyakumari District was the Southernmost tip of Indian Peninsula. The Northern and Western part of the district are hilly tracts and forests. In the South-Eastern and middle parts, the districts have agricultural and traditionally, known as the Nanjil Nadu (the Land of Plough). The Southern border of the district has a long sea-shore. Location of the Kanyakumari District is bounded between $77^{o}05^{l}$ and $77^{o}35^{l}$ of the Eastern longitude and $8^{o}05^{l}$ and $8^{o}35^{l}$ of the Northern latitude. The soil is red, varying in the quantity of ferruginous element. The climate of the District is warm and humid. The mean annual rainfall was 167.64 mm and varied from 70 mm (minimum during February) to 442 mm (maximum - October).

Collection and Authentication of Plant Material

The fresh leaves and flowers of *Plumeria obtusa, Plumeria pudica, Plumeria rubra I X p subsessilis* and *Plumeria rubra* were collected from the different locations of Kanyakumari District, Tamil Nadu, India during the month of January – March 2020. The species were identified by Dr. R. Raj Vikraman, Senior Scientist and Head, Division of Garden Management Education Extension and Training, JNTBGRI, Kerala. In the study, the plant species recorded have been arranged alphabetically for each species the binomial name is followed by the common name, life-forms, propagation, native, flowering and fruiting periods are recorded (Table 1). Photographs were taken in the appropriate periods while visiting the gardens. A brief description of the plant was also recorded in the field. Well-preserved specimens with voucher numbers were deposited in the Herbarium in the Department of Botany and Research Centre, Nesamony Memorial Christian College, Marthandam, Tamil Nadu, India.

Leaf data

Shoots of two plants per species were collected and used for leaf data collection. From those shoots, 5 healthy mature and fresh leaves were used to measure the traits of each species. On each leaf 15 traits were measured and calculated. For each leaf the petiole length, petiole diameter, blade length and blade width were measured with a common ruler. Following this qualitative morphological leaf traits such as leaf arrangement, petiole, latex, pubescence, petiole color, blade color, leaf surface, leaf shape, leaf margin, leaf apex and venation were studied. Apart from this quantitative leaf traits such as petiole length, petiole width, blade length, blade width and number of veins were also studied. The qualitative and quantitative traits of leaves of *Plumeria* species were defined in Table 2.

Flower data

As regards the duration of the flowering period, ten recently opened flowers of each species were randomly collected and measured the flower traits of each species. On each flower 21 traits were measured and calculated. Flower length, calyx length, corolla length, androecium length and gynoecium length were measured with a common ruler for each flower. Following qualitative morphological flower traits were studied flower color, pedicel color, flower bud color, calyx color, corolla color, androecium color and gynoecium color. Quantitative flower traits such as flower length, pedicel length, androecium length and gynoecium length were also studied. The qualitative and quantitative traits of flowers of *Plumeria* species were defined in Table 2.

RESULTS

Leaf traits

The results obtained for all measurements in the leaf and flower are showed in Table 3. Scored morphological traits of leaves included 11 quantitative and 4 qualitative ones. Morphological analysis carried out with quantitative leaf traits indicated significant differences between each of the four taxa analyzed. The quantitative traits such as petiole length and blade length showed large variation among the studied species. It has found that petiole length and width of *P. rubra* (4.4, 0.4) is higher than the other species (Table 3). PeL ranged between 1.1 cm (*P. pudica*) and 4.4 cm (*P. obtusa* and *P. rubra*). *P. rubra subsessilis* presented the highest blade length (28. 5 cm), whereas the lowest blade length was found in *P. obtusa* and *P. rubra.*

The leaves are used as a taxonomic tool for the identification of plant species. Hence on the basis of morphological features of leaves the plant species of *Plumeria obtusa*, *Plumeria pudica*, *P. rubra subsessilis* and *P. rubra* are compared and identified. Entire margin is present in *P. obtusa, P. rubra subsessilis* and *P. rubra* whereas *P. pudica* shows wavy margin. The shape is oblong with distinct apex in *P. obtusa* and spoon shaped having acute apex in *P. pudica* (Fig B. 1-8). *P. rubra subsessilis* and *P. rubra* leaves are elliptic in shape, they did not have any differences in leaf shape, but *P. rubra subsessilis* leaves are much larger than *P. rubra*.

