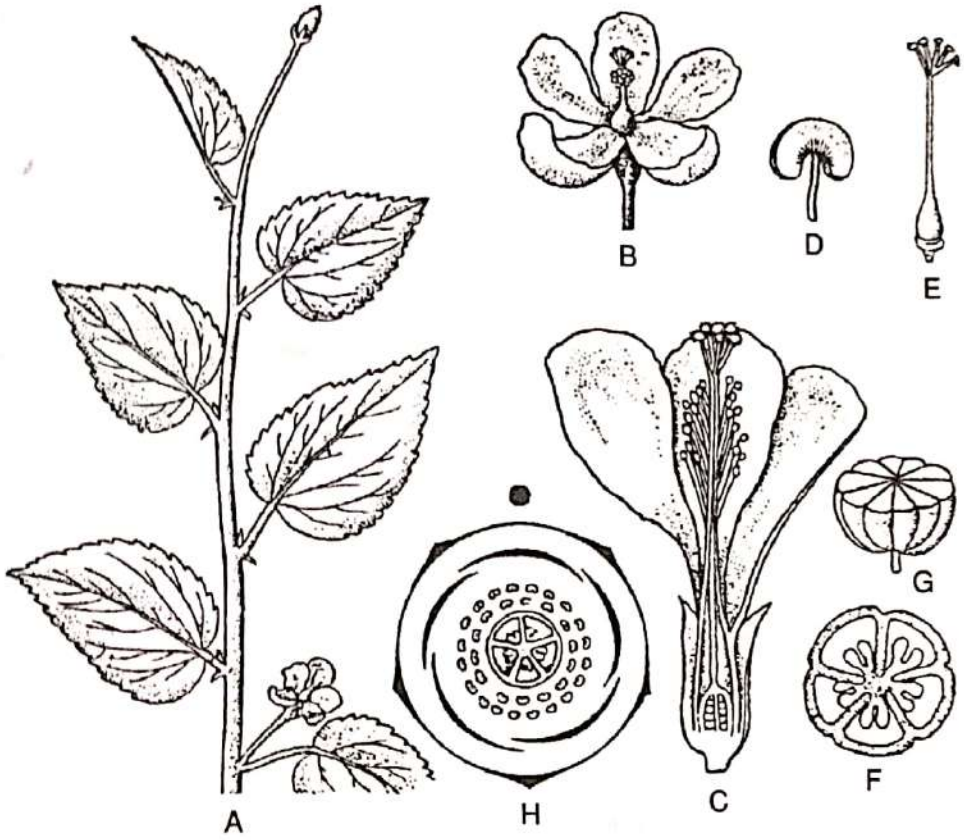

Fig. 4.52 : Malvaceae (*Sida cordifolia*) : A. Portion of a plant with flower; B. Single flower; C. Vertical section of flower; D. Stamen; E. Gynoecium; F. T.S. of ovary; G. Fruit and H. Floral diagram

Ureneae, Hibisceae and Bombaceae. The sub-family Bombaceae include the members with large trees, flowers bisexual — often appear before the leaves, leathery sepals, monadelphous or polydelphous stamens, hairy outgrowth on pericarp etc. Engler treated this tribe Bombaceae as a separate family.

Malvaceae is related to Tiliaceae and Sterculiaceae but differ in monothecous anther and staminal tube. Most of the taxonomists included it under Malvales along with Tiliaceae and Sterculiaceae. Hutchinson (1959, 69, 1973), however, retained only Malvaceae under the order Malvales and Sterculiaceae and Tiliaceae along with Bombacaceae, Gonystylaceae and Scytopetalaceae under a single order Tiliales.

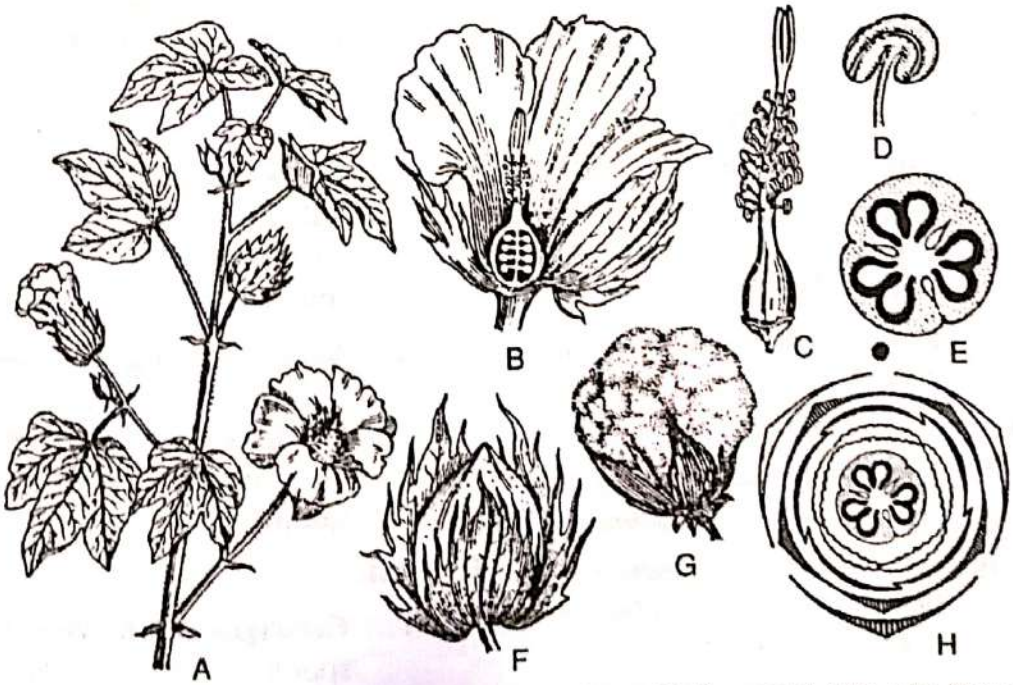

Fig. 4.53 : Malvaceae (*Gossypium herbaceum*) : A. Part of a plant with flower; B. V.S. of a flower; C. Monadelphous stamen with gynoecium; D. Stamen; E. T.S. of ovary; F. Fruit encircled by calyx; G. Dehiscent fruit and H. Floral diagram

