ComparisonStudy on Apopetalous and Sympetalous Flowering Plants in Mawlamyine University Campus

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Abstract

The present study deals with the comparison of morphological characters on apopetalous and sympetalous flowering plants in MawlamyineUniversity Campus, which is situated in Mawlamyine Township, Mon State. A total of 17 species belong to 7 genera under7 families of apopetalous and sympetalous flowering plants were collected, preserved and identified from July, 2017 to January, 2018. The detailed morphological characters of the habits, leaves, inflorescences, flowers, calyx, corolla, stamens, ovaries, fruit and seeds had been studied and compared. In preset research, the total of 17 species under the class angiospermopsida (angiosperms) were systematically arranged according to Angiosperm Phylogeny Group (APG) IV system. The characteristics of families and the morphological characters of genera and species were presented. An artificial key to the studied species was also constructed. The species were recorded by photographs.

Keywords: apopetalous, sympetalous and flowering plants.

INTRODUCTION

Taxonomy is a science that includes identification, nomenclature and classification of objects, and is usually restricted to objects of biological origin; when limited to plants, it is often referred to as systematic botany. Identification is the determination of a taxon as being identical with or similar to another and already known element; the determination may or may not be arrived at by the aid of literature or by comparison with plants of known identify. Nomenclature is concerned with the determination of the correct name of a known plant according to a nomenclatural system. Once the plant has been identified it becomes necessary that it have a scientific name (Lawrence, 1964).

Myanmar is exceptionally rich in plant biodiversity. About 7,000 species are included in the checklist of Myanmar by Hundley and Chit KoKo (1987). Recently, Kress et al. (2003) had recorded 273 families, 2,371 genera and over 11,800 species in the checklist of Myanmar. In this research, a total of 17 species were selected belonging to 7 genera under 7 families have been collected. These species are popularly well known in Myanmar, as well as in other parts of grown as ornamentals, while some possess medicinal properties, and practical demonstrate specimen (for students especially botany and zoology). The record on detail morphological characters of floral parts is very useful information for identification of researchers in various fields of study like ecology, pharmacognosy, anatomy, ethonobotany, and industrial plants. Therefore; the future of these apopetalous and sympetalous flowering plants in mawlamyine university campus must be sustainable, maintenance and conservation, because expend of the more and more construct the development of roads, constructions of class rooms building and etc, gradually, slowly rare and lost.

The aim of the research is to verify the names, affinities, geographical distribution and morphological characteristics of sympetalous flowering plants of Mawlamyine Township. The information accumulated from these studies is to know the scientific knowledge of the inventory of plant resources. The objectives are to identify and classify the angiosperms, to record the list of collected plants and to compare the morphological characters of apopetalous and synpetalous flowers from the study areas.

MATERIALS AND METHODS

Identification of genera and species were carried out by referring to the available literature such as Flora of British India (Hooker 1875-1897), Flora of Java (Backer & Brick 1963-1968), Flora of Ceylon (Dassanayake 1980-2001), Taxonomy of Angiosperms (B.P Pandey1999) and Laboratory Manual of Plant Taxonomy (N.S Subrahmanyam 1996). The index for nomenclature data was referred in Index Kewensis (Jackson, 1885) by which the names and synonyms of plant up to the rank of species being confirmed. The families of these species were arranged according to Angiosperms Phylogeny Group (APG) IV Systems. Myanmar names were referred to Hundley and Chit KoKo (1987) and Kress et al (2003). The

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comparative characters of the studied species were presented by using their different characters. An artificial key of these species were also constructed.

RESULTS

List of Collected Species from Mawlamyine University Campus

In this study 17 species belonging to 7 genera of 7 families from angiospermopsida (angiosperms) were arranged according to the phylogenetic relationships, based on recent cladistics analyses and the classification proposed by the Angiosperm Phylogenetic Group (APG) IV show in Table.

Table 1.List of Collected Species.

Kingdom - Viridiplantae (Green plants)
Division - Embryophyta (Embryophytes)
Subdivision - Tracheophytina (Tracheophytes)
Class - Angiospermopsida (Angiosperms)

