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Establishment of a Taxonomic Garden in the KFRI Sub Centre Campus

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Peechi, Thrissur, Kerala
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Abstract of Project Proposal

Code	KFRI 533/2007
Title	**Establishment of a Taxonomic Garden in the KFRI Sub Centre Campus**
Objectives	To assemble plants in family-wise in a taxonomic garden adjacent to the Bioresources Nature Park in the KFRI Sub Centre Campus
Project period	July 2007- March 2012
Funded by	KFRI Plan Grant
Scientific personnel	U.M. Chandrashekara

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ABSTRACT

Live models that display the scientific classification of plants are referred to as taxonomic garden. These gardens are highly effective in providing opportunities for comparing similarities and differences within taxonomic groupings. Even though grouping plants by types is a familiar practice, a taxonomic scheme in the layout of an entire garden is not common. Thus, a Taxonomic Garden was established in the campus of Kerala Forest Research Institute Sub Centre at Nilambur in order to accomplish the above concept. The Garden, covering about 2-ha land is located adjoining to the Teak Museum and Bioresources Nature Park Complex. Forty seven angiosperm families, giving priorities to those that are taught in graduate and post-graduate degree classes in botany and forestry in Indian universities were assembled. For each family, a separate bed (family bed) was prepared and planted with one to five species. In front of each family bed a signboard depicting details such as characteristic features of the family, general floral formula, number of general and species reported from Kerala, number of species belonging to different conservation status, and names of species planted in the family bed is provided. The purpose of the Taxonomic Garden is mainly educational. Here basics and importance of plant classification are communicated through guided tours to the visitors of Teak Museum and Bioresources Nature Park. In the report, the need of further expansion of this Garden by integrating more number of angiosperm families is stressed. Strategies for using the Garden to promote teaching, research and capacity building in the field of taxonomy and allied subjects are also discussed.

INTROUDCTION

The dynamic growth of the human population throughout the world in recent years has increased the pressure on its natural resources. Human activities, the driving force behind this growth, threaten the biological resources. For instance, botanists have identified more than 400,000 species of plants worldwide (CBD, 2009). Given the deplorable rates of deforestation throughout the tropics, where most of the planet's biodiversity is located, it is predicted that the region may loose two-third of plant species by the end of the century, unless concerted and collaborative efforts to conserve them are made (Taylor, 2004). It is now recognised that lack of scientific information on tropical biodiversity is one of the major impediments in assessing biodiversity richness in the region, predicting biodiversity change or loss and also implementing sound and scientifically-based sustainable utilisation and conservation efforts. Adequate taxonomic expertise is also identified as a crucial tool to determine the state-of-the-art of biodiversity in a region. Inadequacy of long-term investment in the human infrastructural (including, biological collections) and information resources necessary to underpin the science of taxonomy are recognised as impediments that prevent development of appropriate biodiversity conservation policies and programmes. Realising the need of taxonomic expertise, several attempts are being made in India to promote taxonomic research and capacity building. For instance, several programmes and projects have been initiated to strengthen botanical gardens of the country as nodal institutions for promoting taxonomic education and training. However, when the richness and need for conservation of biodiversity in the sub-continent are considered, the efforts in taxonomic capacity building are to be further intensified. It may be mentioned here that many modern botanical gardens within and outside the country have reoriented their mandate to expand genetic diversity/biodiversity in them. However, even in such gardens, either limited or no attempts are made the expositions of how plants might be related to one another. Therefore, it is clear that due to absence of display of plants following a taxonomic scheme the gardens offer little opportunities to general public in general and student community in particular to familiarise themselves with plants and to study their relationships. However, there are good examples of growing related plants together and allowing comparison of the characteristics of species within a genus or genera

within a family. For instance, the Systematic Beds (sometimes also called 'Order Beds') of herbaceous plants at gardens like Kew and Cambridge and Central Park Arboretum at New York have long provided botany students with a compact synopsis of the plant kingdom arranged in taxonomic sequence. However, in the botanical gardens of India, grouping of plants by type is restricted only to small, separate collection of palms, rose, cacti, or other genera; plant displays that illustrate the scientific classification of plants to provide opportunities to compare the similarities and differences within taxonomic groupings are lacking in the country. Considering these aspects, the Kerala Forest Research Institute undertook this project to establish a Taxonomic Garden in the Bioresources Nature Trail located in its Sub Centre at Nilambur with an aim to assemble angiosperm plants in family-wise in the garden. The specific intention of establishing the Taxonomic Garden is to train school and college students in identifying plants in the field and to give them an overall idea of relationships between different families as well as the evolutionary development in the flowering plants. The focus of the taxonomic garden is also to trigger the interest among general public on science and practices of plants classification. Details of the activities that led to the establishment of Taxonomic Garden are given in the following Section.

LOCATION AND CLIMATE

Nilambur, in Malappuram District of Kerala State (Figure 1) is the place where the world's first commercial teak plantation was raised during 1842-1844 by H.V. Conolly, the then collector of Malabar. The historic importance of Nilambur also inspired the establishment of a Teak Museum in the KFRI Sub Centre campus (76^0 $15^{'}$ $28^{''}$ E longitude and 11^0 $18^{'}$ $14^{''}$ N latitude) in the year 1995. The Teak Museum provides information on cultivation, management, utilization and socio-economics, ecology and allied aspects of teak (*Tectona grandis*) - the reputed timber species of South-east Asia. Adjacent to the Teak Museum, the Institute has also established a Bioresource Nature Park that has conservation themes for the lower groups of plants such as algae, bryophytes and pteridophytes, plants found in specialized ecological niche such as xerophytes (cacti and succulents) and hydrophytes (aquatic plants), beneficial plants (eg. medicinal plants) and ornamental plants (eg. orchids). Each month, an average of about 9,000 visitors including farmers, general public, students and researchers visit the Teak Museum and adjacent the Bioresources Nature Park, both

located at the KFRI Sub Centre campus. The Taxonomic Garden is established adjacent to the Bioresources Nature Park.

Figure 1. Map of Kerala showing Nilambur where the Bioresources Nature Trail is present.

ACTIVITIES UNDERTAKEN

Site selection and landscaping

About 2 ha area has been selected and the weed growth removed. The land was levelled to prevent water-logging during rainy season in some parts at the site. The area was fenced using GI chain-link fencing material. The height of the fence is 1.5 m and at 2 m intervals concrete posts were provided. The posts were fixed to the ground using concrete and rubble. Sometimes, wild boars dig soil below the chain link and enter into the garden. They also damage the fence by pushing the basal part of the chain-link. Therefore, to avoid such damages, base of the chain-link fence was fixed properly to the ground using metal hooks and wire. Apart from this, inner side of the fence was strengthened using asbestos sheets of 40-60 cm height, fixed to the ground along with the chain-link. After levelling the area, near the centre of the site, eight small ponds were dug in a circle. The excavated soil was heaped in the centre of the garden to make a mound of about 2 m tall and 2 m radius using soil and boulders. Irrigation facilities such as pipe lines and sprinklers were provided to cover the entire area of the garden.

Preparation of family beds

For each plant family, a raised bed (45 cm high, supported with roof tiles) of 3 m x 3 m was prepared. At the time of bed preparation, around 3 kg of compost was added as basal dose in each bed. For integrating aquatic plants into the Taxonomic Garden, ponds were constructed in a circular pattern near the centre of the garden. Apart from ponds, a few concrete tubs of different dimensions were also fixed to the ground level. The bottom of these ponds and tubs was filled with rich clayey soil to provide sufficient nutrition. Water plants are heavy feeders, and will not bloom unless they receive proper nutrition. Thus the soil was enriched by providing well-decomposed cattle dung manure. The manure was placed at the bottom and then covered with clayey soil to prevent floating of the manure. Certain angiosperm families are primarily dominated by tree species. Therefore, within the Taxonomic Garden a separate section was demarked to grow trees belonging respective families. At least 5 m space between trees was maintained.

About 1.5 m wide path was provided to walk through and see family beds that were laid on either side of the path. Lawn grass was planted along the paths and space between the

family beds were planted with spreading creepers like *Arachis pintoi* and *Wedelia chinensis*. They were mowed regularly to keep the garden neat and tidy and also to prevent them growing wild and encroaching the family beds.

Selection of beds for families

Certain deviations from the usual sequence of beds of traditional systematic garden concept were made while establishing the Taxonomic Garden in the Sub Centre Campus. Such deviations were required in order to overcome horticultural difficulties while establishing the garden. Taxonomic groups above the species level often contain plants from widely dissimilar habitats. Therefore, an attempt has been made to identify species of a family which share similar micro-site conditions. When comes to the family-level, the varying degrees of sun and shade tolerance as well as differing nutritional and moisture requirement among plants of closely related families cause problems when they are assembled together under similar conditions. In addition, families predominated by woody plants, climbers, epiphytes, xerophytes and hydrophytes lend themselves less successfully to a sequential taxonomic treatment. Thus, in the present endeavour certain exceptions were made to hard-and–fast rule of the taxonomic sequencing. Some of the changes made to the conventional taxonomic garden concept are given below:

a) Four beds in the front row of the garden were used to plant species of one monocot family and three dicot families. Three dicot families were chosen to represent three sub-classes namely polypetalae, gamopetalae and monochlamydae. This arrangement was found to be adequate to explain how monocots are different from dicots, and within the class dicotyledons, how three sub-classes were derived based on the petal characters. Arrangement of other plant families was based on the suitability of micro-sites within the garden.

b) A synoptic collection rather than collection of a broad spectrum of species of a family was planned as that affords the opportunities of choosing plants based on ease of culture.

c) Within the garden diverse micro-sites were developed to have an option to arrange certain families based on habitat requirement and ecological features. For instance, beds were prepared near trees to grow epiphyte/ climbers and shade loving plants.