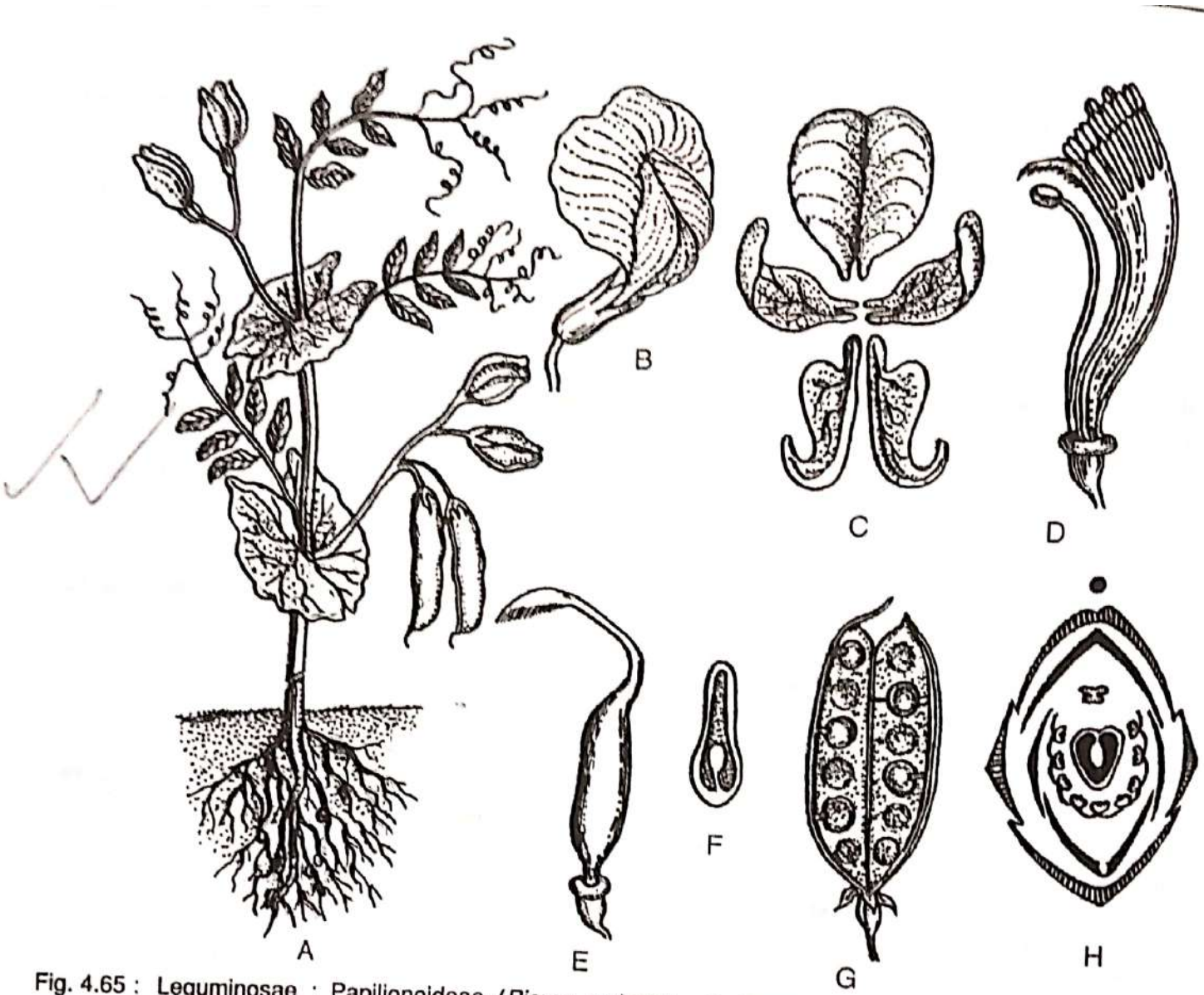

Fig. 4.65 : Leguminosae : Papilionoideae (*Pisum sativum*) : A. Plant with flowers and fruits; B. Single flower; C. Arrangement of petals; D. Flower with calyx and corolla removed, showing diadelphous androecium and pistil; E. Pistil; F. T.S. ovary; G. Splitted fruit, showing seeds and H. Floral diagram