Family	No.	Scientific name	Myanmar name
Magnoliaceae	1.	*Micheliachampaca*L.	Sagawa
	2.	*Micheliadoltsopa*Buch-Ham.ex.DC.	Saga-byu
Lythraceae	3.	*Lagerstroemia speciosa*(L.) Pers	Pyinma
	4.	*Lagerstroemia indica*L.	Pan-ei
Myrtaceae	5.	*Psidiumguajava*L.	Malaka
	6.	*Psidiumacidum Mart.*	Malaka-chin
Solanaceae	7.	*Solanumtorvum Sw.*	Myobyet-khayan
	8.	*Solanumindicum L.*	Khayan-kazaw
Rubiaceae	9.	*Ixoracoccinea*L. var. *lutea*	Ponne-yeik-gyi
	10.	*Ixoracoccinea*L.	Ponna-yeik
	11.	*Ixoranigricans*Br.	Sagwe-gale
Apocynaceae	12.	*Plumeriarubra*L.	Tayok-saga-ani
	13.	*Plumeriaobtusa*L.	Akyaw
	14.	*Plumeria alba L.*	Tayok-saga-hypu
Lamiaceae	15.	*Ocimumgrastissimum L.*	Taw-pin-sein
	16.	*Ocimumamericanum L.*	Pinsein
	17.	*Ocimum sanctum L.*	Kala-pinsein, Pinsein-nets

Table 2. Comparison of Morphological characters on two species in genus *Michelia*

Habit		
Micheliachampaca L.		*M. doltsopa*Buch-Ham.ex.DC.
Aromatic tree		Aromatic tree
Leaves		
Characters	*M. champaca* L.	*M. doltsopa*Buch-Ham.ex.DC.
Arrangement	alternate, simple	alternate, simple
Margin	entire	Wavy
Inflorescences		
Characters	*M. champaca* L.	*M. doltsopa*Buch-Ham.ex.DC.
Type	solitary and axillary cymes	solitary and axillary cymes
Flowers		
Characters	*M. champaca* L.	*M. doltsopa*Buch-Ham.ex.DC.
Colour	yellow	creamish-white
Perianth		
Characters	*M. champaca* L.	*M. doltsopa*Buch-Ham.ex.DC.
No.	9 - 15, apotepalous	9 - 11, apotepalous
Colour	yellow	creamish - white
Stamens		
Characters	*M. champaca* L.	*M. doltsopa*Buch-Ham.ex.DC.
No.	numerous, apostemonous	numerous, apostemonous
Ovaries		
Characters	*M. champaca* L.	*M. doltsopa*Buch-Ham.ex.DC.
No.of. carpel	carpels ∞, apocarpous	carpels ∞, apocarpous
Shape	androgynophore present.	androgynophore present.

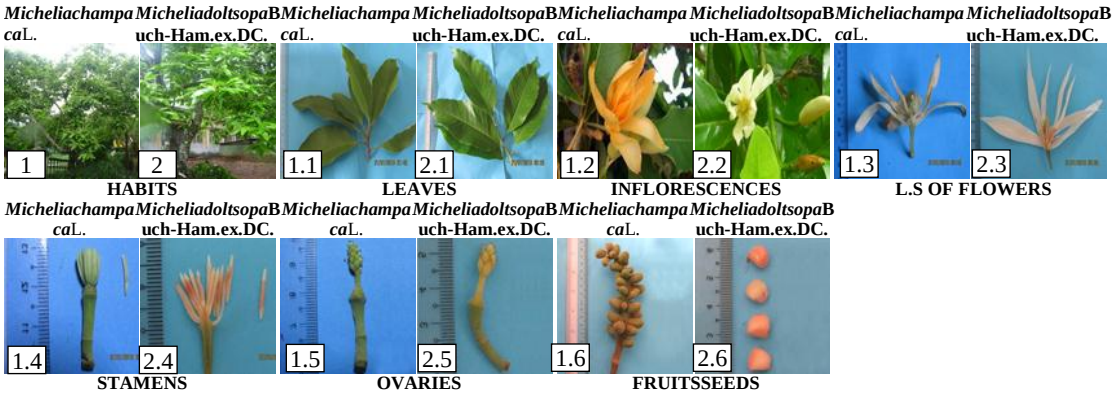


Figure 1. Morphological characters of ***Micheliachampaca***L. and ***Micheliadoltsopa***Buch-Ham.ex.DC.