Analysis of comparison between the leaf traits of four *Plumeria* species shows that there is difference in morphological characters such as leaf color, leaf margin, leaf shape and leaf apex. In *P. obtusa* and *P. rubra subsessilis* the leaf color is dark green, where as in *P. pudica* and *P. rubra* shows green colored leaves. Certain characteristics like spiral arrangement of leaves on stem, long petiole and exstipulate traits are common in all the species (Fig A. 1-4). Presence of white milky latex was observed while plucking leaves and flowers in all the 4 species (Table 3).

The four species therefore shared common attributes as revealed in the leaf morphology. The similarity of the four *Plumeria* species was simple leaf type, whorled leaf arrangement, smooth leaf surfaces and green to dark green leaf colors.

Flower traits

The results obtained for all the measurements in flower morphological traits reported 13 quantitative and 8 qualitative ones (Table 3). Morphological analysis carried out with quantitative flower traits indicated significant differences between each of the four taxa analyzed.

Flowers of four species studied here showed a large variation in color of different parts. Petal color is the most attractive aspect of differentiation of *Plumeria* species, varying from white and yellow (*P. obtusa* and *P. pudica*) to pink and yellow in *P. rubra subsessilis and P. rubra*. Stamens were longer in *P. obtusa* (0.4 cm) than other species (0.3 cm) (Fig C. 1-28).

The four species therefore shared common attributes as revealed in the floral morphology. Similar floral attributes include; complete flowers with a large pedicel and cymose flower type. The flowers are usually bisexual, actinomorphic and hypogynous. The calyx was

usually synsepalous. The corolla is sympetalous with 5 convolute petals, twisted aestivation. The sepals are smaller than the petals, which are twisted aestivation (Fig. C. 1-8). The androecium is composed of 5 stamens, epipetalous, apostemonous, monadelphous. The gynoecium is syncarpous, often only apically (with ovaries) distinct, with a superior, rarely half-inferior ovary, 2 carpels, and 1-2 locules. The stigma is capitate or lobed.

Table 1 Description of the *Plumeria* species

Sl. No.	Botanical Name	Common Name	Habit	Propagation	Native	Flowering & Fruiting
1.	*Plumeria obtusa* L.	White Frangipani	Tree	Vegetative	America and India	July - August
2.	*Plumeria pudica* Jacq.	Bridal Bouquet	Shrub	Vegetative	Panama and Colombia	Throughout the year
3.	*Plumeria rubra I X p subsessilis* A. DC.	Frangipani	Tree	Seed and Vegetative	Pacific Islands and Mexico	Throughout the year
4.	*Plumeria rubra* L.	Frangipani	Tree	Seed and Vegetative	Pakistan	January - June

Table 2 List of Morphological Traits and Abbreviations Used

Organ	Morphological Trait	Abbreviation
	Quantitative characters	
LEAF	Leaf Arrangement	LA
	Petiole	P
	Petiole Color	PeC
	Latex	L
	Pubescence	Pub
	Blade Color	BC
	Leaf Surface	LS
	Leaf Shape	LSh
	Leaf Margin	LM