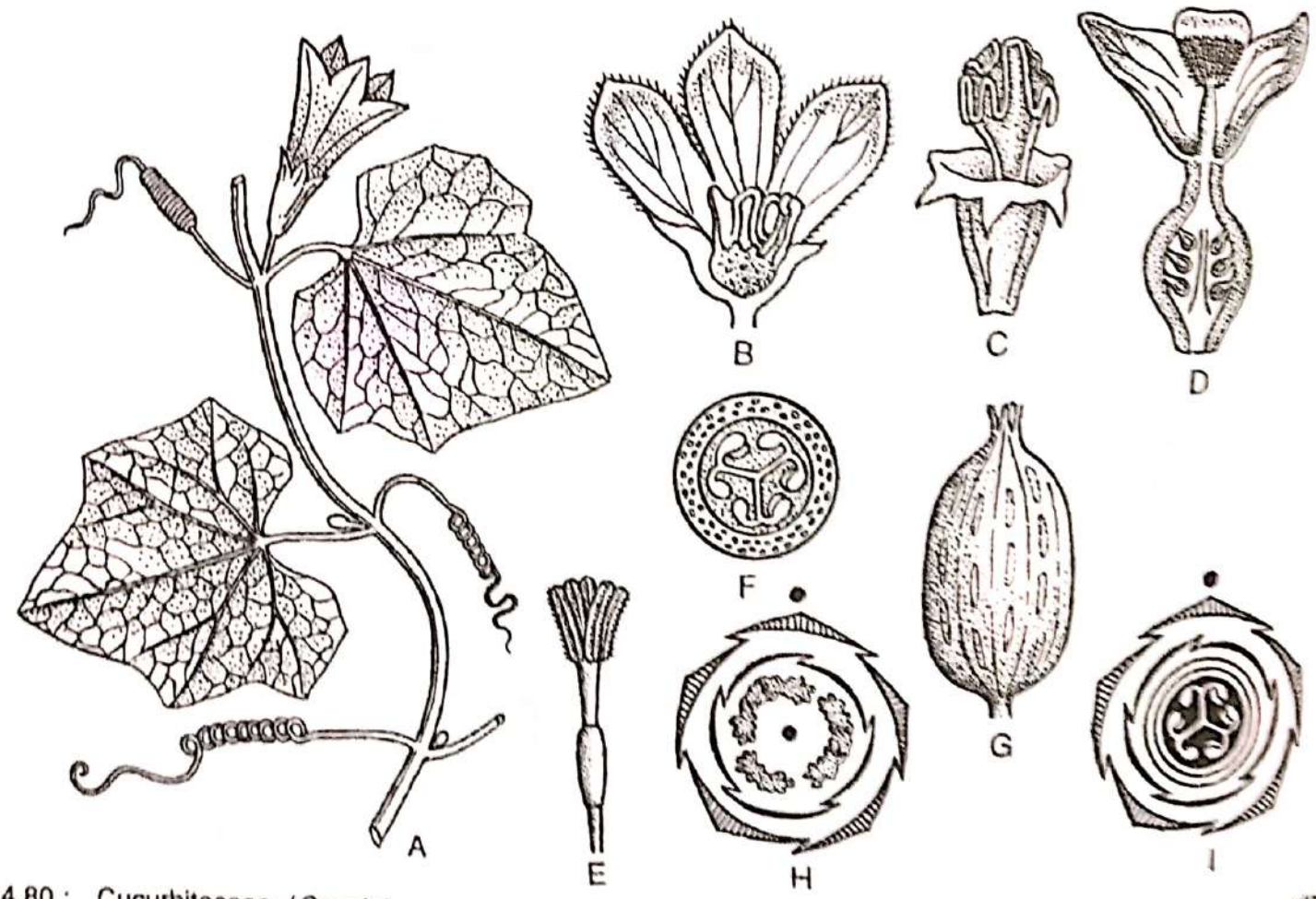

Fig. 4.80 : Cucurbitaceae (*Coccinia grandis*) : A. Portion of a plant with male flower; B. V.S. of a staminate flower; C. Staminate flower after removal of corolla; D. V.S. of a pistillate flower; E. Pistil; F. T.S. of ovary; G. Fruit; H. Floral diagram of staminate flower, and I. Floral diagram of pistillate flower

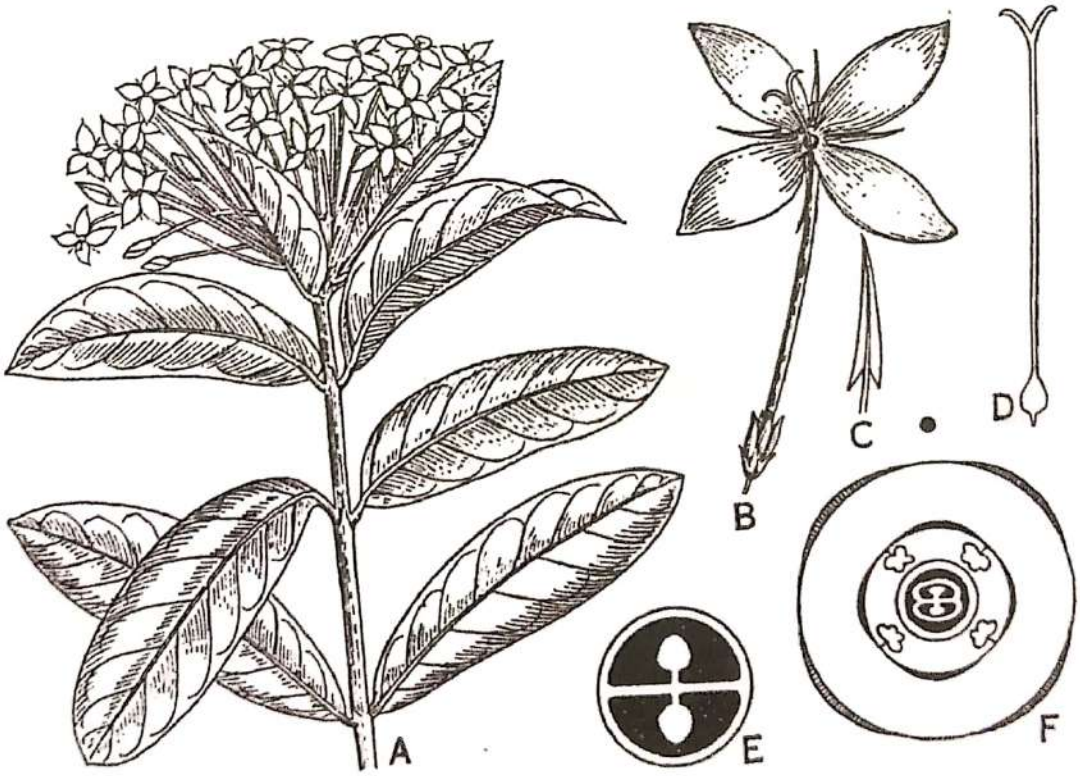

Fig. 4.84 : Rubiaceae (*Ixora coccinea*) : A. Portion of a plant with inflorescence; B. Single flower; C. Single stamen; D. Pistil; E. T.S. of ovary, and F. Floral diagram