Similarly, members of certain families were planted in ponds and pots. Cactaceae members were grown on a mound.

Planting in family beds

During the project period, forty seven angiosperm families were assembled in the Garden (Table 1). Priority has been given to families that are generally taught in graduate and post-graduate degree classes in subjects like Botany and Forestry in Indian Universities.

Table 1. Angiosperm families selected for establishing Taxonomic Garden at KFRI Sub Centre

Class	Sub-class	Series	Order	Family
Dicotyledons	Polypetalae	Thalamiflorae	Ranales	Ranunculaceae
				Annonaceae
				Nelumbonaceae
				Nymphaeaceae
			Parietales	Brassicaceae
				Capparidaceae
				Theaceae
			Malvales	Malvaceae
		Disciflorae	Geraniales	Oxalidaceae
				Rutaceae
			Celastrales	Vitaceae
			Sapindales	Anacardiaceae
			Rosales	Caesalpiniaceae
				Fabaceae
				Mimosaceae
				Rosaceae
			Passiflorales	Caricaceae
				Cucurbitaceae
			Ficoidales	Cactaceae
			Umbellales	Apiaceae
	Gamopetalae	Inferae	Rubiales	Rubiaceae
			Asterales	Asteraceae
		Bicarpellatae	Gentianales	Apocynaceae
				Asclepiadaceae
			Polemoniales	Convolvulaceae
				Solanaceae
			Personales	Scrophulariaceae
				Bignoniaceae
				Acanthaceae
			Lamiales	Verbenaeae
				Lamiaceae

Table 1. Angiosperm families selected for establishing Taxonomic Garden at KFRI Sub Centre

Class	Sub-class	Series	Order	Family
Dicotyledons (cont'd)	Monochlamydeae	Curvembryae	Caryophyllales	Amaranthaceae
				Basellaceae
		Multiovulatae terrestris	Aristolchiales	Aristalochiaceae
		Unisexuales	Euphorbiales	Euphorbiaceae
Monocotyledons		Microspermae	Orchidales	Orchidaceae
		Epigynae	Bromeliales	Bromeliaceae
			Zingiberales	Cannaceae
				Zingiberaceae
		Coronarieae	Liliales	Liliaceae
				Dracaenaceae
				Aloeaceae
			Commelinales	Commelinaceae
		Nudiflorae	Arales	Araceae
		Apocarpae	Alismatales	Alismataceae
		Glumaceae	Cyperales	Cyperaceae
				Poaceae

In a bed, not more than one family is accommodated. One to five species of a given family, which generally share a common micro-habitat, were planted.

Installation of signboards for family beds

A signboard of size 60 cm x 60 cm has been fixed in front of each family bed to a height of about 160 cm from the ground. The signboard provides details such as characteristic features of the family, general floral formula, number of general and species reported from Kerala (Sasidharan, 2004), number of species in the family endemic to the Western Ghats and Kerala, number of rare, endangered and threatened (RET) species reported, names of some endemic and RET species, and names of species planted in the family bed (Figure 2). In the signboard, bold letters were used to indicate certain key features of the family. Details provided in the signboards are given in Appendix 1.

Figure 2. A signboard of a family bed in the Taxonomic Garden of KFRI Sub Centre, Nilambur.

Imparting taxonomic knowledge

The taxonomic garden is primarily developed to guide school and college students in angiosperm taxonomy and to provide an overall idea of the relationships between different angiosperm families as well as the evolutionary development in flowering plants. The Taxonomic Garden being situated adjacent to the Bioresources Nature Park and Teak Museum is being visited by a large number of visitors daily. Thus emphasis is also given to the general public for better understanding of the garden. Assistance of mass communication media was also taken for maximum publicity about the establishment of Taxonomic Garden and facilities available at the Garden. A pamphlet (Figure 3) was also prepared and circulated among all colleges in Kerala where botany is taught at graduate and post-graduate levels. In the revised version of the brochure on Bioresources Nature Park, published by the Institute (KFRI), a write-up on Taxonomic Garden is also provided.

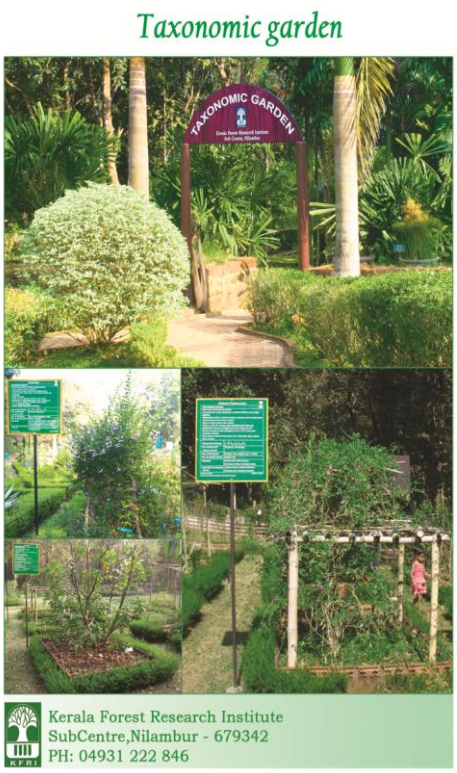

Figure 3. A pamphlet on the Taxonomic Garden of KFRI Sub Centre, Nilambur

Guided tours were arranged for student batches and general public, who showed interest in plant classification, in the (Figure 4). The guide picks up flowers, fruits etc., dissect them and explain how in a family one species is related to other species. Thus it was found that it is possible to explain the basics of plant taxonomy to general public in this garden. The visitors also expressed that the Taxonomic Garden as a plant display unit is highly effective in comparing the similarities and difference within taxonomic groupings. Majority of the visitors felt that the guided-tour instead of a casual visit by an individual or a group of visitors is much more effective for interpretation of the ideas behind the Taxonomic Garden and the general evolutionary trends in flowering plants.

Figure 4. Guided tours organised for college students and trainees of the Forest Department

CONCLUSIONS

One of the mandates of the Kerala Forest Research Institute is to disseminate knowledge and information on forest related matters to end-users, farmers, general public and transfer of technology to stakeholders for social benefits. In order to fulfil this mandate, the Institute has taken up several initiatives, including the establishment of Bioresources Nature Park in its Sub Centre at Nilambur, with an objective of imparting education and plant introduction. The Taxonomic Garden established under the present project assisted to extend the Bioresources Nature Park into exposition of how plants might be related to one another. The Garden is also equipped with opportunities for student community to familiarize themselves with plants and to identify their relationships, as well as for public education. Despite the educational advantages, there were certain horticultural and management

problems that resulted from the taxonomy to the lay out of the garden. In the present project, through necessary minor changes made to the concept of taxonomic garden, the Garden has been made more accessible to the students and general public. It seems that this Taxonomic Garden is first of its kind in India, with a compact synopsis of angiosperm plants arranged in taxonomic sequence. This garden may be further expanded to cover more number of angiosperm families. Subsequently, the Garden can be used to promote teaching, research and capacity building in the field of taxonomy and allied subjects.

ACKNOWLEDGEMENTS

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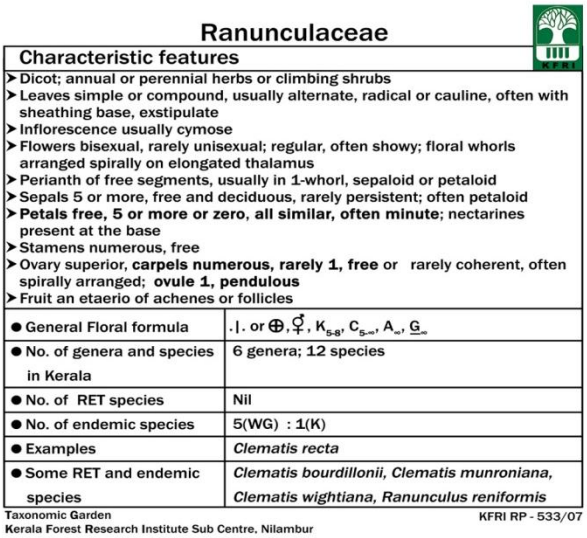
Appendix 1. Signboards of angiosperm families in the Taxonomic Garden at KFRI Sub Centre, Nilambur



Ranunculaceae

Characteristic features

- Dicot; annual or perennial herbs or climbing shrubs
- Leaves simple or compound, usually alternate, radical or cauline, often with sheathing base, exstipulate
- Inflorescence usually cymose
- Flowers bisexual, rarely unisexual; regular, often showy; floral whorls arranged spirally on elongated thalamus
- Perianth of free segments, usually in 1-whorl, sepaloid or petaloid
- Sepals 5 or more, free and deciduous, rarely persistent; often petaloid
- **Petals free, 5 or more or zero, all similar, often minute**; nectarines present at the base
- Stamens numerous, free
- Ovary superior, **carpels numerous, rarely 1, free** or rarely coherent, often spirally arranged; **ovule 1, pendulous**
- Fruit an etaerio of achenes or follicles