	Leaf Apex	LA
	Venation	V
	Qualitative Characters	
	Petiole Length	PeL
	Petiole Diameter	PeD
	Blade Length	BL
	Number of Veins	NV
	Quantitative characters	
FLOWER	Flower Color	FC
	Pedicel Color	PC
	Flower Bud Color	FBC
	Sepal Color	SC
	Corolla Color	CC
	Corolla Tube Color	CTC
	Androecium Color	AdC
	Anther Color	AC
	Filament Color	FiC
	Gynoecium Color	GC
	Stigma Color	StiC
	Style Color	StyC
	Ovary Color	OC
	Qualitative Characters	
	Flower Length	FL
	Flower Bud Length	FBL
	Pedicel Length	PL
	Sepal Length	SeL
	Corolla Length	CL
	Corolla Tube Length	CTL
	Androecium Length	AL
	Gynoecium Length	GL

Table 3 Morphological traits among *Plumeria* species: Quantitative traits and Qualitative traits

Variable set	Trait	*Plumeria obtusa* L.	*Plumeria pudica* Jacq.	*Plumeria rubra I X p subsessilis* A. DC.	*Plumeria rubra* L.
	Quantitative characters				
LEAF	LA	Spiral	Spiral	Spiral	Spiral
	P	Petiolate	Petiolate	Petiolate	Petiolate
	PeC	Light Green	Light Green	Light Green	Light Green
	L	White milky	White milky	White milky	White milky
	Pub	A	A	A	A
	BC	Dark Green	Green	Dark Green	Green
	LS	Smooth	Smooth	Smooth	Smooth
	LSh	Oblong	Spoon Shape	Elliptical	Elliptical
	LM	Entire	Wavy	Entire	Entire
	LA	Distinct tip	Acute	Acute	Acute
	V	Reticulate venation	Reticulate venation	Pinnate venation	Pinnate venation
	Qualitative Characters				
	PeL	4.4	1.1	4.2	4.4
	PeD	0.3	0.1	0.2	0.4
	BL	14.3	25.1	28.5	14.3
	NV	25	38	30	33
	Quantitative characters				
FLOWER	FC	White	White	Pink	Pink
	PC	Green	Yellowish-white	Pink	Pink
	FBC	White and Green	White	Pink and White	Pink
	SC	Green	Greenish	Green and Pink	Pink

			white		
	CC	White and yellow	White and yellow	Pink, White and yellow	Dark pink and yellow
	CTC	White	White	Whitish pink	Pink
	AdC	Yellow	Yellowish white	White	White
	AC	Yellow	Yellowish white	White	White
	FiC	Yellow	Yellowish white	White	Light yellow
	GC	Green	Green	White	Green and white
	StiC	Green	Green	White	Green
	StyC	Green	Green	White	Green
	OC	Green	Green	White	Green
	Qualitative Characters				
	FL	8.9	7.2	6.9	6.3
	FBL	7.6	6.1	5.2	5.2
	PL	1.2	1.5	1.7	2.1
	SeL	0.3	0.3	0.1	0.4
	CL	6.1	4.3	4	4
	CTL	2.5	2.6	1.6	1.3
	AL	0.4	0.3	0.3	0.3
	GL	0.3	0.3	0.6	0.4

Taxonomic Description of the *Plumeria* Species

1. *Plumeria obtusa* L.

Synonyms : *Plumeria apiculata* Urb.; *Plumeria bicolor* Seem.

P. obtusa is a small tree growing up to 5-10m tall. Branches are thick, succulent, widely spaced and covered with knobby protuberances. Stems leaves and flowers have the milky sap.

The leaf is spirally arranged. Long petiole and the maximum length of the petiole measured is 4.4 cm. The leaf is dark green in color with an average thickness of 0.36 mm. The leaf surface of the *Plumeria obtusa* is smooth and the margin is entire with reticulate venation. The apex of leaf shows distinct tip and acute base. Leaves are leathery, obovate to oblong, up to 14.3 cm long. Flowers are white, five-lobed, with a yellow center, borne in clusters at the end of the branches. The flowers are in bouquet-like clusters of 5 white petals, a yellow center and spreading lobes. Each of the sepals and anthers are five in number.

2. *Plumeria pudica* Jacq.