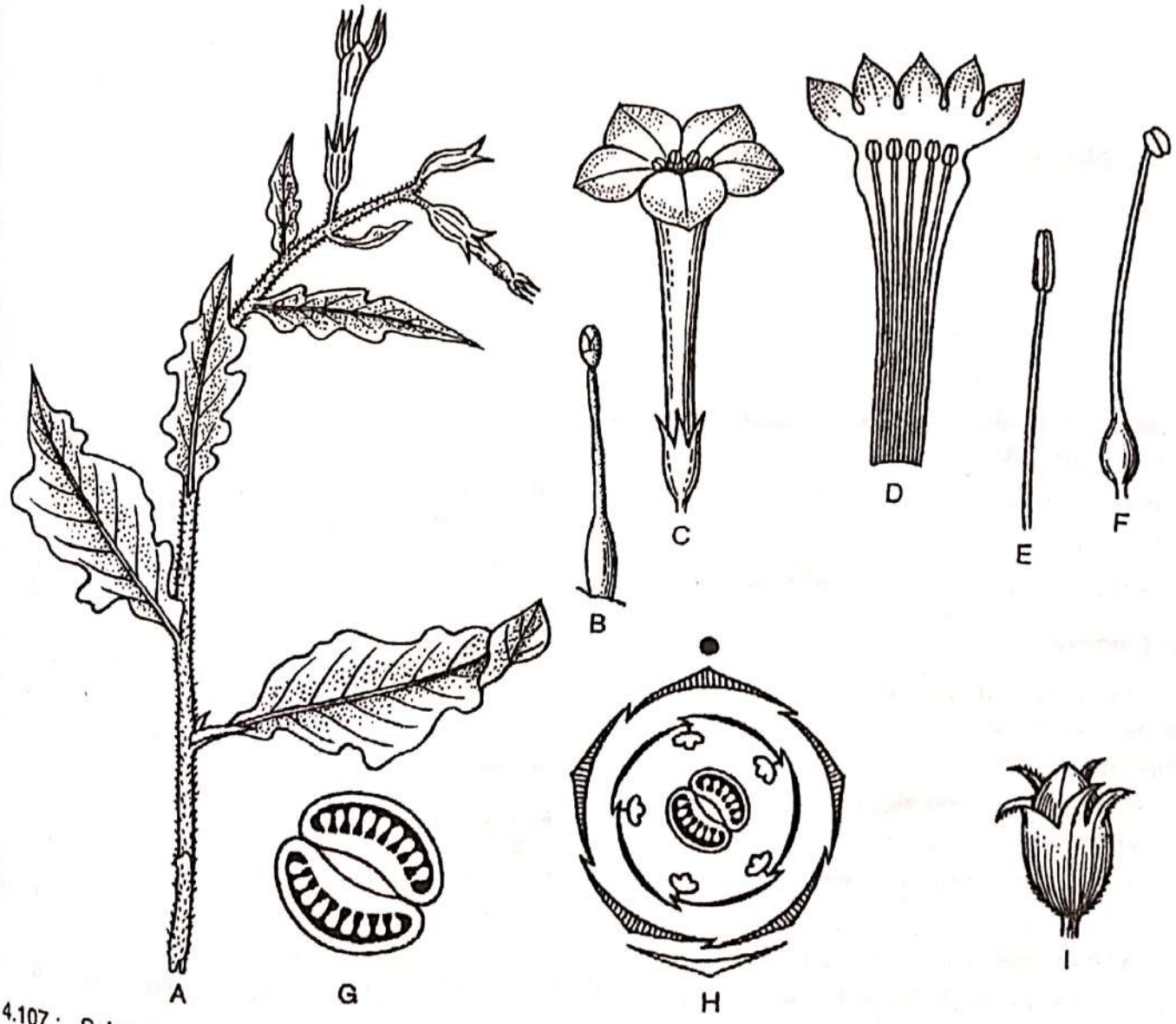

Fig. 4.107 : Solanaceae (*Nicotiana plumbaginifolia*) : A. Portion of a plant with flower; B. A glangular trichome; C. Single flower; D. Corolla split open showing epipetalous stamens; E. Stamen; F. Pistil; G. T.S. of ovary; H. Floral diagram, and I. Fruit

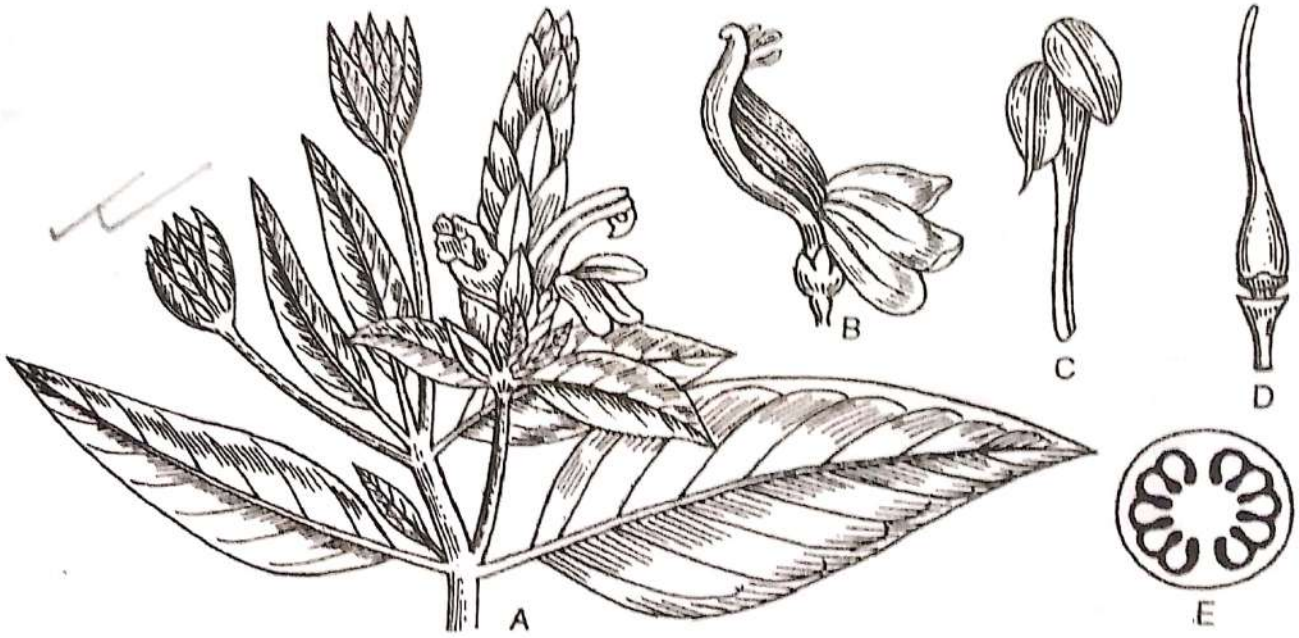

Fig. 4.123 : Acanthaceae (*Adhatoda vasica*) : A. Portion of a plant with flowers; B. Single flower; C. Stamen; D. Pistil, and F. T.S. of ovary