● General Floral formula	.|. or ⊕, ♀, K_{5-8}, $C_{5-\infty}$, A_{∞}, $\underline{G}_{\infty}$
● No. of genera and species in Kerala	6 genera; 12 species
● No. of RET species	Nil
● No. of endemic species	5(WG) : 1(K)
● Examples	*Clematis recta*
● Some RET and endemic species	*Clematis bourdillonii, Clematis munroniana, Clematis wightiana, Ranunculus reniformis*

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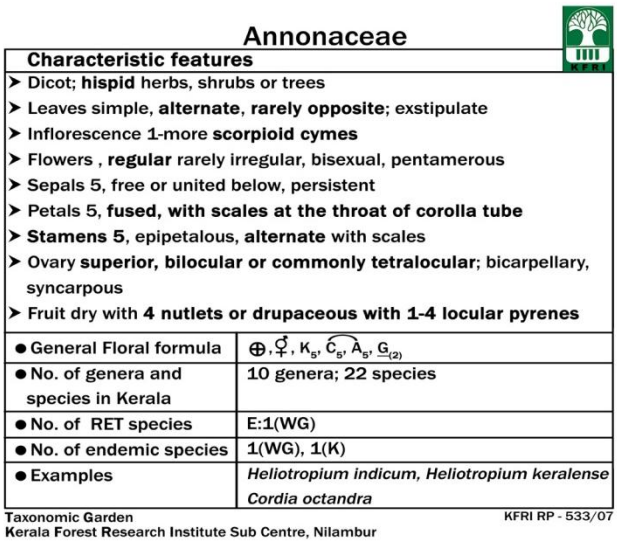

Annonaceae

Characteristic features

- Dicot; **hispid** herbs, shrubs or trees
- Leaves simple, **alternate, rarely opposite**; exstipulate
- Inflorescence 1-more **scorpioid cymes**
- Flowers , **regular** rarely irregular, bisexual, pentamerous
- Sepals 5, free or united below, persistent
- Petals 5, **fused, with scales at the throat of corolla tube**
- **Stamens 5**, epipetalous, **alternate** with scales
- Ovary **superior, bilocular or commonly tetralocular**; bicarpellary, syncarpous
- Fruit dry with **4 nutlets or drupaceous with 1-4 locular pyrenes**

● General Floral formula	⊕, ♀, K_5, $\overset{\frown}{C_5}$, $\overset{\frown}{A_5}$, $\underline{G}_{(2)}$
● No. of genera and species in Kerala	10 genera; 22 species
● No. of RET species	E:1(WG)
● No. of endemic species	1(WG), 1(K)
● Examples	*Heliotropium indicum, Heliotropium keralense Cordia octandra*

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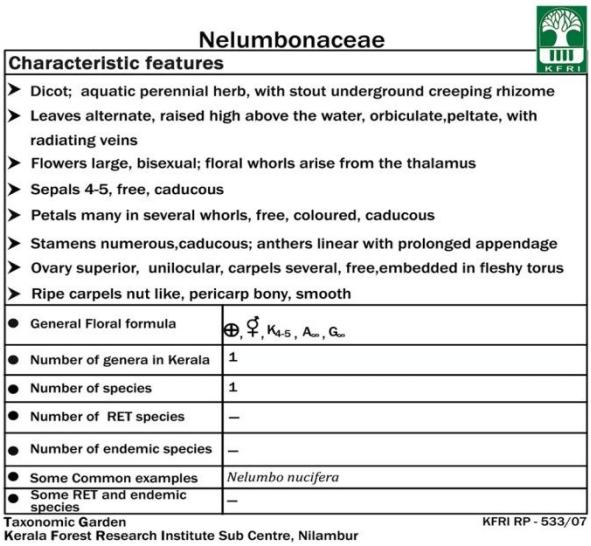

Nelumbonaceae

Characteristic features

- Dicot; aquatic perennial herb, with stout underground creeping rhizome
- Leaves alternate, raised high above the water, orbiculate,peltate, with radiating veins
- Flowers large, bisexual; floral whorls arise from the thalamus
- Sepals 4-5, free, caducous
- Petals many in several whorls, free, coloured, caducous
- Stamens numerous,caducous; anthers linear with prolonged appendage
- Ovary superior, unilocular, carpels several, free,embedded in fleshy torus
- Ripe carpels nut like, pericarp bony, smooth

● General Floral formula	⊕, ♀, K_{4-5}, A_{∞}, G_{∞}
● Number of genera in Kerala	1
● Number of species	1
● Number of RET species	–
● Number of endemic species	–
● Some Common examples	*Nelumbo nucifera*
● Some RET and endemic species	–

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Nymphaeaceae

Characteristic features	
➤ Dicot; aquatic perennial herb with submerged root stock ➤ Leaves alternate, floating,exstipulate ; blade simple, usually dentate, peltate with deep fissure ➤ Flowers solitary, regular,bisexual, showy; perianth differentiated; floral whorls arise from the thalamus ➤ Sepals 4 or more, free ➤ Petals many in several whorls, free and coloured ➤ Stamens numerous, inserted towards the upper edge of cupular receptacle ; anthers linear, introrse, filaments petaloid ➤ Ovary superior, syncarpous, multilocular with many ovules; stigmas sessile with radiating appendages ➤ Fruit a berry Ripe carpels nut like, pericarp bony, smooth	
● General Floral formula	$\oplus, \varphi, K_4, C_\infty, A_\infty, G_{(\infty)}$
● Number of genera in Kerala	1
● Number of species	3
● Number of RET species	–
● Number of endemic species	–
● Some Common examples	*Nymphea nouchali ,Nymphaea omarana var. omarana, , Nymphea omarana var. rosea, Nymphea pubescens*
● Some RET and endemic species	–

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Brassicaceae (Cruciferae)

Characteristic features	
➤ Dicot; **annual, biennial or perennial herbs** ➤ Leaves radical and cauline, alternate, exstipulate; rarely pinnate, compound ➤ Inflorescence racemose ➤ Flowers bisexual, regular, floral whorls arise from thalamus ➤ Sepals 4, free, arranged in two whorls ➤ Petals 4, **free, cruciform**; each petal with distinct limb and claw ➤ Stamens 6, in two whorls, **tetradynamous** ➤ Ovary superior, stipitate, **bilocular** due to false septum ➤ Fruit siliqua or silicula	
● General Floral formula	$\oplus, \varphi, K_{2+2}, C_4, A_{2+4}, \underline{G}_{(2)}$
● No. of genera and species in Kerala	4 genera; 8 species
● No. of RET species	Nil
● No. of endemic species	Nil
● Examples	*Brassica juncea*

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Capparidaceae

Characteristic features	
➤ Dicot; herbs, shrubs trees or climbers ➤ Leaves alternate, simple or palmately lobed, stipules minute or reduced to spines or glands ➤ Inflorescence racemose , corymbose or umbel; bracts often leafy ➤ Flowers bisexual, regular or zygomorphic ➤ Sepals 4, free in whorls of two, unequal ➤ Petals 4, free, usually equal, often clawed ➤ Stamens **4-many, sometimes connate with gynophore** ➤ Ovary superior,bicarpellary, unilocular, on **elongate gynophore; ovules parietal** ➤ Fruit a capsule or berry	
● General Floral formula	.I., or $\oplus, \varphi, K_{2+2}, C_4, A_{4-\infty}, \underline{G}_{(2)}$
● No. of genera and species in Kerala	5 genera; 29 species
● No. of RET species	R: 2(WG)
● No. of endemic species	5(WG)
● Examples	*Cleome burmannii, Cleome speciosa*
● Some RET and endemic species	*Capparis fusifera, Capparis rheedei, Capparis grandiflora*

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Theaceae

Characteristic features	
➤ Dicot; shrubs or small trees	
➤ Leaves alternate; simple, crenate, serrate; exstipulate,	
➤ Inflorescence of racemes, fascicles, or of a solitary flower	
➤ Flowers regular, bisexual, rarely unisexual	
➤ Sepals 5, free or connate at base, persistent	
➤ Petals 5, free or connate at base	
➤ Stamens 5-many, adnate to the base of petals	
➤ Ovary superior or half inferior, 2-6 locular, syncarpous	
➤ Fruit a berry or loculicidal capsule	
● General Floral formula	$\oplus, ♀, K_{5 \text{ or } (5)}, C_{5 \text{ or } (5)}, A_{5-\infty}, \underline{G}\ \overline{(2\text{-}6)}$
● No. of genera and species in Kerala	4 genus; 4 species
● No. of RET species	Nil
● No. of endemic species	Nil
● Examples	*Eurya nitida, Camellia sinensis*