Table 3. Comparison of Morphological characters on two species in genus *Lagerstroemia*

Habit		
Lagerstroemia speciosa(L.) Pers		*Lagerstroemia indica* L.
Tree		Small tree
Leaves		
Characters	*L. speciosa*(L.) Pers	*L. indica*L.
Arrangement	opposite, simple	opposite, simple
Shape	elliptic	elliptic to obovate
Margin	entire	Cilia
Inflorescences		
Characters	*L. speciosa*(L.) Pers	*L. indica*L.
Type	terminal, paniculate cymes	axillary and terminal, paniculate cymes
Flowers		
Characters	*L. speciosa*(L.) Pers	*L. indica*L.
Colour	purple	Pink
Sepals		
Characters	*L. speciosa*(L.) Pers	*L. indica*L.
No.	(6), synsepalous	(6), synsepalous
Petals		
Characters	*L. speciosa*(L.) Pers	*L. indica*L.
No.	6, apopetalous	6, apopetalous
Stamens		
Characters	*L. speciosa*(L.) Pers	*L. indica*L.
No.	numerous, apostemonous	6 + ∞, biseriate, apostemonous
Ovaries		
Characters	*L. speciosa*(L.) Pers	*L. indica*L.
No.of carpel	(6), 6 - carpelled, syncarpous	(6), 6 - carpelled, syncarpous

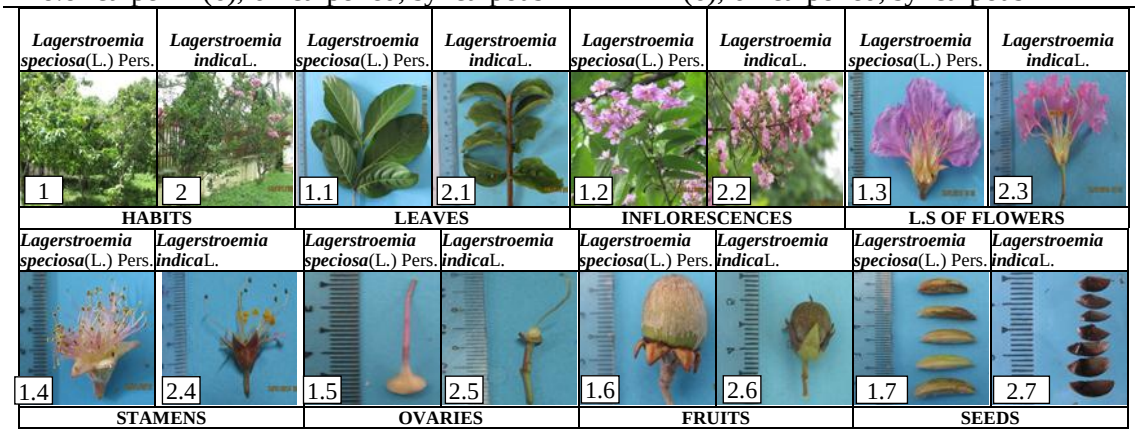


Figure 2. Morphological characters of ***Lagerstroemia speciosa***(L.) Pers. and ***Lagerstroemia indica*** L.

Table 4. Comparison of Morphological characters on two species in genus *Psidium*

Habit		
*Psidiumguajava*L.		*Psidiumacidum* Mart.
Small tree		Small tree
Leaves		
Characters	*P.guajava* L.	*P.acidum* Mart.
Arrangement	opposite and distichous	opposite and distichous
Shape	oblong to elliptic	elliptic
Inflorescences		
Characters	*P.guajava* L.	*P.acidum* Mart.
Type	solitary and axillary cymes	axillary, 1 - 3 flowered cymes
Flowers		
Characters	*P.guajava* L.	*P.acidum* Mart.
Colour	white	White
Sepals		
Characters	*P.guajava* L.	*P.acidum* Mart.
No.	4 - 5, aposepalous	4 - 6, aposepalous
Petals		
Characters	*P.guajava* L.	*P.acidum* Mart.
No.	4 - 5, apopetalous	4 - 6, apopetalous
Stamens		
Characters	*P.guajava* L.	*P.acidum* Mart.
No.	numerous, apostemonous	numerous, apostemonous
Ovaries		
Characters	*P.guajava* L.	*P.acidum* Mart.
No.of carpel	(4 - 5), 4 - 5 carpelled	(4 - 6), 4 - 6 carpelled