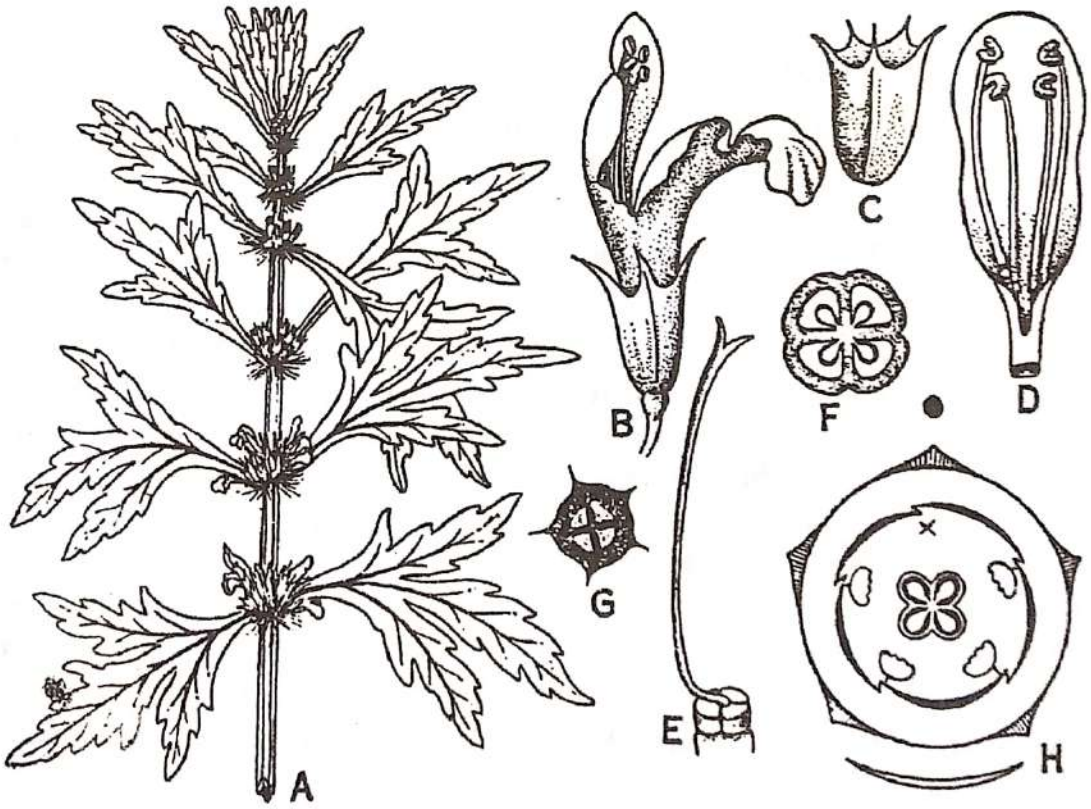

Fig. 4.130 : Labiatae (*Leonurus sibiricus*) : A. Portion of a plant showing verticillaster inflorescences; B. Single flower; C. Calyx; D. Corolla split open showing epipetalous stamens; E. Pistil showing gynobasic style; F. T.S. of ovary; G. Fruit, and H. Floral diagram

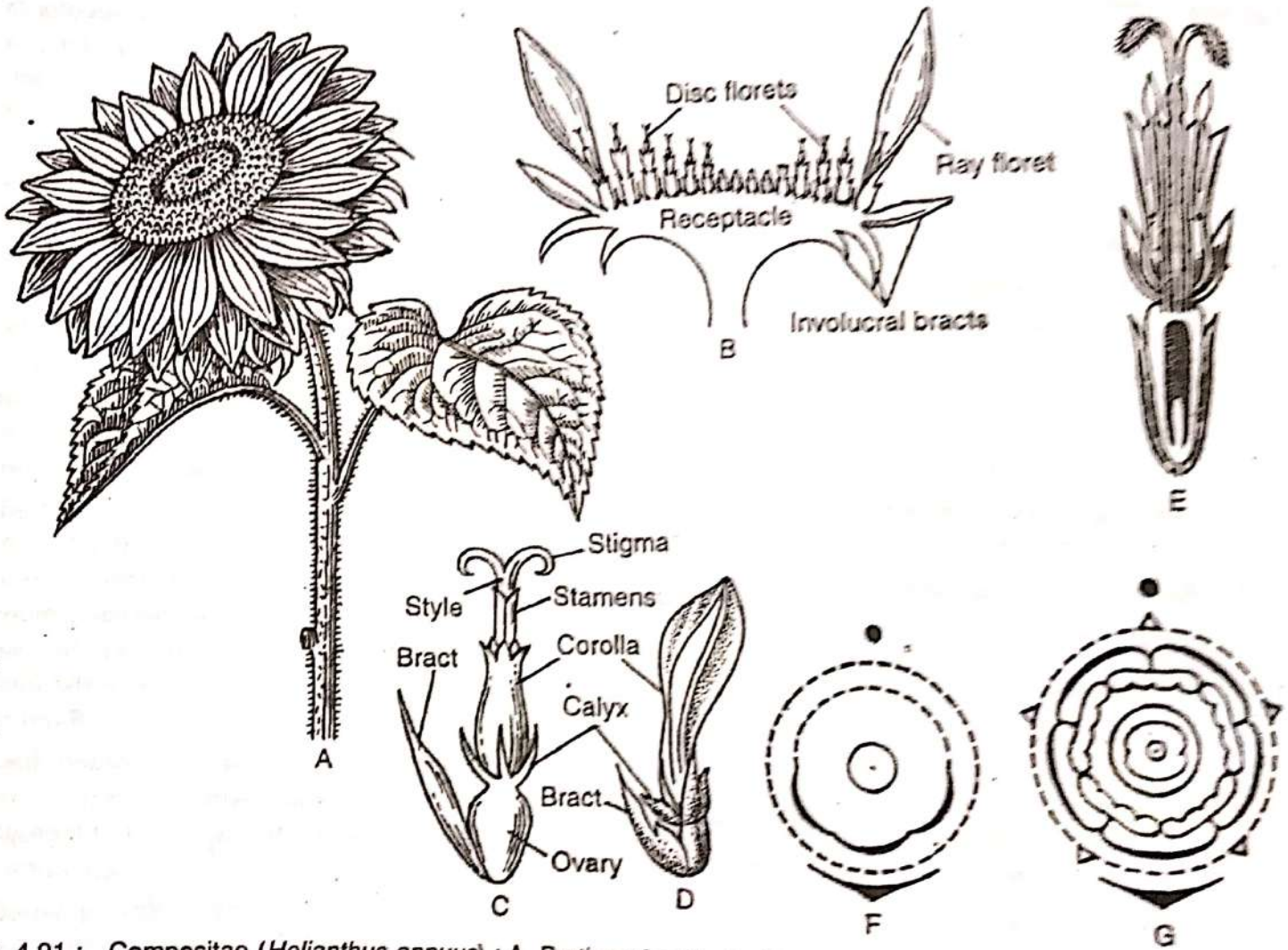

Fig. 4.91 : **Compositae** (*Helianthus annuus*) : A. Portion of a plant with capitulum inflorescence; B. V.S. of a capitulum with both ray and disc florets; C. Single disc floret; D. Single ray floret; E. L.S. of a disc floret; F-G. Floral diagram of ray floret (F), and disc floret (G)

Musaceae, Zingiberaceae and also with

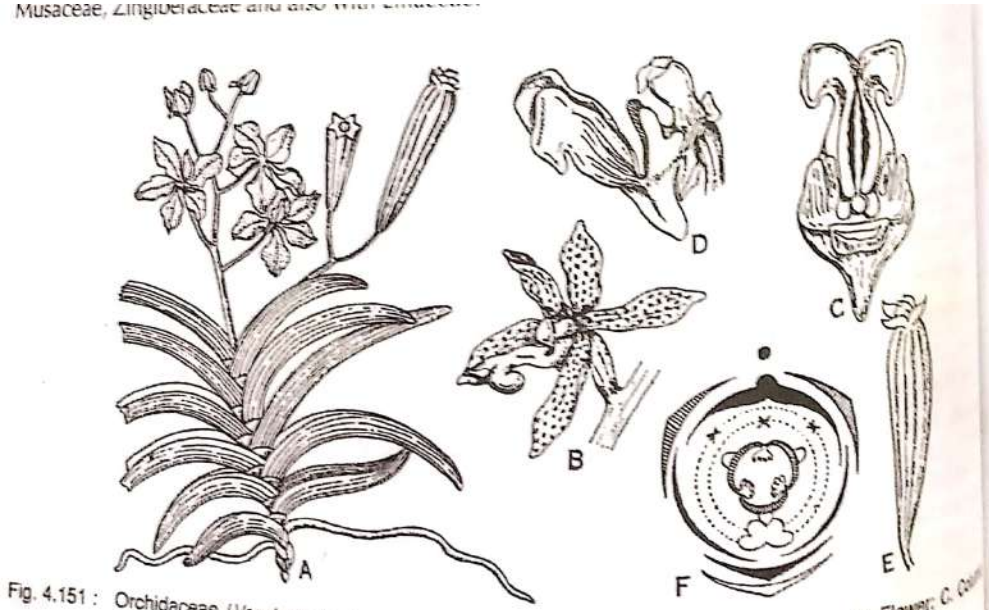

Fig. 4.151 : Orchidaceae (*Vanda tessellata*) : A. Portion of a plant with flowers and fruits; B. Flower; C. Column; D. Back view of column; E. Fruit, and F. Floral diagram

a column known as *gynostemium*.