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Malvaceae

Characteristic features	
➤ Dicot; herbs,shrubs or trees; **sap usually mucilaginous**, young parts often stellate hairy	
➤ Leaves **simple, alternate**, often palmately lobed or pinnatisect, **palmately veined, stipulate**	
➤ Inflorescence various, often racemes or of solitary flower	
➤ Flowers bisexual, regular, pentamerous	
➤ Sepals usually 5, free or fused, **epicalyx often present**	
➤ Petals 5, large and showy, free or adnate to the base of the staminal tube	
➤ Stamens epipetalous, **numerous**, usually **monadelphous; anthers monothecous**	
➤ Ovary superior, 5-many celled, syncarpous; style passes through staminal tube, stigmas free	
➤ Fruit capsule, schizocarp or berry	
➤ Seeds reniform or obovoid	
● General Floral formula	$\oplus, ♀, K_{5 \text{ or } (5)}, \overset{\frown}{C_5}, A_{(\infty)}, \overline{G}_{(2\text{-}\infty)}$
● No. of genera and species in Kerala	17 genera; 68 species
● No. of RET species	Endangered: 1 (K)
● No. of endemic species	3 (K)
● Examples	*Abelmoschus rugosus, Hibiscus rosa-sinensis*
● Some RET and endemic spcies	*Julostylis polyandra, Sida beddomei Hibiscus sreenarayanianus,*

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Oxalidaceae

Characteristic features	
➤ Dicot, acid herbs, rarely woody	
➤ Leaves radical or cauline and **alternate, digitate or 3-many foliate**	
➤ Flowers on axillary or radical umbel	
➤ Sepals 5, imbricate	
➤ Petals 5, contorted	
➤ Stamens 10, arranged in two whorls, filaments free or united at the base	
➤ Ovary superior, **2-more locular**, 5 celled, axile placentation	
➤ Fruit usually a capsule	
➤ Seeds non endospermic	
● General Floral formula	$\oplus, ♀, K_5, C_5, A_{5+5}, \underline{G}_{(5)}$
● No. of genera and species in Kerala	2 genera; 15species
● No. of RET species	E: 1(WG)
● No. of endemic species	3(WG); 3(K)
● Examples	*Averrhoa carambola, Biophytum sensitivum, Oxalis corniculata, Oxalis latifolia*
● Some RET and endemic species	*Biophytum congestiflorum, Biophytum insigne, Biophytum longipedunculatum*

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Rutaceae

Characteristic features

- Dicot; trees, shrubs, rarely herbs or climbers
- Leaves usually **alternate** and **compound**, **entire-serrate** exstipulate, **pellucid gland-dotted**, often with winged petiole
- Inflorescence may be cymose or racemose or of solitary flower
- Flowers usually bisexual, actinomorphic, rarely unisexual and zygomorphic; 4-5 merous
- **Sepals usually 5**, connate below
- Petals usually 5, **free**
- Stamens 10, rarely 8, occasionally **numerous**, arranged in **obdiplostemonous** manner, inserted around a distinct disc
- Ovary sessile, superior with 3,4 or 5 carpels, rarely numerous, syncarpous
- Fruit may be berry(hespiridium), drupe or capsule

● General Floral formula	.|. or ⊕ , ⚥ , $K_{5 \text{ or } (5)}$, C_5, $A_{8\text{-}10 \text{ or } \infty}$, $\underline{G}_{(3\text{-}5) \text{ or } \infty}$
● No. of genera and species in Kerala	20 genera; 39 species
● No. of RET species	R:2(WG), E:1(WG)
● No. of endemic species	6(WG)
● Examples	*Citrus aurantium ,Citrus limon*
● Some RET and endemic species	*Zanthoxylum rhetsa, Vepris bilocularis, Melicope indica*

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Vitaceae

Characteristic features

- Dicot; **tendriliferous** climbing herbs or shrubs; **stems and branches nodose**
- Leaves alternate, stipulate, simple or compound, usually crenate-serrate, **palmately veined**
- **Inflorescence leaf-opposed**, often axillary, cymose
- Flowers bisexual or unisexual, regular
- Sepals 4-5, fused, persistent
- Petals 4-5, caducous
- Stamens 4-5, opposite to petals, disc intrastaminal
- Ovary superior, bilocular, **style short or none**
- Fruit an indehiscent berry

● General Floral formula	⊕ , ⚥ , $K_{(4\text{-}5)}$, $C_{(4\text{-}5)}$, $A_{4\text{-}5}$, $\underline{G}_{(2)}$
● No. of genera and species in Kerala	7 genera; 28 species
● No. of RET species	Nil
● No. of endemic species	1(WG)
● Examples	*Vitis discolor, Vitis vinifera*
● Some RET and endemic species	*Cayratia pedata var.glabra*

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Anacardiaceae

Characteristic features

- Dicot; trees or shrubs, usually with **acrid sap**
- Leaves **alternate**, rarely opposite, **simple** or pinnately **compound**, exstipulate
- Inflorescence axillary or terminal **panicle**
- Flowers small, regular, bisexual or unisexual, **pentamerous**
- Sepals 3-5, free or fused, often accrescent or spathaceous
- Petals 3-5, free, rarely absent
- Stamens twice or as many as and alternate with petals [number of fertile stamens varies from 1-10], **unequal**, fused basally or free, inserted on **intrastaminal disc**, anthers bithecous
- Ovary superior rarely inferior, 1-6 **carpelled**, styles usually combined, stigma capitate, **single ovuled**
- Fruit a drupe
- Seeds non-endospermic

● General Floral formula	⊕ , ⚥ , $K_{(3\text{-}5)}$, $C_{3\text{-}5}$, $A_{(3\text{-}10) \text{ or } 3\text{-}10}$, $\underline{G}_{(1\text{-}6)}$
● No. of genera and species in Kerala	12 genera; 27 species
● No. of RET species	R:3(WG); E:1(WG), 1(K); T:2(WG)
● No. of endemic species	12 (WG) ; 2 (Kerala)
● Examples	*Mangifera indica*
● Some RET and endemic species	*Holigarna grahamii, Nothopegia aureo-fulva, Solenocarpus indicus*

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Caesalpiniaceae

Characteristic features

- Dicot; trees, shrubs or herbs, often climbers
- Leaves alternate, **uni-** or **bi-pinnately compound; leaflets exstipellate; rarely simple**
- Inflorescence racemose
- Flowers bisexual, **zygomorphic** rarely regular, often large, showy, pentamerous
- Sepals 5, free or basally connate, **enclosing disc**
- Petals 5, free or 0, **subsimilar with distinct claw; aestivation ascendingly imbricate**
- Stamens **10 or fewer due to abortion**, rarely numerous
- Ovary superior, **monocarpellary**, **unilocular**, free or stipitate
- Fruit a dry pod-either **legume or loment**

● General Floral formula	.|., ⚥, $K_{5 \text{ or } (5)}$, C_5, A_{10}, $\underline{G}_1$
● No. of genera and species in Kerala	17 genera; 60 species
● No. of RET species	E:6(WG); E: 1(K)
● No. of endemic species	11(WG); K(1)
● Examples	*Senna biflora, Caesalpinia pulcherrima*
● Some RET and endemic species	*Cynometra beddomei, Cynometra travancorica, Dialium travancoricum, Senna intermedia*

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Fabaceae (Papilionaceae)

Characteristic features

- Dicot; herbs, shrubs, trees or climbers
- Leaves alternate, usually **uni-pinnate**, sometimes trifoliate, rarely simple; **stipellate**
- **Inflorescence** axillary or terminal racemes or panicles, rarely of solitary flower
- Flowers bisexual, pentamerous, irregular
- Sepals 5, usually connate, often unequal
- Petals 5, usually free, unequal, upper **(standard) petal outermost, suborbicular**; lateral ones **(wings)** oblong, lower **(keel)** upcurved
- Stamens normally 10, often diadelphous [9+1 or 5+5], rarely fewer, sometimes indefinite
- Ovary superior, unilocular; style usually with a sharp bend, stigma capitate
- Fruit a dry pod

● General Floral formula	.|., ⚥, $K_{(5)}$, $C_{(5)}$, $A_{(9)+1}$, $\underline{G}_{(1)}$
● No. of genera and species in Kerala	55 genera; 278 species
● No. of RET species	R:7(WG), 1(K); E:3(WG), 1(K); T: 1(WG)
● No. of endemic species	42(WG); 5(K)
● Examples	*Arachis pintoii, Clitoria ternatea, Desmodium triflorum, Dalbergia latifolia*
● Some RET and endemic species	*Cajanus lineatus, Crotalaria barbarata, Crotalaria bidiei, Dalbergia beddomei*

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Mimosaceae

Characteristic features

- Dicot; Shrubs, trees, rarely climbers or herbs
- Leaves alternate, usually **bipinnate**, sometimes trifoliate, rarely simple; **stipellate or exstipellate**
- Inflorescence a **spherical head** or a **compound spike**
- Flowers bisexual, regular, small
- Sepals 5, usually connate, often unequal
- Petals 5, connate, equal
- Stamens often many or 10, rarely 4 or 8
- Ovary superior, unilocular, stipitate
- Fruit a dry pod or lomentum

● General Floral formula	.|., ⚥, $K_{(5\text{-}4)}$, $C_{(5\text{-}4)}$, $A_{\infty\text{-}10}$, $\underline{G}_{(1)}$
● No. of genera and species in Kerala	18 genera; 43 species
● No. of RET species	R:1(WG)
● No. of endemic species	K :2(WG)
● Examples	*Acacia aroma, Calliandra haematocephala, Mimosa pudica*
● Some RET and endemic species	*Albizia lathamii, Archidendendron monadelphum, Inga cynometroides*