Synonyms : *Plumeria caracasana* J.R.Johnst.; *Plumeria cochleata* S.F.Blake

P. pudica is a shrub which usually has one or two slender trunks that branch close to the ground forming a dense slightly spreading crown. The leaf arrangement on the stem is spiral. Leaves are green and unique fiddle-shaped or spoon-shaped. The leaf surface is wavy with reticulate venation. The petiole is short and maximum length of the petiole is measured as 1.1 cm. Presence of white milky latex is observed while plucking leaves and flowers. Its flowers are white with yellow center. It can be grown easily and bloom heavily for a long time. Flowers are salverform, white, 5 overlapping petals with yellow throat up to 3½ inches across, and arranged on terminal cymes.

3. *Plumeria rubra I X p subsessilis* A. DC.

Synonyms : *Plumeria stenopetala* var. *angustissima* Urb.

Frangipani is a large tree. It is widely spaced thick succulent branches are round or pointed, and have long leather, fleshy leaves in clusters near the branch tips. Leaves tend to fall in early winter since they are deciduous and sensitive to cold. Leaves are simple, dark green, 28-30 cm long. It has very fragrant flowers. Calyx is green, pedicel pink color. Corolla has 3 colors mixed, whitish pink and white with yellow centers. The petals are large and strongly overlapping, giving the impression of a flower in the process of unfolding.

4. *Plumeria rubra* L.

Synonyms : *Plumeria acuminata* W.T.Aiton; *Plumeria jamesonii* Hook.

P. rubra is a small tree, 3 to 7 m high, with a crooked trunk, smooth and shining stems, succulent, with abundant sticky, milky latex. Leaves are crowded at the terminal end of the

branch, commonly oblong in shape, 14 to 20 cm long, spirally arranged at the ends of the branches. Leaves tend to fall in early winter since they are deciduous and sensitive to cold. The inflorescence is cymose, terminal or axillary, with bracteoles. Flowers are numerous, fragrant and large, the upper portion pink, while the inner lower portion yellow, 5 to 6 cm long. Seeds are numerous and winged. Flowers white with yellow centre, in terminal peduncled cymes. Calyx small, glandular, lobes short, rounded. Corolla is salver-shaped and lobes oval-obovate. The stamens are inserted on the inside of the corolla tube. Fruits are linear-oblong or ellipsoid follicles, with a pointed tip, 15 to 20 cm long and 1.5 to 2 cm in diameters.

Figure A. Habit of the *Plumeria* species

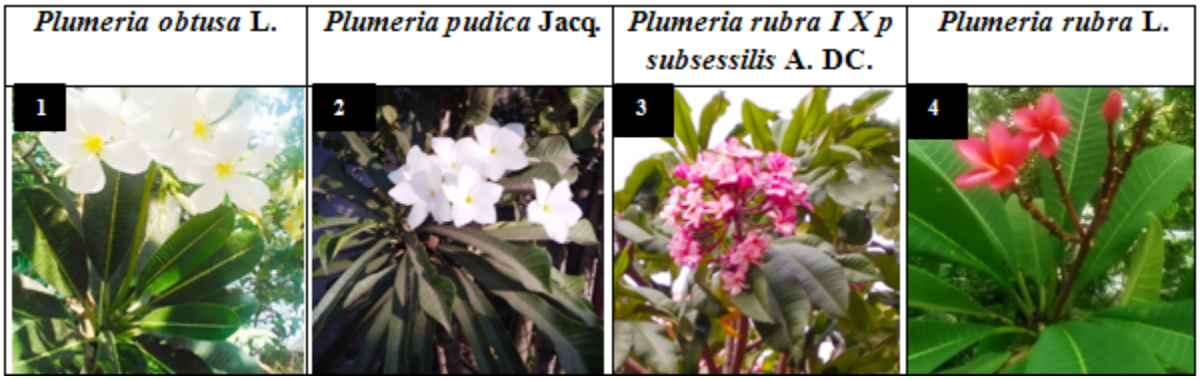


Figure B. Leaf of *Plumeria* species (Dorsal view)