7. Pollen grains are united into a mass and present in a special structure the, *pollinium*

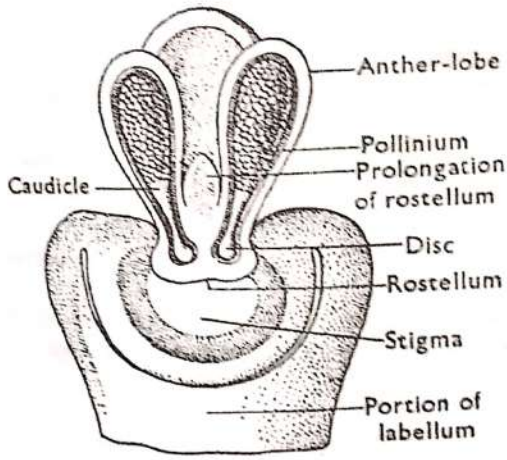

Fig. 4.152 : L.S. of an Orchid flower

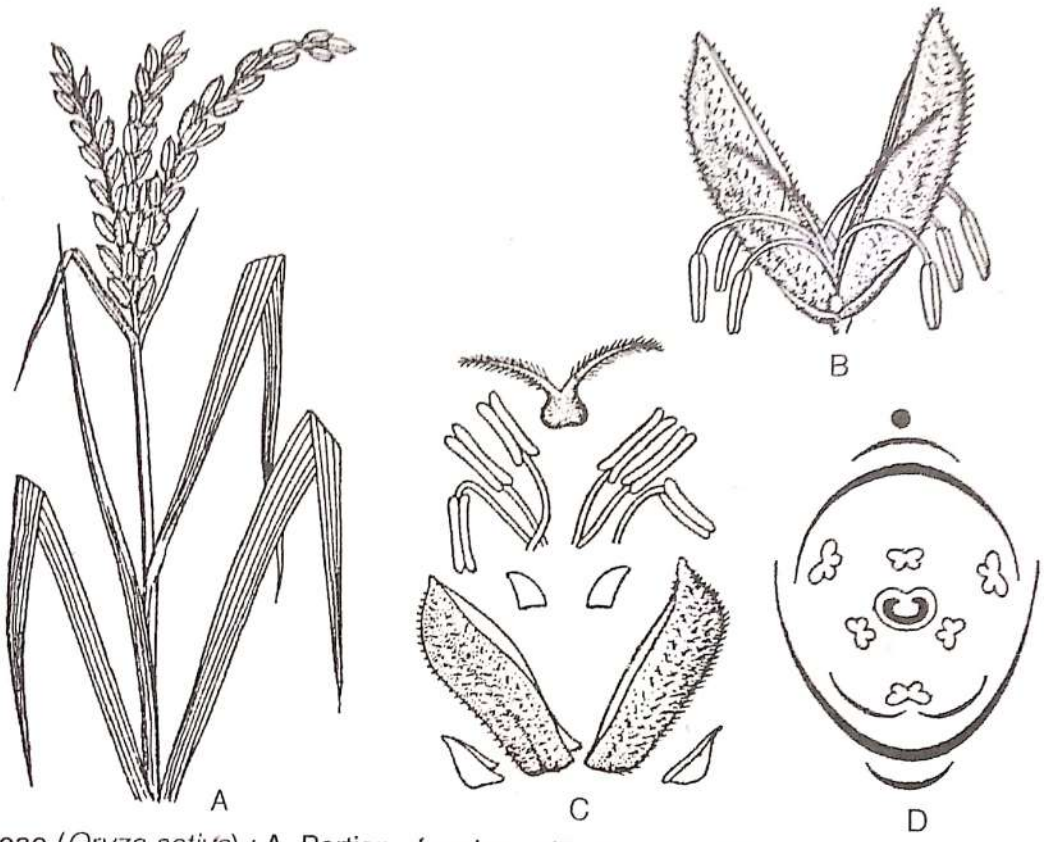

Fig. 4.173 : Gramineae (*Oryza sativa*) : A. Portion of a plant with inflorescence; B. Single flower; C. Flower dissected out, and D. Floral diagram

Topic 5.2: Diagnostic Features of Angiospermic families: GE 2.

Malvaceae

Habit: Herb or Shrub, annual, sometimes perennial
* Tree - Kydia sp., Thespesia sp.

Stem: Erect, herbaceous, or woody, branched, pubescent, stellate hairs, mucilage ~~(scanty)~~ juice present;

Leaf: Alternate, simple, stipulate, stipules free lateral, petiolate, palmately veined, entire or variously lobed margin, ~~Mult~~ multifoliate;

Inflorescence: Solitary axillary or terminally cymose;

Flower: Bisexual, regular, actinomorphic, pentamerous, hypogynous, showy, subtended by epicalyx;
* Unisexual - Napaea sp.
* Epicalyx absent - Sida sp., Abutilon sp.

Calyx: Sepals 5, gamosepalous, united at the base, sometimes polysepalous, valvate aestivation

Corolla: Petals 5, polypetalous but adnate to the base of staminal tube, showy, twisted aestivation

Note: * : Exceptions

P.T.O

Androecium : Stamens numerous, monadelphous, unilocular anther, reniform, staminal tube formed by union of filaments, pollens large, spiny ~~(exime)~~ exine;

Gynoecium : Carpels 3 to many, Syncarpous, superior ovary 2 to 3 locules, one to many ovules in each locule, placentation axile, style passing through staminal column and branched above, stigma as many or twice the ~~nut~~ number of carpels;

Fruit : Capsule, schizocarp or berry*

* Malvaviscus sp.

Seed : Reniform, scanty endosperm or non-endospermic, curved embryo, pubescent, folded cotyledons.