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Rosaceae

Characteristic features	
➤ Dicot; trees, shrubs or herbs. Very often climbing and spiny at the nodes and internodes ➤ Leaves alternate, rarely opposite; simple or pinnately compound, petiolate, stipulate, leaf margin serrated or entire ➤ Inflorescence various- corymbose, corymb, umbellate, racemose or of solitary flower ➤ Flowers usually bisexual, rarely unisexual, actinomorphic ➤ Sepals 5, fused ➤ Petals 5, rarely 4, free, arise from the rim of hypanthium, sometimes absent ➤ Stamens **free**, usually indefinite (15-60), sometimes 5-10, arranged in 1-many whorls, **arising from hypanthium** ➤ Ovary superior, **carpels 1-many**, fused or free ➤ Fruit dry or fleshy, may be a pome, pyriform berry, an etaerio of achenes or one seeded drupe	
● General Floral formula	⊕, ♀♂, $K_{(5)}$, C_5, A_∞, $\underline{G}_{1-\infty}$
● No. of genera and species in Kerala	2 genus; 6 species
● No. of RET species	Nil
● No. of endemic species	Nil
● Examples	*Rosa multiflora, Rubus niveus*

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Caricaceae

Characteristic features		
➤ Dicot; **trees, stem hollow, latex milky** ➤ **Leaves alternate, estipulate large, palmately lobed and subdivided; leaf scars prominent** ➤ Inflorescence a pendulous raceme in fascicles ➤ **Flowers unisexual** ➤ Staminate flowers: **stamens in 2-whorls**, outer stalked, inner ones sessile ➤ Pistillate flowers : 2-4 per axil, **all but one abortive; ovary inferior**, 3-5 carpels united, unilocular ➤ Fruit spherical to oblong berry		
● General Floral formula	⊕, ♀, $K_{(5)}$, $C_{(5)}$, A_0, $\overline{G}_{(3-5)}$	⊕, ♂, $K_{(5)}$, $C_{(5)}$, A_{5+5}, G_0
● No. of genera and species in Kerala	1 genus; 1 species	
● No. of RET species	Nil	
● No. of endemic species	Nil	
● Examples	*Carica papaya*	

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Cucurbitaceae

Characteristic features		
➤ Dicot; annual or perennial, **trailing vines with tendrils** ➤ Leave simple, alternate, **palmately** lobed and **veined**, exstipulate ➤ Inflorescence axillary raceme, umbel, fascicle or of single flower ➤ Flowers regular, unisexual, rarely bisexual and either **monoecious** or **dioecious** ➤ Sepals 5, fused ➤ Petals 5, fused ➤ Stamens **usually 5, seemingly 3 due to synandrous condition** ➤ Ovary **inferior, unilocular, carpels 3, fused** ➤ Fruit a pepo, seeds often compressed		
● General Floral formula	⊕, ♀, $K_{(5)}$, $C_{(5)}$, A_0, $G_{(3)}$	⊕, ♂, $K_{(5)}$, $C_{(5)}$, $A_{3 \text{ or } (5)}$, G_0
● No. of genera and species in Kerala	20 genera; 43 species	
● No. of RET species	R:2(WG); R&T: 1(K)	
● No. of endemic species	1(WG), 1(K)	
● Examples	*Coccinea grandis*	
● Some RET and endemic species	*Luffa umbellata, Trichosanthes anamalaiensis, Zehneria maysorensis*	

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Cactaceae

Characteristic features	
➤ Dicot; perennial herbs, shrubs, trees or climbers; mostly fleshy succulents of xerophytic habits ➤ Stem jointed or not, fluted or terete, armed with spiny areoles and barbed bristles ➤ Leaves usually reduced, modified or absent ➤ Inflorescence mostly of a solitary flower, rarely panicle ➤ Flowers bisexual, regular, often large and brightly colored ➤ Perianth of many lobes, outer smaller calycine, inner petaloid; connate at base ➤ Stamens numerous, often epiphyllus ➤ Ovary inferior,unilocular; 3-many carpelled, syncarpous ➤ Fruit a fleshy berry	
● General Floral formula	⊕, or ♂ ♀ $\overline{G}_{(3-\infty)}$
● Number of genera ad species in Kerala	3 genera; 5 species
● Number of RET species	–
● Number of endemic species	–
● Some Common examples	*Cereus jamakaru, Mammillaria bocasana, Mammillaria bombycina, Opuntia ficus-indica*

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Apiaceae (Umbelliferae)

Characteristic features	
➤ Dicot; annual, biennial or perennial herbs; rarely shrubs ➤ Leaves alternate or radical, exstipulate, blade simple or compound, petiole usually sheathing ➤ **Inflorescence an umbel**, simple or compound ➤ Flowers regular often zygomorphic, bisexual or polygamous, bracts in the form of involucre ➤ Sepals 5, free, adnate to ovary ➤ **Petals 5, free, rarely absent** ➤ Stamens 5, alternate to petals ➤ Ovary inferior, bilocular, syncarpous, **crowned by two lobed disc** ➤ **Fruit a cremocarp**	
● General Floral formula	⊕ or .|. , ♂, K_5, C_5, A_5, $\overline{G}_{(2)}$
● No. of genera and species in Kerala	13 genera; 26 species
● No. of RET species	Rare: 2(WG); T:1(WG); E: 1(WG)
● No. of endemic species	11(WG)
● Example	*Eryngium foetidum, Centella asiatica*
● Some RET and endemic species	*Peucedanum anamallayense,Pimpinella pulneyensis, Polyzygus tuberosus, Vanasushava pedata*

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Rubiaceae

Characteristic features	
➤ Dicot; trees, shrubs, herbs or climbers ➤ Leaves simple, opposite, decussate or whorled; entire or rarely toothed; **stipules conspicuous, inter or intrapetiolar** ➤ Inflorescence **various but basically a dichasial cyme** ➤ Flowers bisexual, regular, **4-6 merous** ➤ Sepals 4- 5, fused, truncate or lobed ➤ Petals 4-5, fused, tubular or companulate ➤ Stamens 4-5, epipetalous, alternate to corolla lobes, **anthers free** ➤ Ovary **inferior**, usually bicarpellary, syncarpous, disc annular ➤ Fruit a berry, capsule or drupe	
● General Floral formula	⊕ , ♂ , $K_{(4-5)}$, $\overline{C_{(4-5)}}$, A_{4-5}, $\overline{G}_{(2)}$
● No. of genera and species in Kerala	50 genera; 242 species
● No. of RET species	R:14(WG), 1(K); E:24(WG), 6(K); T:3(WG), 1(K)
● No. of endemic species	89(WG), 23(K)
● Examples	*Ixora coccinea 'Nana Red', Ixora singaporensis, Mussaenda philippica 'Aurorae', Pentas karmesiana, Serissa foetida 'Variegata'*
● Some RET and endemic species	*Hedyotis albo-nervia, Hedyotis articularis*

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Asteraceae

Characteristic features

- Dicot; herbs, shrubs or climbers, rarely small trees; **largest family in Angiosperms**
- Leaves usually alternate, rarely opposite or whorled, often radical; estipulate
- **Inflorescence 1-few-many- flowered capitulum (Head), subtended by involucre of bracts**; the capitulum may be homogamous or heterogamous of 3-kinds: **ligulate, discoid or tubular**; receptacle flat or raised, glabrous or pilose, fimbriate or paleate
- Flowers **bisexual** or **unisexual**, **regular (tubular)** or **irregular (ligulate)**
- Calyx segments **(pappus) modified into bristles, hairs or scales, sometime absent**
- Corolla tubular, usually with 5 lobed limb, ligulate or dentate; disc annular
- Stamens 5, epipetalous, **syngensious**, alternating with corolla
- **Ovary inferior**, carpels 2, syncarpous, **unilocular**
- Fruit cypsela (1-seeded achene)

● General Floral formula	$\oplus$, ⚥, $K_{0\text{-pappus}}$, $\widehat{C_{(5)}, A_{(5)}}$, $\overline{G}_{(2)}$	.|., ♀, $K_{0\text{-pappus}}$, $C_{(5)}$, A_0, $\overline{G}_3$
● No. of genera and species in Kerala	60 genera; 182 species	
● No. of RET species	R: 6(WG); E:6 (WG), E:1(K);T:4(WG)	
● No. of endemic species	37(WG); 2(K)	
● Examples	*Aster azureus, Aster laevis, Coryopsis lanceolata, Helianthus helianthoides 'Ballerina'*	
● Some RET and endemic species	*Anaphalis travancorica, Vernonia travancorica, Youngia nilgiriensis*	

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Apocynaceae

Characteristic features

- Dicot; herbs, shrubs, trees or climbers usually **with milky latex**
- Leaves simple, opposite or whorled, exstipulate
- Inflorescence axillary or terminal cyme, corymbs or panicles
- Flowers regular, bisexual, pentamerous
- Sepals 5, fused
- Petals 5, fused, **often with corona**
- Stamens 5,epipetalous, inserted in the corolla tube
- Ovary superior, carpels 2
- Fruit mostly follicle, sometimes drupe, berry or capsule

● General Floral formula	$\oplus$, ⚥, $K_{(5)}$, $C_{(5)}$, A_5, $\underline{G}_{(2)\text{ or }2}$
● No. of genera and species in Kerala	26 genera; 40 species
● No. of RET species	R&T: 1(WG); E:1(WG)
● No. of endemic species	7(WG)
● Examples	*Alstonia venenata, Catharanthus roseus, Kopsia fruticosa, Tabernaemontana divaricata 'Dwarf', Wrightia antidysenterica*
● Some RET and endemic species	*Ichnocarpus frutescens, Rauvolfia hookeri, Rauvolfia micrantha, Tabernaemontana heyneana*