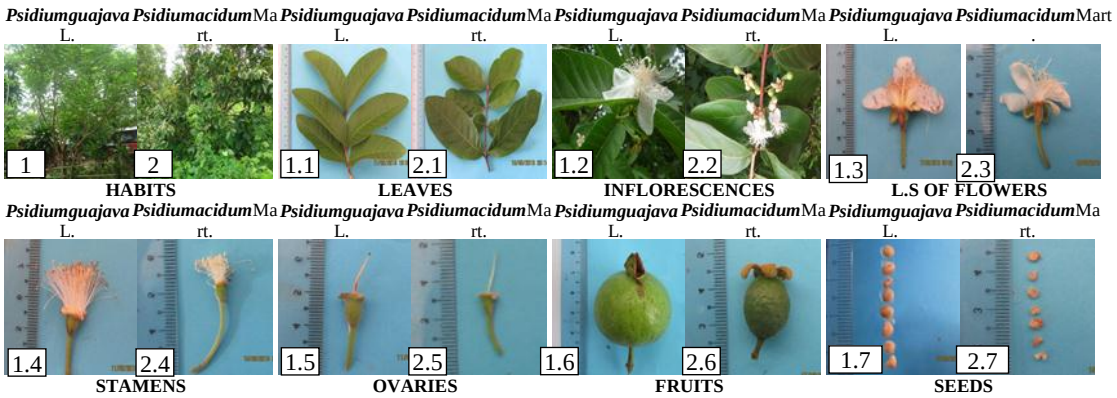


Figure 3. Morphological characters of ***Psidiumguajava***L. and ***Psidiumacidum***Mart.

Table 5. Comparison of Morphological characters on two species in genus *Solanum*

Habit		
*Solanumtorvum*Sw.		*Solanumindicum*L.
Spinous small tree		Spinous small tree
Leaves		
Characters	*S.torvum*Sw.	*S.indicum*L.
Arrangement	alternate or in the flowering portion apparently opposite	alternate or in the flowering portion apparently opposite
Inflorescences		
Characters	*S.torvum*Sw.	*S.indicum*L.
Type	leaf - opposed, helicoid cymes	leaf - opposed, helicoid cymes
Flowers		
Characters	*S.torvum*Sw.	*S.indicum*L.

Colour	white	Violet
Sepals		
Characters	*S.torvum*Sw.	*S.indicum*L.
No.	(5), synsepalous	(5), synsepalous
Shape	campanulate	campanulate
Petals		
Characters	*S.torvum*Sw.	*S.indicum*L.
No.	(5), synpetalous	(5), sypetalous
Stamens		
Characters	*S.torvum*Sw.	*S.indicum*L.
No.	5, apostemonous,	5, apostemonous,
Ovaries		
Characters	*S.torvum*Sw.	*S.indicum*L.
No.of carpel	(2), 2 - carpelled, syncarpous	(2), 2 - carpelled, syncarpous

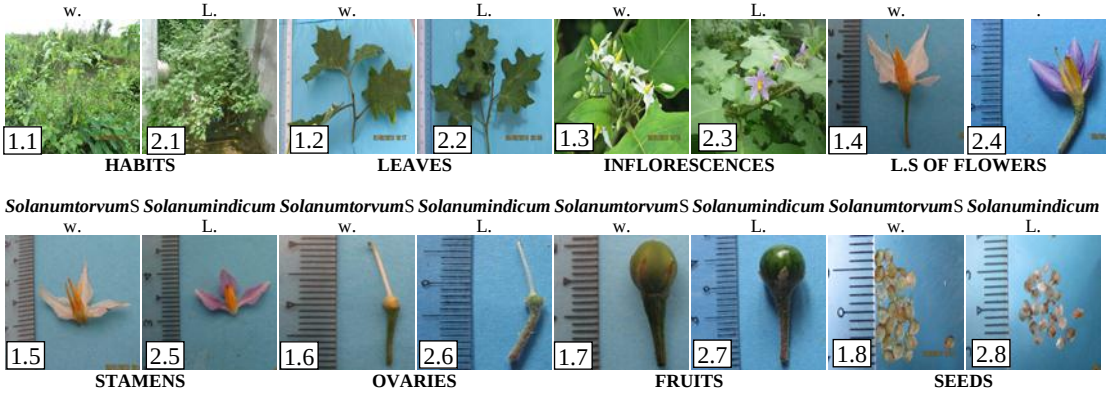


Figure 4. Morphological characters of ***Solanumtorvum***Sw. and ***Solanumindicum***L.

Table 6. Comparison of Morphological characters on three species in genus *Ixora*

Habit		
*Ixoracoccinea*L.var.*lutea*	*Ixoracoccinea* L.	*Ixoranigricans*Br.
Small tree	Shrub	Shrub
Leaves		
Characters	*I. coccinea*L.var.*lutea*	*I. coccinea* L.	*I. nigricans*Br.
Arrangement	opposite and decussate	opposite and decussate	opposite and decussate
Inflorescences		
Characters	*I.coccinea*L.var.*lutea*	*I. coccinea* L.	*I. nigricans*Br.
Type	terminal, corymbose cymes	terminal, corymbose cymes	terminal, corymbose cymes
Flowers		
Characters	*I.coccinea*L.var.*lutea*	*I. coccinea* L.	*I. nigricans*Br.
Colour	red	Red	white
Sepals		
Characters	*I. coccinea*L.var.*lutea*	*I. coccinea* L.	*I. nigricans*Br
No.	(4), synsepalous	4, synsepalous	4, synsepalous
Petals		
Characters	*I. coccinea*L.var.*lutea*	*I. coccinea* L.	*I. nigricans*Br.
No.	(4), synpetalous	(4), synpetalous	(4), synpetalous
Stamens		
Characters	*I.coccinea*L.var.*lutea*	*I. coccinea* L.	*I. nigricans*Br.
No.	4, apostemonous,	4, apostemonous,	4, apostemonous,
Ovaries		
Characters	*I. coccinea*L.var.*lutea*	*I. coccinea* L.	*I. nigricans*Br.
No.of carpel	(2), 2 - carpelled,	(2), 2 - carpelled,	(2), 2 - carpelled,