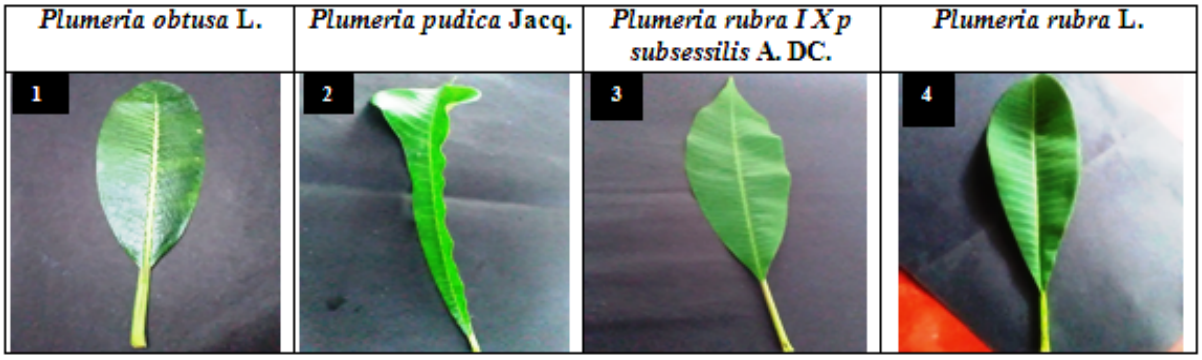
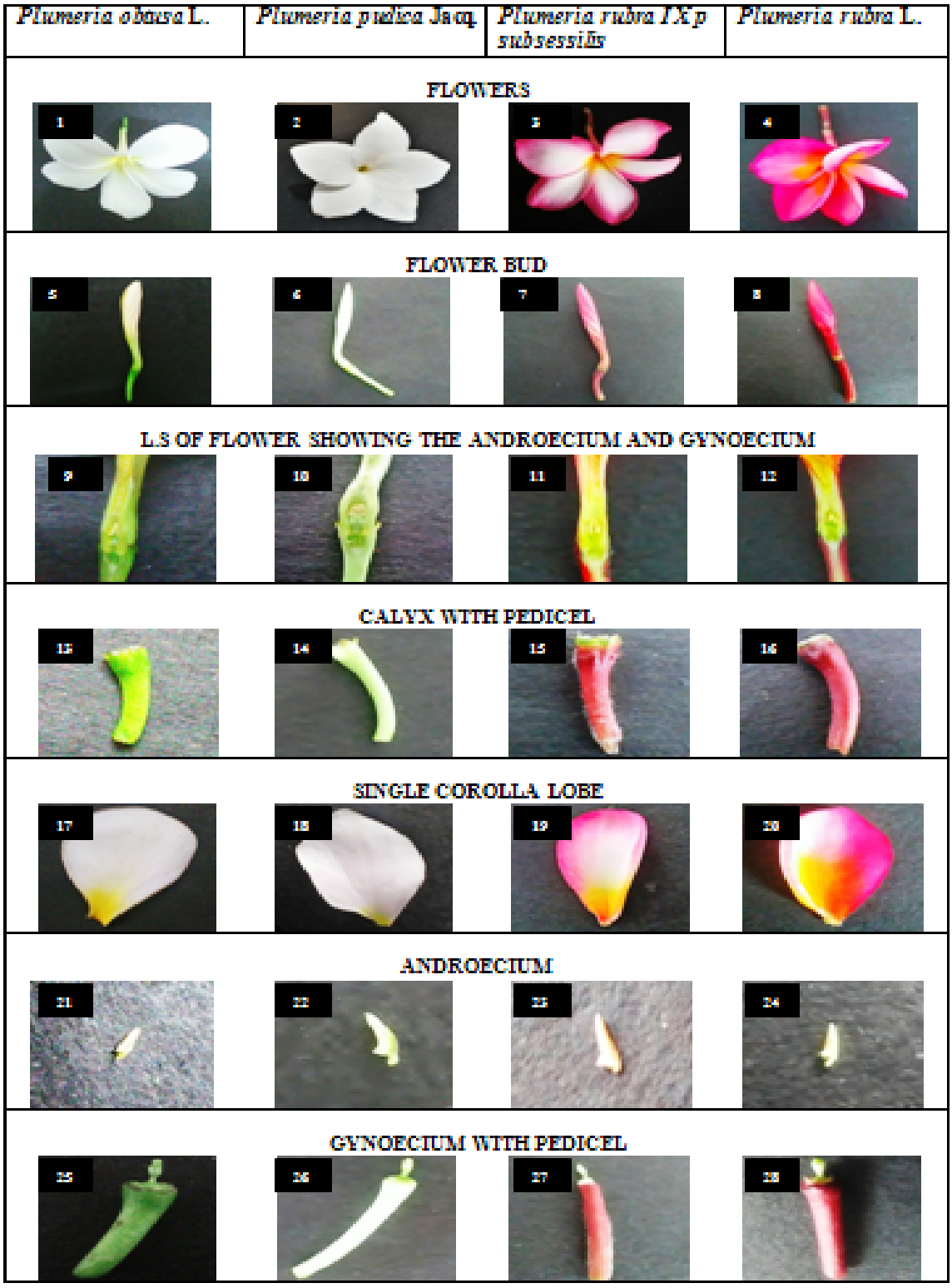