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Convolvulaceae

Characteristic features

- Dicot; scandent herbs or shrubs
- Leaves simple, alternate, exstipulate, venation pinnate or palmate
- Inflorescence axillary cyme or of solitary flower
- Flowers regular, bisexual, pentamerous
- Sepals 5, free or fused, persistent
- Petals 5, fused, campanulate or funnel shaped
- Stamens 5, free,epipetalous, alternate with the corolla lobes
- Ovary superior, bi-locular
- Fruit a loculicidal capsule, berry or nut

● General Floral formula	$\oplus$, ⚥, K_5, $\widehat{C_{(5)}, A_5}$, $G_{(2)}$
● No. of genera and species in Kerala	16 genera; 76 species
● No. of RET species	E:1(K)
● No. of endemic species	3(WG); 2(K)
● Examples	*Argyreia hirsuta*
● Some RET and endemic species	*Argyreia sericea, Lepistemon leiocalyx, Neuropeltis malabarica*

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Solanaceae

Characteristic features

- Dicot; erect or climbing herbs or shrubs,rarely small trees
- Leaves alternate, **often unequally paired in upper parts**, simple, exstipulate, often pinnate
- Flowers **regular**, bisexual on cymose inflorescence, often solitary
- Sepals 5, fused, persistent and often accrescent in fruit
- Petals 5, fused, funnel or cup shaped, **lobes plicate or convolute**
- Stamens 5, as many as and alternate with petals, sometimes 4 or didynamous, epipetalous
- Ovary superior, bilocular (often becomes 3-5 locular due to false septation), fused, **placentation axile**, nectariferous disc present
- Fruit a berry or septicidal capsule

● General Floral formula	$\oplus, \varphi, K_{(5)}, \overset{\frown}{C_{(5)}}, \overset{\frown}{A}_{5 \text{ or } 2+2}, \underline{G}_{(2)}$
● No. of genera and species in Kerala	11 genera; 39 species
● No. of RET species	Nil
● No. of endemic species	1(WG)
● Examples	*Capsicum annuum, Lycopersicum esculentum Solanum americanum, Withania somnifera*
● Some RET and endemic species	*Solanum vagum*

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Scrophulariaceae

Characteristic features

- Dicot; herbs, shrubs, rarely small trees
- Leaves may be alternate, opposite or whorled, exstipulate; **often showing heterophylly**
- Inflorescence cymose or racemose; sometimes flower solitary
- Flowers bisexual, **irregular**, rarely regular
- Sepals 5, fused, persistent
- Petals 5, fused, **bilipped, spurred** or **saccate**
- Stamens 4, epipetalous; didynamous or 2 (with 2 staminodes)
- Ovary superior,bilocular, carpels 2, syncarpous, situated on a necter secreting disc (**placentation axillary)**
- Fruit generally capsule, rarely berry

● General Floral formula	$.\mid., \varphi, K_{(5)}, \overset{\frown}{C_{(5)}}, \overset{\frown}{A}_{4 \text{ or } 2}, \underline{G}_{(2)}$
● No. of genera and species in Kerala	27 genera; 68 species
● No. of RET species	E:1(WG)
● No. of endemic species	3(WG); 1(K)
● Examples	*Angelonia salicariaefolia, Otacanthus caeruleus, Russelia equisetiformis, Angelonia grandiflora, Torenia bicolor*
● Some RET and endemic species	*Adenosma malabaricum, Lindernia manilaliana, Micrargeria wightii*

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Bignoniaceae

Characteristic features

- Dicot; trees, shrubs or climbers
- Leaves opposite, **compound, odd-pinnate**; exstipulate
- Inflorescence paniculate or racemose
- Flowers , irregular, bisexual, showy
- Sepals 5, fused, companulate
- Petals 5, fused, **tubular ventricose, usually bilipped**
- **Stamens 4**, epipetalous, included, a**lternate** with petals, didynamous; often with staminode
- Ovary **superior**, bilocular; bicarpellary, syncarpous; **ovules many**
- Fruit bivalved woody capsule, **seeds winged**

● General Floral formula	$.\mid., \varphi, K_{(5)}, \overset{\frown}{C_{(5)}}, \overset{\frown}{A}_{4}, \underline{G}_{(2)}$
● No. of genera and species in Kerala	16 genera; 19 species
● No. of RET species	Nil
● No. of endemic species	Nil
● Examples	*Podranea ricasoliana, Tecomaria capensis, Tecoma goudichadi*

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Acanthaceae

Characteristic features	
➤ Dicot; herbs, shrubs or climbers; sometimes spiny ➤ Leaves opposite, simple, exstipulate ➤ Inflorescence cymose, racemose or of solitary flower ➤ Flowers bisexual, zygomorphic with prominent bracts and bracteoles ➤ Sepals 4-5, fused ➤ Petals 5, fused, 2-lipped, sometimes nearly regular ➤ Stamens 2, if 4 then didynamous, rarely 5; epipetalous ➤ Ovary superior, bilocular, syncarpous, disc present ➤ Fruit a loculicidal capsule ➤ Seeds usually supported on retinacula	
● General Floral formula	+, ♀, $K_{(4-5)}, \overset{\frown}{C_{(5)}, A_{2 \text{ or } 4}}, G_{(2)}$,
● Number of genera in Kerala	34
● Number of species in kerala	180
● Number of RET species	Rare: 1(WG), Endangered: 1(WG)
● Number of endemic species	55(WG); 7(Kerala)
● Some Common examples	*Asystasia gangetica, Barleria cristata 'Candida', Barleria strigosa, Crossandra infundibuliformis, Graptophyllum pictum, Thunbergia hybrida*
● Some RET and endemic species	*Andrographis affinis, Andrographis atropurpurea, Andrographis elongata, Andrographis explicata, Thunbergia bicolor*

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Verbenaceae

Characteristic features	
➤ Dicot; herbs, shrubs, trees or climbers ➤ **Stems and branches are usually quadrangular**, often prickly ➤ Leaves simple, rarely compound, **opposite or whorled**, rarely alternate, exstipulate ➤ Inflorescence raceme, panicle or spike; bracteate ➤ Flowers bisexual, usually irregular, **pentamerous** ➤ Sepals 5, rarely 4 or more, fused, persistent ➤ Petals 5, fused, **salverform**, tube erect or curved; limb bi-lipped or five lobed ➤ Stamens 4, **equal or didynamous**, epipetalous; rarely 2 or 5 ➤ Ovary superior, bilocular, rarely 4-8 locular ➤ Fruit a drupe, rarely capsule	
● General Floral formula	.|., ⚥, $K_{(5)}, \overset{\frown}{C_{(5)}, A_4}, \underline{G}_{(2)}$
● No. of genera and species in Kerala	14 genera; 55 species
● No. of RET species	Rare: 2(WG)
● No. of endemic species	3(WG)
● Examples	*Clerodendrum paniculatum, Clerodendrum thompsonae, Clerodendrum macrosiphon, Stachytarpheta australis*
● Some RET and endemic species	*Premna villosa, Premna glaberrima, Premna wightiana*

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Lamiaceae

Characteristic features	
➤ Dicot; annual or perennial **herbs**, rarely shrubs; with aromatic oil glands, stem quadrangular ➤ Leaves opposite or whorled, simple or rarely pinnatisect, margin usually serrate, exstipulate ➤ Inflorescence **verticillaster**, often reduced to true cyme, rarely flowers solitary ➤ Flowers bisexual, zygomorphic ➤ Sepals 4-5,unequal or 2-lipped, persistant, fused ➤ Petals 4-5, lobed or **bilipped**, fused ➤ Stamens **alternate with petals, usually 4, didynamous, rarely 2**, epipetalous ➤ **Ovary superior, 4-lobed,with gynobasic style**, bicarpellary (due to false septa 4 carpels formed) syncarpous, disc prominent, hypogynous ➤ Fruit 4- 1 seeded erect nutlets ➤ Seeds small, non endospermic	
● General Floral formula	.|., ⚥, $K_{(4-5)}, \overset{\frown}{C_{(4-5)}, A_{2+2 \text{ or } 2}}, \underline{G}_{(2)}$
● No. of genera and species in Kerala	22 genera; 115 species
● No. of RET species	R:1(WG); R&T: 2(WG); E:2(WG)
● No. of endemic species	23 (WG) : 3(Kerala)
● Examples	*Ocimum tenuiflorum, Salvia coccinea, Salvia splendens*
● Some RET and endemic species	*Leucas pubescens, Pogostemon atropurpureus, Pogostemon vestilus*

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Amaranthaceae

Characteristic features

- Dicot ; herbs, rarely shrubs
- Leaves opposite or alternate, exstipulate
- Inflorescence an axillary cyme, spike or raceme
- **Flowers small**, regular, bisexual, rarely unisexual, pentamerous
- Tepals 3-5, free or basally connate, **scarious**
- Stamens as many as tepals, sometimes with pseudostaminodes
- Ovary superior, unilocular rarely 2-3 celled
- Fruit 1-many seeded utricle, rarely capsule, nut or berry, Seeds albuminous