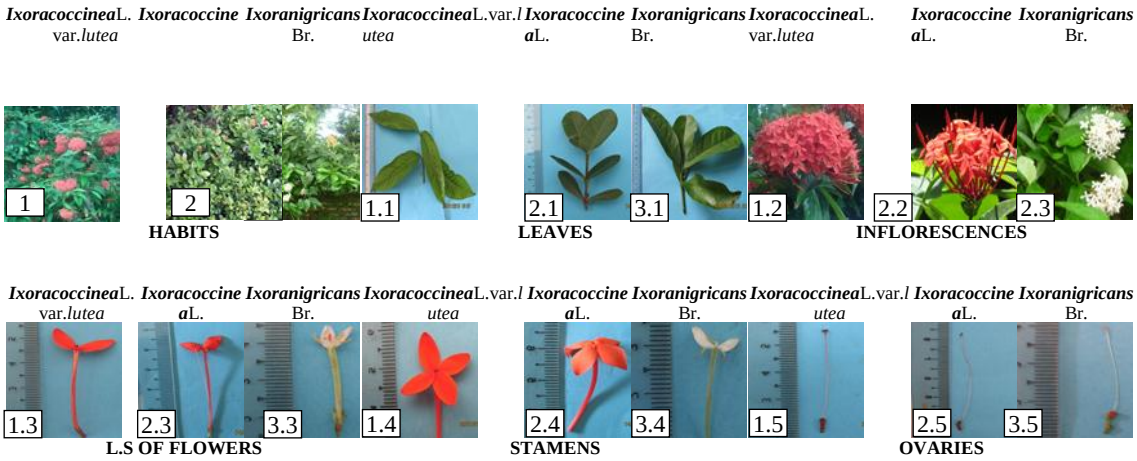


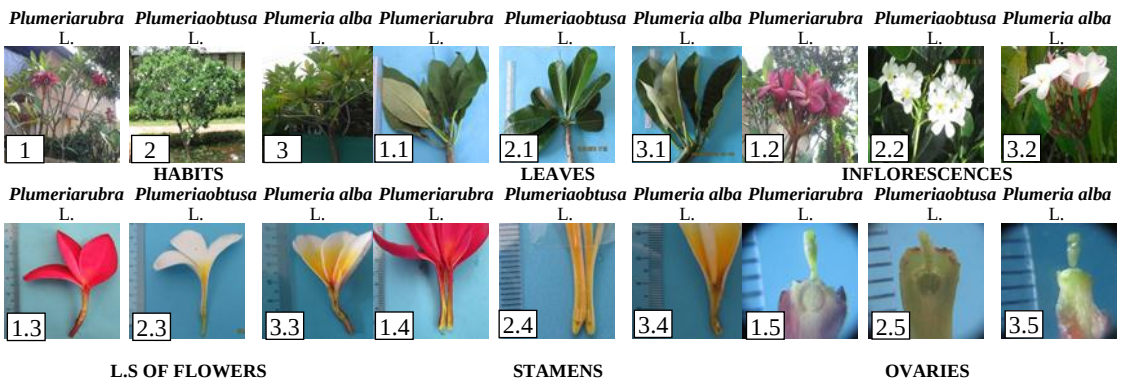
Figure 5.Morphological characters of ***Ixoracoccinea***L. var. *lutea*,***Ixoracoccinea***L. and ***Ixora Nigricans*** Br.