Figure C. The photographs showing the Floral morphology of the four *Plumeria* species



DISCUSSION

The characteristic features of leaf and floral traits of the four *Plumeria* species are summarized in Tables 1 and 3. The outcome of this investigation showed strong intervariant relationship among the investigated species. In *P. obtusa* observed corolla length was 6.1 cm but Kamran et al (2020) reported 4.1 cm length of petals in Multan.

The present study showed that the leaf length of *P. obtusa* was 14.3 cm and a similar report was given by Singh et al., 2019. Edward et al., 1994 reported *P. rubra* consists of alternate type of leaf arrangement but the present investigation showed the leaves are spirally arranged.

CONCLUSION

Based on these findings, species of *Plumeria* can be readily distinguished from one another as certain features are considered diagnostic. The overlapping similarities as well as distinguishing characteristics are observed among the species.

ACKNOWLEDGEMENT

The authors wish to thank Manonmanium Sundaranar University, Abishekapatti, Tirunelveli 627 012, Tamil Nadu, India.

REFERENCES

1. Judd WS, Campbell CS, Kellogg EA, Stevens PF, Donoghue MJ. Plant systematics: a phylogenetic approach, 2nd edn. Sunderland: Sinauer Associates. 2002.
2. Kapoor SL, Sharga AN. House plants. Vatika Prakashnan, India. 1993.
3. Kingston C, Mishra BP, Nisha BS, Jeeva S, Livingstone C, Laloo RC. Diversity and distribution of economically important plants in traditional homegardens of Kanyakumari district, Tamilnadu, Southern Peninsular India. Journal of Nature Conservation. 2006; 18: 41-54.
4. Kamran RM, Hafiz Abdul Khaliq, Muhammad Uzair. Parmacognostic and phytochemical studies on *Plumeria obtusa* L. JPHYTO. 2020; 9(2): 120-124.
5. Singh R, Kuldeep Vinchurkar, Surekha Dhokhane, Dinesh Mishra. Parmacognostical and phytochemical Evaluation of *Plumeria obtusa* (Linn.) Leaves. Pramana Research Journal. 2019; 9(8): 198-206.
6. Edward F, Gilman, Dennis G Watson. *Plumeria rubra* Frangipani. Fact sheet University of Florida. 1994; 1-4.