● General Floral formula	$\oplus$, ⚥, $P_{3\text{-}5 \text{ or } (3\text{-}5)}$, $A_{3\text{-}5}$, $\underline{G}_{(2\text{-}3)}$
● No. of genera and species in Kerala	14 genera; 40 species
● No. of RET species	Nil
● No. of endemic species	1(WG)
● Examples	*Amaranthus caudatus, Amaranthus spinosus, Celosia argentea var.plumosa, Gomphrena globosa, Iresine herbstii 'Aureo-reticulata', Iresine lindenii*
● Some RET and endemic species	*Indobanalia thyrsiflora*

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Basellaceae

Characteristic features

- Dicot; much branched succulent, **twining** herbs with perennial rhizome
- Leaves entire, alternate, subsucculent
- Inflorescence spicate
- Flowers sessile, regular, bisexual; bracts caducous, **bracteoles 2, united into a cup; adnate to and larger than tepals**
- Perianth petaloid or calycine, fleshy, 5 lobed, connate, accrescent
- Stamens 5, epiphyllus, **anthers versatile**
- Ovary half inferior or superior, unilocular
- Fruit a **globose utricle**

● General Floral formula	$\oplus$, ⚥, $\widehat{P_{(5)}, A_5}$, $G_{\bar{3}}$ or $\underline{G}_3$
● No. of genera and species in Kerala	1 genus; 1 species
● No. of RET species	Nil
● No. of endemic species	Nil
● Examples	*Basella alba*

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Aristolochiaceae

Characteristic features

- Dicot ; herbs or shrubs often climbing from a woody base
- Leaves alternate, simple, entire or lobed, **palmately veined** , exstipulate
- Inflorescence axillary or terminal; fascicles, short raceme or a single flower
- Flowers **regular or irregular**, bisexual
- Tepals 3, corolline, **tubular or half inflated and ventricose at base**, variously free or united above
- Stamens 6-numerous, free or adnate to style and stigma
- Ovary inferior, 4-6 celled
- Fruit usually 4-6 valved, many seeded septicidal capsule or berry

● General Floral formula	$\oplus$ or .|. , ⚥, P_3, $A_{6\text{-}\infty}$, $G_{(4\text{-}6)}$
● No. of genera and species in Kerala	2 genera; 12 species
● No. of RET species	E: 1
● No. of endemic species	3(K): 4(WG)
● Examples	*Aristolochia elegans, Aristolochia indica, Thottea siliquosa*
● Some RET and endemic species	*Thottea barberi, Aristolochia krisagathra, Thottea idukkiana*

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Euphorbiaceae

Characteristic features		
➤ Dicot; herbs, shrubs or trees, **very often with acrid milky sap**		
➤ Leaves usually alternate, simple, rarely compound, **stipulate**		
➤ Inflorescence usually of axillary cymes or spikes or cyathium, bracteate		
➤ Flowers **unisexual**, regular, usually **monoecious**		
➤ Sepals 3-5, free or absent		
➤ Petals 4-5, free; **in genus Euphorbia flowers are naked, arranged in flower like cyathia**		
➤ Stamens 1- many, usually free, **anthers erect in bud**, disc present		
➤ Ovary superior, tricarpellary, syncarpous **usually 3-locular, ovules 2 in each locule**, nectariferous gland present		
➤ Fruit a schizocarp or septicidal capsule		
● General Floral formula	$\oplus, ♀, K_{3-5}, C_{4-5}, A_0, \underline{G}_3$	$\oplus, ♂, K_{3-5}, C_{4-5}, A_{1-\infty}, G_0$
● No. of genera and species in Kerala	46 genera; 80 species	
● No. of RET species	E:4(WG);E:2(K) R:7(WG); T:3(WG)	
● No. of endemic species	30(WG); 7(K)	
● Examples	*Acalypha chamaedrifolia, Acalypha hispida, Euphorbia milii, Euphorbia pulcherrima, Jatropha podagrica*	
● Some RET and endemic species	*Phyllanthus megacarpa, Euphorbia santapaui, Aporosa bourdillonii, Cleistanthus sankunnianus*	

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Orchidaceae

Characteristic features	
➤ Monocot; perennial herbs, terrestrial(with or without subterranean tubers),epiphytic or saprophytic; stem monopodial or sympodial, often swollen into pseudobulbs	
➤ Leaves alternate, often distichous, or rarely opposite, often fleshy, linear to ovate, with convergentor divergent veins	
➤ Flowers bracteate,bisexual, irregular[medianly zygomorphic],often showy; usually resupinate	
Tepals 6, arranged in two trimerous petaloid whorls, segments of outer whorl almost equal; inneranterior	
➤ tepal(lip or labellum) greatly modified enclosing column; lateral two equal	
➤ Stamens highly modified with only 1-2 fertile ones; filaments united with style to form a column(gynostegium); tip of the column(rostellum) bears stigmas and 1-2 fertile anthers; pollen grains agglutinated into 2-8 pollinia, column sometime produced into a foot which adnate to lateral sepals forming mentum	
➤ Ovary inferior, unilocular, tricarpellary, syncarpous; stigmas 3,of which 2 often fused and functional; third one absent or modified into rostellum	
● Fruit a capsule, Seeds numerous, minute	
● General Floral formula	$\uparrow ♂ ♀, P_{3+3}, A_{1 \text{ or } 2}, \underline{\overline{G}}_{(3)}$
● Number of genera in Kerala	73
● Number of species in Kerala	248
● Number of RET species	R&T: 2(WG), 1(K) ; E: 3(WG), 1(K); T: 2(WG)
● Number of endemic species	82 (WG) : 19(Kerala)
● Examples	*Cymbidium aloifolium, Bulbophyllum rosemarianum, Pholidota imbricate, Rhynchostylis retusa, Spathoglottis plicata, Spathoglottis plicata'Hybrid'*
● Some RET and endemic species	*Bulbophyllum aureum, Corymborkis veratrifolia, Taeniophyllum scaberulum*

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Bromeliaceae

Characteristic features	
➤ Monocot; **terrestrial** or **epiphytic herbs**; rarely shrubby or arboreus; foliage color varies from green to different hues	
➤ Leaves usually arranged as **basal rosettes, leathery; margin spiny, base sheathing**	
➤ Inflorescence a spike, raceme, panicle or capitule; **bracts usually brightly colored**	
➤ Flower bisexual, perianth in two whorls, **corolloid**	
➤ Sepals 3, free or connate	
➤ Petals 3, connate	
➤ Stamens 6, free or connate	
➤ Ovary inferior,half inferior or superior, carpels 3, syncarpous,	
➤ Fruit a **baccate**, berry or septicidal capsule	
● General Floral formula	.|. or $\oplus, ♂ ♀, K_3, C_{(3)}, A_6, \underline{\overline{G}}_{(3)}$
● No. of genera and species in Kerala	4 genera; 7 species
● No. of RET species	Nil
● No. of endemic species	Nil
● Examples	*Ananas comosus, Ananas nanus, Billbergia 'Fantasia', Cryptanthus bivittatus 'Tricolor', Neoregelia carolinae, Neoregelia* sp.

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Cannaceae

Characteristic features

- Monocot; perennial herbs with **erect stem**
- Leaves large, alternate, sheath closed, ligule absent, venation striate, **petiole not pulvinate**
- Inflorescence a branching spike, bracteate
- Flower bisexual, **irregular, showy**
- Perianth in two whorls
- Sepals 3, free, **sub equal, herbaceous**, persistent
- Petals 3, basally connate, narrow, **colored, shorter than petaloid staminodes**
- **Androecium highly modified, tubular below, 3-5 segments petaloid, colored; stamen 1 bearing single anther cell on the margin of a petaloid staminode**
- Ovary inferior, carpels 3, syncarpous, **ovules many per locule, style petaloid**
- Fruit a 3-valved **warty capsule**

● General Floral formula	.I., ⚥, K_3, $C_{(3)}$, A_1, $\overline{G}_{(3)}$
● No. of genera and species in Kerala	1 genus; 1 species
● No. of RET species	Nil
● No. of endemic species	Nil
● Examples	*Canna x generalis,* *Canna x generalis* ' Striped Beauty'

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Zingiberaceae

Characteristic features

- Monocot; perennial herbs with **aromatic fleshy rhizome often with tubers; aerial stem stright**
- Leaves **distichous**, basal or cauline, sheaths open, ligulate, venation striate or smooth
- Inflorescence a bracteate raceme or spike, often panicle on terminal leafy or basal, leafless shoots
- Flowers, bisexual, irregular, bracteate, perianth distinguishable into **calyx and corolla**
- Sepals 3, united
- Petals 3, **often showy, connate, usually the posterior lobe large and hooded**
- Stamens in 2-whorls, inner whorl with **one fertile stamen**, other 2 fused and modified to form **petaloid labellum; outer whorl with 2 petaloid staminodes** or absent
- Ovary inferior, 3-locular, **style filiform, clasped by anthers**
- Fruit a loculicidal capsule or [berry] bacca