Table 7. Comparison of Morphological characters on three species in genus *Plumeria*

Habit

Plumeriarubra L.	*Plumeriaobtusa* L.	*Plumeria alba* L.
Tree latex present	Tree latex present	Tree latex present

Leaves			
Characters	*P. rubra* L.	*P. obtuse* L.	*P. alba* L.
Arrangement	spiral	Spiral	spiral
Shape	oblong - ellipitc	Obovate	elliptic
Inflorescences			
Characters	*P. rubra* L.	*P. obtusa* L.	*P. alba* L.
Type	terminal	Axillary	axillary and terminal
Flowers			
Characters	*P. rubra* L.	*P. obtusa* L.	*P. alba* L.
Colour	red	White	white
Sepals			
Characters	*P. rubra* L.	*P. obtusa* L.	*P. alba* L.
No.	(5), synsepalous	(5), synsepalous	(5), synsepalous
Petals			
Characters	*P. rubra* L.	*P. obtusa* L.	*P. alba* L.
No.	(5), synpetalous	(5), synpetalous	(5), synpetalous
Stamens			
Characters	*P. rubra* L.	*P. obtusa* L.	*P. alba* L.
No.	5, apostemonous	5, apostemonous	5, apostemonous
Ovaries			
Characters	*P. rubra* L.	*P. obtusa* L.	*P. alba* L.
No.of carpel	(2), 2 - carpelled	(2), 2 – carpelled	(2), 2 - carpelled



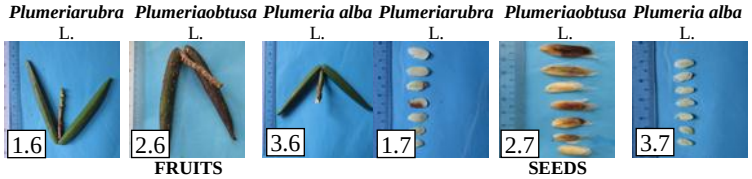


Figure 6.Morphological characters of***Plumeriarubra***L.,***Plumeriaobtusa***L.and ***Plumeria alba*** L.

Table 8. Comparison of Morphological characters on three species in genus *Ocimum*

Habit			
*Ocimumgrastissimum*L.	*Ocimumamericanum*L.	*Ocimum sanctum* L.	
Aromatic shrubs	Aromatic annual herbs Stem	Aromatic perennial herbs	
Leaves			
Characters	*O. grastissimum* L.	*O. americanum* L.	*O. sanctum* L.
Arrangement	opposite and decussate	opposite and decussate	opposite and decussate
Shape	ovate to ovate-elliptic	Ovate	ovate
Inflorescences			
Characters	*O. grastissimum* L.	*O. americanum* L.	*O. sanctum* L.
Type	terminal, verticillaster	terminal, verticillaster	terminal, verticillaster
Flowers			
Characters	*O. grastissimum* L.	*O. americanum* L.	*O. sanctum* L.
Colour	violet	White	purple
Sepals			
Characters	*O. grastissimum* L.	*O. americanum* L.	*O. sanctum* L.
No.	(1 + 4), synsepalous	(1 + 4), synsepalous	(1 + 4), synsepalous
Petals			
Characters	*O. grastissimum* L.	*O. americanum* L.	*O. sanctum* L.
No.	(4 + 1), synpetalous	(4 + 1), synpetalous	(4 + 1), synpetalous
Stamens			
Characters	*O. grastissimum* L.	*O. americanum* L.	*O. sanctum* L.
No.	2 + 2, apostemonous	2 + 2, apostemonous	2 + 2, apostemonous
Ovaries			
Characters	*O. grastissimum* L.	*O. americanum* L.	*O. sanctum* L.
No.of carpel	(2), 2 - carpelled	(2), 2 – carpelled	(2), 2 - carpelled

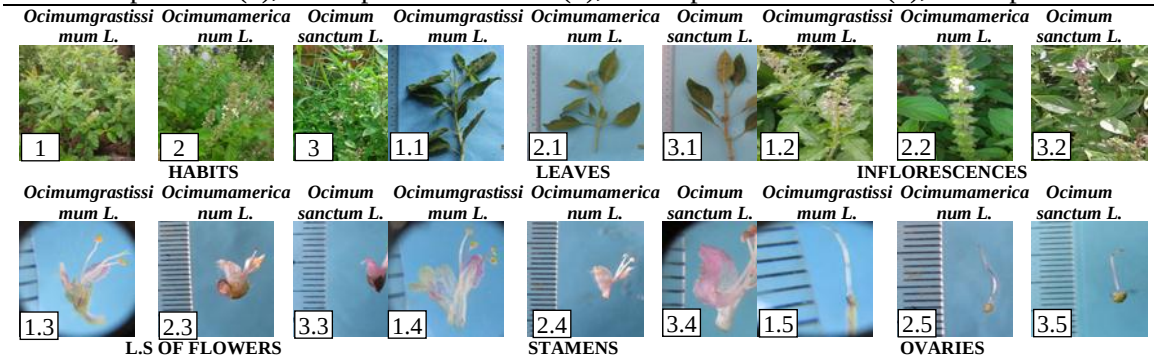


Figure 6. Morphological characters of ***Ocimumgrastissimum***L., ***Ocimumamericanum***L. and ***Ocimum sanctum*** L.