Floral formula: Br. ⊕ ⚥ $Epik_{3-9}\ K_{(5)}\ C_{(5)\ or\ 5}\ A_{(\infty)}\ \underline{G}_{(5-\infty)}$

Common Plants: Sida alba, Urena lobata

Economically important plants: Vegetable: Abelmoschus esculentus

Fibre: Gossypium sp.

Leguminosae (Fabaceae)

Habit: Herb, sometimes shrub, annual or perennial;

Stem: Herbaceous or woody, branched, sometimes with tendrils arising from nodes;
Climber: Abrus sp.
Tree: Robinia sp.

Root: Tap root with root nodules;

Leaf: Alternate, compound, stipulate, petiolate, pulvinous base (swollen at end of petiole);
* Leaf simple: Crotalaria juncea

Inflorescence: Racemose, terminal or axile;

Flower: Bisexual, actinomorphic or zygomorphic, lateral ~~inflo~~ in position, ~~hypo~~ hypogynous or perigynous;

Calyx: Sepals 5, gamosepalous or polysepalous odd sepal anterior, imbricate; aestivation
* Sepals 3: Mimosa juniperina
Sepals 4: Mimosa pudica

Corolla: Petals 5, free, imbricate aestivation, or valvate;

Androecium: Stamens 10 or many, usually diadelphous with 9+1 arrangement, anther dithecous, pollens large white or yellow;

Gynoecium: Carpel 1, ovary superior, unilocular, one to many ovules in each locule, marginal placentation, style 1, long, bent, stigma 1, capitate;

Fruit: Usually legume, sometimes lomentum

Seed: Non endospermic, embryo large and curved, cotyledons fleshy and plano convex

Floral formula: Subfamily Papilionoideae:

$\% \, ♀♂ \, K_{(5)} C_5 A_{(9)+1 \text{ or } (10)} \underline{G}_1$

Subfamily Caesalpinoideae:

$\% \, ♀♂ \, K_{(5) \text{ or } 5} C_5 A_{10} \underline{G}_1$

Subfamily Mimosoideae:

$\oplus \, ♀♂ \, K_{(4-5)} C_{4-5} A_{\infty \text{ or } 10 \text{ or } 4} \underline{G}_1$

Common Plants:

Papilionoideae	Caesalpinoidae	Mimosoideae
Crotalaria sp.	Cassia sp.	Mimosa pudica
Dalbergia sissoo	Delonix regia	Albizzia lebbeck

Economically important Plants:

i. Glycine max (soyabean)	Cassia fistula (laxative)	Acacia catechu (khair or catha)
Cajanas cajan (arhardal)	Saraca asoka (medicinal)	Albizzia lebbeck (ornamental)

Cucurbitaceae

Habit: Annual or perennial climbing herbs, rarely shrub, ~~monoce~~ monoecious or dioecious;

Stem: Herbaceous, pentangular with ridges and furrows, green, tendrils present, arising from nodes;

Leaf: Simple, alternate, exstipulate, palmately or pinnately lobed, palmately veined, petiolate, long hollow petiole, tendril absent

* Leafless: Acanthosicyos sp.

Inflorescence: Axillary or solitary or aggregate cymose

Flower: Unisexual, actinomorphic, pentamerous, epigynous, white or yellow, ebracteate,

	Male flower	~~Fema~~ Female flower
Calyx:	Sepals 5, gamosepalous, tubular, valvate or imbricate aestivation	(Same as male flower) Calyx tube fused with ovary
Corolla:	Petals 5, gamopetalous, salver to campanulate in shape or rotate, valvate or imbricate aestivation	Same as male flower
Androecium:	Stamens 1 to 5 appears as 3, dithecous, anther may be twisted, monadelphous and other variations	Absent, sometimes 2, 3 or 5 staminodes are present.

Gynoecium: Absent

Carpels 3, syncarpous, inferior ovary, unilocular, parietal placentation or trilocular with axile placentation, style 1, stigma 3, each bifid

Fruit: Pepo, indehiscent;

Seed: Many non-endospermic

Floral formula: Male flower:

~~$\oplus\ \sigma\ K_{3-5}\ C_{3-5}\ A_{1-\infty}\ G_0$/pistillode~~

$\oplus\ \sigma\ K_{(5)}\ C_{(5)}\ A_{(2)+(2)+1}\ G_0$

Female flower

~~$\oplus\ \varphi\ K_{3-5}\ C_{3-5}\ A_0$/staminode (2,3 or 5) $\underline{G}_{(3)}$~~

$\oplus\ \varphi\ K_{(5)}\ C_{(5)}\ A_3$ staminodia $\underline{G}_{(3)}$

Common plant: Coccinia grandis

Cucumis melo

Economically important plant: Vegetable: Cucurbita maxima

Fruit: Cucumis sativa

Medicinal: Bryonia callosa

Characteristic features	Rubiaceae	Solanaceae	Acanthaceae	Labiatae (Lamiaceae)
Habit:	Herbs or shrubs, rarely trees; Anthocephalus is a tree *climber: Paederia sp. *Parasite: Hymenopogen parasitica.	Herb, or shrub or small trees; *climber: Solanum trilobatum	Herb or shrub, rarely woody climbers; *climber: Thunbergia sp. *Tree: Strobilanthus sp.	Herb and shrub, aromatic; *Tree: Leucoseptrum sp
Stem:	Erect or prostrate to cauline, distinct nodes and internodes;	Erect, herbaceous or woody, Sometimes modified to tuber (Solanum tuberosum);	stem with swollen nodes, vary from prostrate to erect;	Stem erect, quadrangular, pubescent, glandular hair;
Leaf:	Opposite decussate or whorled, stipulate, stipule interpetiolar or intrapetiolar, simple, margin entire, petiolate with small petiole, or ~~gone~~ sessile;	Alternate, exstipulate, simple, margin entire, dorsiventral, lobed;	Opposite decussate, exstipulate, simple, margin entire, cystolyth often present;	Opposite decussate, exstipulate, simple, pubescent, glandular hair present;
Inflorescence:	Dichasial cyme; *solitary: Gardenia sp.	Cymose: cymose panicle or helicoid cyme; *Solitary: Datura sp	Dichasial cyme, sometimes monochasium, flowers rarely solitary;	Verticillaster. *Racemose: Ocimum sp Spike: Teucrium sp
Flower:	Bracteate, bisexual, actinomorphic, penta- or tetramerous, epigynous; *unisexual: Coprosma sp hypogynous: Pagamea sp.	Bracteate or ebracteate, pedicellate, bisexual, actinomorphic, hypogynous, pentamerous; *zygomorphic: Browallia sp.	Bracteate, Bracteolate, complete, bisexual, zygomorphic, hypogynous, bracteoles often large and coloured, enclosing the flowers;	Bisexual, zygomorphic, bracteate, bracteolate, ~~or~~ hypogynous; *Actinomorphic: Mentha sp.