● General Floral formula	.I., ⚥, $K_{(3)}$, $\widehat{C_3, A_1}$, $\overline{G}_{(3)}$
● No. of genera and species in Kerala	9 genera; 51 species
● No. of RET species	T: 1(WG)
● No. of endemic species	7(K); 5(WG)
● Examples	*Alpinia purpurata ,Curcuma longa, Curcuma zeodaria, Hedychium coronarium, Kaempferia galanga, Kaempferia pulchra*
● Some RET and endemic species	*Alpinia smithiae, Boesenbergia pulcherrima, Curcuma coriacea, Hedychium venustum*

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Liliaceae

Characteristic features

- Monocot; herbs, sometimes climbing, rarely shrubs or trees; root stock a rhizome, bulb, corm or tuber with fibrous to fleshy roots
- Leaves simple, cauline or radical, parallel veined
- Inflorescence axillary or terminal racemose; often flowers solitary
- Flowers regular, bisexual, 3-merous
- Perianth petaloid, 6-merous arranged in two whorls, free or connate
- Stamens usually 6 in 2-whorls, rarely 3, epipetalous, filaments free or connate, anthers versatile
- Ovary superior, **tricarpellary, syncarpous**, fused or free
- Fruit berry or capsule

● General Floral formula	⊕, ⚥, $\widehat{P_{3+3 \text{ or } (3+3)}, A_{3+3 \text{ or } (3+3)}}$, $\underline{G}_{(3)}$
● No. of genera and species in Kerala	8 genera; 15 species
● No. of RET species	Nil
● No. of endemic species	3(WG)
● Examples	*Chlorophytum laxum, Dianella tasmanica, Dianella tasmanica 'Variegata'*
● Some RET and endemic species	*Chlorophytum attenuatum, Diosporum leschenaultianum*

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Dracaenaceae

Characteristic features	
➤ Monocot; shrubs or small trees ➤ Leaves alternate, basal or crowded and sub terminal; sheathing at base ➤ Inflorescence raceme, panicle, head or an umbel ➤ Flowers bisexual, regular ➤ Tepals 6, **connate below in a tube** ➤ Stamens 6, epipetalous ➤ Ovary superior, 3-locular, **ovules solitary in each cell** ➤ Fruit a globose berry	
● General Floral formula	$\oplus, ⚥, \overset{\frown}{T_6, A_6}, \underline{G}_{(3)}$
● No. of genera and species in Kerala	2 genera; 6 species
● No. of RET species	Nil
● No. of endemic species	Nil
● Examples	*Dracaena fragrans 'Victoriae', Dracaena godseffiana, Dracaena deremensis ' Compacta', Sansevieria cylindrica*

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Aloaceae

Characteristic features	
➤ Monocot; succulent herbs with **rhizomatous root stock** ➤ **Leaves fleshy**, arranged in rosette, **margin spiny**, apex tapering and spine tipped ➤ Inflorescence raceme; scapes 1-3 ➤ Flowers bisexual, regular ➤ Perianth **petaloid**, lobes 6, **united throughout** ➤ **Stamens 6**, arranged in two whorls ➤ Ovary **superior, trilocular**, fused ➤ Fruit a loculicidal capsule	
● General Floral formula	$\oplus, ⚥, P_{(6)}, A_{3+3}, \underline{G}_{(3)}$
● No. of genera and species in Kerala	1 genera; 5 species
● No. of RET species	NIL
● No. of endemic species	NIL
● Examples	*Aloe vera, Aloe abyssinica, Aloe bakeri, Aloe jucunda, Aloe barbedensis*

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Commelinaceae

Characteristic features	
➤ Monocot, annual or perennial succulent herbs with swollen nodes; often with tuberous roots ➤ Leaves simple, alternate, venation parallel, sheath closed ➤ Inflorescence helicoid cyme either terminal or axillary with spathaceous bracts ➤ Flowers bisexual, rarely unisexual; usually regular, trimerous ➤ Perianth 6 in 2 whorls; outer whorl green, membranaous, free; inner one colored, free or connate ➤ Stamens 6, often few reduced to staminodes ➤ Ovary superior, tricarpellary, syncarpous, trilocular ➤ Fruit a loculicidal capsule rarely berry	
● General Floral formula	$\oplus, ⚥, K_{2\text{-}3}, C_{2\text{-}3}, A_{3+3}, \underline{G}_{(3)}$
● No. of genera and species in Kerala	7 genera; 55 species
● No. of RET species	Rare: 2(WG)
● No. of endemic species	4(WG)
● Examples	*Callisia repens, Cyanotis somaliensis, Tradescantia spathacea 'Compacta' ,Tradescantia spathacea, 'Tradescantia spathacea 'Compacta Variegata', Tradescantia zebrina*
● Some RET and endemic species	*Aneilema ovalifolia, Cyanotis burmanniana, Cyanotis vaginata*

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Araceae

Characteristic features

- Monocot; herbs or climbing shrubs; perennials with rhizomatous or tuberous root stock
- Leaves simple, radial often alternate; entire of lobed and variously compound; venation reticulate, petiole base sheathing
- Inflorescence a spadix surrounded by single, often colourful bract
- Flowers regular, usually unisexual and naked; bisexual flowers often present
- Perianth 4-6 or 0
- Stamens 2-8, arranged in two whorls, sometimes fused into synandria
- Ovary superior, 1-3 celled
- Fruit a berry

General Floral formula	$\oplus, \hat{\delta}$ or ♀ or ☿, $P_{0\text{-}6}$, $A_{2\text{-}8}$, $\underline{G}_{(1\text{-}3)}$
Number of genera in Kerala	20
Number of species in kerala	62
Number of RET species	T: 4 (WG), R:1 (WG)
Number of endemic species	33 (WG)
Some Common examples	*Alocasia amazonica, Diffenbachia daguense, Monstera deliciosa, Diffenbachia amoena 'Tropic Snow', Diffenbachia maculata Rudolph Roehrs', Spathiphyllum clevelandii, Spathiphyllum wallisii Pothos scandens*
Some RET and endemic species	*Typhonium flagelliformae, Theriophonum sivaganganum, Pothos keralensis, Pothos armatus*

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Alismataceae

Characteristic features

- Monocot; annual or perennial herbs of wet habitat with stout rhizome, often with milky juice
- Leaves radical or clustered at the nodes of floating stems with long petiole and sheathing base
- Inflorescence of umbellate or paniculate whorls
- Sepals 4-5, free, caducous
- Flowers regular, bisexual or unisexual.
- Tepals 6, arranged in two whorls, outer sepaloid, inner petaloid; rarely zero
- Stamens usually 6 or more, rarely 3
- Ovary superior, carpels 3-6 or many
- Fruit an achene, or a follicle

General Floral formula	$\oplus, ☿$ or ♀ or $\hat{\delta}, P_{3+3}, A_{3\text{-}\infty}, G_{3\text{-}\infty}$
Number of genera in Kerala	3
Number of species	5
Number of RET species	–
Number of endemic species	–
Some Common examples	*Alisma plantago-aquatica, Echinodorus palaefolius, Limnocharis flava, Sagittaria guayanensis*
Some RET and endemic species	–

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Cyperaceae

Characteristic features

- Monocot; annual or perennial herbs of wet habitat
- Stem solid, triangular, often rhizomatous
- Leaves linear, alternate,3-ranked, often crowded at the base of the stem, sheath closed, ligule absent
- Inflorescence may be spike, globose head or panicle of **spikelets**.
- Flower very small, unisexual or bisexual in the axil of glume
- Perianth of 3-6 bristles or scales, often absent
- Stamens usually 3, rarely 6, sometimes reduced to 1
- Ovary superior, unilocular, carpels 3 or 2, syncarpous
- Fruit an achene, nut or nutlet

General Floral formula	·I· , ☿ or ♀ or $\hat{\delta}$, $P_{0\text{-}6}$, $A_{3 \text{ or } 6 \text{ or } 1}$, $\underline{G}_{(3) \text{ or } (2)}$
No. of genera and species in Kerala	19 genera; 216 species
No. of RET species	Nil
No. of endemic species	11(K); 8(WG)
Examples	*Cyperus alternifolius*
Some RET and endemic species	*Cyperus pilosus, Eleocharis dulcis, Fimbristylis aestivalis*

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Poaceae

Characteristic features	
➤ Monocot; annual, biennial **herbs** or **woody shrubs** ➤ Leaves **2-ranked, entire**, sessile, very rarely petiolate; alternate, lanceolate, surface smooth or glabrous; ligulate, sheath open ➤ Inflorescence spike or panicle of **spikelets** ➤ Flowers(florets) bisexual or unisexual, irregular in the **axil of glumaceous bracts** ➤ Perianth absent or represented by minute, membraneous, scale like, two or three tepals (lodicules) ➤ Stamens usually three, rarely six or sometimes reduced to 2 - 1, anthers versatile ➤ Ovary superior, monocarpellary, fused, placentation basal; **styles usually 2** ➤ Fruit usually **caryopsis**, rarely a nut or berry; **seed rounded**	
● General Floral formula	·l· ,♀ or ♂ or ☿, P_{0-3}, A_{0-6}, $\underline{G}_{(1)}$
● No. of genera and species in Kerala	117 genera; 416 species
● No. of RET species	R:3(WG); R:7(K);T:1(WG)
● No. of endemic species	27: (WG); 59:(K)
● Examples	*Coix lacryma –jobi, Pleioblastus distichus, Pogonatherum crinitum*
● Some RET and endemic species	*Ochlandra setigera, Glyphochloa divergens, Dimeria kanjirapalliana*

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