DISCUSSION AND CONCLUSION

In the present study, 6 species of flowering plants belonging to 3 genera of 3 apopetalous families and 11 species belonging to 4 genera of 4 sympetalous families are observed.

It is observed that 17 species belonging to the family Magnoliaceae, Lythraceae, Myrtaceae, Solanaceae, Rubiaceae, Apocynaceae and Lamiaceae respectively. The Morphological characters of comparison are specially considered to two to three different species of single respective genera. The detailed comparative data were already presented with the tables. The discussion will be emphasized only on the most distinguishing and early recognizable characters.

The morphological characters of comparison are specially considered to two to eight different species of single respective genera. The discussion will be emphasized only on the most distinguishing and easily recognizable characters.

In family Magnoliaceae, *Micheliachampaca*and *Micheliadoltsopa*Buch-Ham.ex.DC.are aromatic trees whereas the arrangement of leaves are alternate. The leaf tips of *M. champaca*is acute to acuminate and entire margins however *M.doltsopa*Buch-Ham.ex.DC., is acute and wavy margins. Inflorescences of two species are solitary and axillary cymes. The colours of flowers are also different. The flower of *M. champaca* is yellow but the flower of *M. doltsopa*Buch-Ham.ex.DC.iscreamish-white. The number of perianth in *M. champaca*is more than *M.doltsopa*Buch-Ham.ex.DC.These two species of stamens and apocarpous ovaries are spirally arranged on the androgynophore. These characters are agreed with those stated by Hooker (1875), Dassanayake (1987) and Subrahmanyam (1999).

In family Lythraceae, the arrangement of leaves are opposite in *Lagerstroemiaspeciosa*and *Lagerstroemia indica*. The shape of the leaf is elliptic in *L. speciosa*but it is elliptic to obovate in *L. indica*. The leaf margin is entire in *L. speciosa*whereas cilia in *L. indica*. The inflorescences of two species are paniculate cymes. The flower colour of *L speciosa*is is purple and pink in *L. indica*. The shape of the petal is obovate in *L. speciosa*whereas ovate in *L. indica*. The stamens are numerous in *L speciosa*but those are in *L indica*is 6 + α, biseriate stamens. The number of carpels and locules are the same as between these two species. These characters are agreed with those mentioned by Hooker (1879), Dassanayake (1995) and Subrahmanyam (1999).

In family Myrtaceae, the shape of the leaf is oblong to elliptic in *Psidiumguajava*but it is elliptic in *Psidiumacidum*. The inflorescences are solitary and axillary cyme in *P. guajava*whereas axillary and 1 - 3 flowered cymes are observed in *P. acidum*. The number of sepals and petals are 4 - 5 in *P. guajava*but it is 4 - 6 in *P. acidum*. The shapes of petals are oblong-ovate in *P. guajava*and elliptic in *P. acidum*. The colour of flowers, numerous stamens and inferior ovaries of *P. guajava* are same as *P. acidum*. Fruits of *P. guajava* are larger than *P. acidum*. These characters are similar to those described by Hooker (1879), Dassanayake (1981) and Subrahmanyam (1999).

In family Solanaceae, *Solanumtorvum*and *Solanumindicum*are spinous small trees and stems with stellate hairs. The shape of the leaf is ovate, coarsely 2-3 sinuate in *S. torvum*and broadly ovate with large actuely triangular lobes in *S. indicum*. The inflorescences of two species are leaf - opposed and helicoid cymes. The flower colours of *S. torvum*is white but violet in *S. indicum*. These species are found to be porous dehiscences and ovaries oblique. These characters are in agreement with those mentioned by Hooker (1885), Dassanayake (1987), Pandey (1999) and Subrahmanyam (1999).

In family Rubiaceae, *Ixoracoccinea*var. is small tree but shrubs in *Ixoracoccinea*and *Ixoranigricans*. The arrangements of leaves are opposite and decussate in those species. The shape of the leaf is elliptic in *I. coccinea*vzx.*lutea*. Those of *I. coccinea*and *I. nigricans* are obovate. The leaf tips are acuminate in *I coccinea*var., *lutea*apiculate in *I. coccinea*and acute to obtuse in *I. nigricans*. The leaf bases are acute in *I.coccinea*var. and *I.nigricans*, obtuse in *I. coccinea*. The inflorescences of three species are corymbose cymes. The colours of flowers are red in *I. coccinea*var. *lutea*and *I. coccinea*but white in *I. nigricans*. The corolla shapes of the three species are similar to each other. The number of stamens are 4 and inferior ovaries in three species. These characters are in agreement with those mentioned by Hooker (1882), Dassanayake (1987) and Subrahmanyam (1999).

In family Apocynaceae, *Plumeriarubra*, *Plumeriaobtusa*and *Plumeriaalba*are trees, stems with latex present in three species. The shape of the leaf is oblong-elliptic in *P. rubra*, obovate in *P. obtusa*and elliptic in *P. alba*. The leaf tip is acuminate in *P. rubra*, obtuse to retuse in *P. obtusa*whereas acute in *P. alba*. The inflorescence in *P. rubra*is terminal paniculate cymes but axillary paniculate cymes in *P. obtusa*, axillary and terminal paniculate cymes in *P. alba*. The shape of colour is funnelform and twisted aestivation in these species. The colourof corolla is red in *P. rubra*but it is white in *P. obtusa*and *P. alba*. These characters are in agreement with those reported by Hooker (1882), Backer (1962), Dassanayake (1987), Pandey (1999) and Subrahmanyam (1999).

In family Lamiaceae, *Ocimumgrastissimum* is aromatic shrub but aromatic annual herb in *Ocimumamericanum*, aromatic perennial herb in *Ocimum sanctum*. *O. grastissimum*and *O. sanctum*are serrate margins but those of double serrate in *O. americanum*. The inflorescences are verticillaster in these species. The flowers colours of the three species are significantly different violet in *O. grastissimum*but those *O. americanum*is white and *O. sanctum*is purple.

The ovaries of these species are 2 - carpelled, 4 - loculed and gynobasic style the same as 4 nutlets fruit. These characters are in agreement with those mentioned by Hooker (1885), Backer (1962), Dassanayake (1981), Pandey (1999) and Subrahmanyam (1999).

In conclusion, the plants specimens have been provided with their name and description on the basis of the morphological characters. The present work will be useful not only in basic Systematic Botany but also in advanced, Medicinal and Industrial plants. Therefore, it is hoped that the present research work can give the valuable information and wide knowledge for the students, other researchers and local people in various ways. In addition, this study will be partially fulfilled the requirement of taxonomic information of Mawlanyine Township in Mon State.

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REFERENCES

Backer.C.A. & R.C.B.V.D. Brick, 1962.**Flora of Java Vol. II.**Rijksherbarium, Leyden, N. V. P. Noordhoof.

Cronquist, A. 1981.**An Integrated System of Classification of Flowering Plants,** Columbia University press New York.

Dassanayake, M.D. 1987,1996, 1998. **A Revised Handbook to the Flora of Ceylon,Vol. IV, VI, X, XII** University of Peradeniya, Department of Agriculture, Peradeniya, Sri Lanka.

Heywood, V.H. 2007,.**Flowering Plants of the Families of the World.Firefly Books;** Ontario, Canada.

Hooker, J.D, 1882, 1885**The Flora of British India, Vol. III, IV,** L. Reeve & Co, 5 Henrietta street, Covent Garden, London.

Hundley, H.G. & Chit KoKo. 1987. **List of Trees, Shrubs, Herbs and Principal Climbers,** etc. Fourth Revised edition SweDawOo Press, Mayangon, Yangon, Myanmar.

Hutchinson, J. 1967. **Key to the Families of Flowering Plants of the World.**Claredon Press Oxford, London.

Jackson, B.D. 1885. **Index Kewensis.An Enumeration of the Genera and Specie FloweringPlants Parts Vol. I-IV** and Supplement.Royal Botanical Garden, Kew.

Kress, J. W., Robert A. D., Ellen F. & Yin YinKyi. 2003. **A Checklist of the Trees, Shrubs, Herbsand Climbers of Myanmar.**Department of Systematic Biology - Botany.National Museum of Natural History, Washington DC. USA.

Lawrence, G. H.M. 1964. **Taxonomy of Vascular Plants.**The Macmillan Campany. New York.

Rendle, A. B. 1952. **Classification of Flowering Plants, ALfred Barton Rendle, Volume II.Dicotyledons,** Cambridge At the University Press.

Subrahmanyan, N. S. 1999. **Laboratory Manual of plant Taxonomy,** Reader in Botany, SriVenketashWara College, University of Delhi.

http://eol.org/data objects/4972575, http://eol.org/pages/418307/names/synonyms