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Characteristic features contd.	Rubiaceae	Solanaceae	Acanthaceae	Labiatae (Lamiaceae)
Calyx:	Sepals 4-5, polysepalous, persistant, rarely unequal in which 1 sepal is enlarged and brightly coloured, valvate aestivation;	Sepals 5, gamosepalous, persistant, five lobed, valvate aestivation;	sepals 5, polysepalous or gamosepalous, valvate or quincuncial aestivation;	Sepals 5, gamosepalous, persistant, valvate or imbricate aestivation;
Corolla:	Petals 4-5, gamopetalous, salver to funnel shaped, valvate, twisted, imbricate or contorted aestivation;	Petals 5, gamopetalous, connate in a rotate or funnel or bell shaped, lobes imbricate, plicate or convolute;	Petals 5, gamopetalous, petals fuse to form tube like structure, mostly bilabiate, imbricate or twisted;	Petals 5, gamopetalous, bilabiate corolla, valvate, imbricate or contorted; * tetramerous and regular in <u>Mentha</u> sp.
Androecium:	Stamens 4-5, epipetalous, inserted in corolla tube, anther dithecous, basifixed, introrse, longitudinal dehiscence;	Stamens 5, epipetalous, filament of unequal length, anther dithecous, introrse, dehiscence by apical pore;	Stamens 4, didynamous, epipetalous, anther dithecous, spurred or hairy, longitudinal dehiscence;	Stamens 4, didynamous, epipetalous, posterior stamen either absent or represented by staminode;
Gynoecium:	Carpels 2, syncarpous, inferior ovary, bilocular, 1-many ovules in each locule, axile placentation, style single, stigma bifid or capitate; * parietal placentation: <u>Gardenia sp.</u> * 1 ovule in each locule: <u>Coffea sp.</u>	Carpels 2, syncarpous, superior ovary, Obliquely placed, bilocular or pentalocular, numerous anatropous ovules in each locule, axile placentation, style terminal, simple, stigma bilobed or capitate;	Carpels 2, syncarpous, superior ovary, bilocular, 1-many ovules in each locule, axile placentation, style long, slender and narrow, stigma 2, anterior stigma often larger with nectar secreting disc;	Carpels 2, syncarpous, superior ovary, bilocular but become tetralocular due to development of false septum, axile placentation, ~~one to many ovules in each~~ style gynobasic, stigma bifid, nectar secreting disc present;

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Characteristic feature Confd	Rubiaceae (1)	Solanaceae (2)	Acanthaceae (3)	Labiatae (Lamiaceae) (4)
Fruit:	Capsule, Berry (Coffea sp) Schizocarp (Gallium sp) Drupe, aggregate (Morinda sp);	Many seeded berry or capsule (Datura) with persistant calyx;	Capsule;	1 seeded nutlet;
Seed:	small straight or curved embryo. winged, albuminous, fleshy endosperm.	Seeds flat, compressed, albuminous, curved embryo.	Seeds non-endospermic, exalbuminous, embryo large, seeds supported on retinacula or jaculator.	Seeds non-endosperm-mic, exalbuminous, straight embryo.
Floral formula:	(1) Br ⊕ ♂ $K_{4 \text{ or } 5}\,\overline{C_{(4) \text{ or } (5)}}\,A_{(4) \text{ or } 5}\,\underline{\underline{G}}_{(2)}$ [Rubiaceae] (2) Br or ♁Br ⊕ ♂ $K_{(5)}\,\overline{C_{(5)}}\,A_5\,\underline{\underline{G}}_{(2)}$ [Solanaceae]		(3) Br. BrL. % ♂ $K_{(5)}\,\overline{C_{(5)} \text{ or } 5}\,A_4\,\underline{\underline{G}}_{(2)}$ [Acanthaceae] (4) Br. BrL. % ♂ $K_{(5)}\,\overline{C_{(5)}}\,A_{4 \text{ or } 2}\,\underline{\underline{G}}_{(2)}$ [Labiatae]	
Common plants:	Oldenlandia sp Dentella repense.	Solanum nigrum Physalis minima	Adhatoda vasica Justicia simplex	Leonurus sibiricus Leucas aspera
Economically imp plants	Coffea arabica (coffee) Cinchona officinalis (medicine)	Capsicum annum (vegetable) Atropa belladona (Drug/Medicine)	Andrographis paniculata (medicine) Barleria sp (ornamental)	Lavandula latifolia (perfumery) Ocimum sanctum (medicine).

Compositae (Asteraceae)

Habit: Herb, shrub, tree or woody climber, with watery or milky sap;

Stem: Herbaceous to woody, branched, with milky sap;

Leaf: Opposite, alternate, whorled, exstipulate, simple, pinnately or palmately veined;

Inflorescence: Capitulum or head, involucre of bracts, homogenous (similar florets) or heterogenous (ray & disc floret);

Flower: Bisexual, unisexual or neuter, epigynous, pentamerous, zygomorphic, florets of 2 types:

Disc floret	Ray floret
tubular, sessile, actinomorphic, bisexual, complete, bracteate, located towards the centre of inflorescence;	ligulate, sessile, zygomorphic, unisexual, generally without androecium, located towards periphery of inflorescence;

Calyx: Absent or represented by pappus, hair or bristles;

Corolla: Petals 5, gamopetalous, tubular disc floret or bilabiate with 3-lobed upper lip and bilobed lower lip, ray floret valvate aestivation;

Androecium: Stamens 5, epipetalous, syngeneceous, protandrous, anthers always united in a tube;

Gynoecium: Carpels 2, syncarpous, ovary inferior, unilocular, single anatropous ovule ~~in each locule~~, basal ~~ovule~~ placentation, style single, stigma 2, bifid;

Fruit: Cypsella, crowned by pappus;

Seed: small, non-endospermic, exalbuminous straight embryo;

Floral formula: unisexual ray florets:

% ♀ $K_{pappus}\ C_{(5)}\ A_0\ \underline{G}_{(2)}$

Bisexual disc florets:

% ♂ $K_{pappus}\ \overline{C_{(5)}\ A_{(5)}}\ \underline{G}_{(2)}$

Common plants: Blumea lacera
Tridax procumbens

Economically imp plants: Calendula officinalis, Dahlia pinnata, Cosmos bipinnatus (ornamental)

Helianthus annus (vegetable oil)

Arnica montana, Mikania cordata [medicinal]

Advanced features of Compositae (Asteraceae)

1) Largest family among dicots with 1100 genera, 20000 species distributed in Arctic and Tropical zones.
2) Capitulum inflorescence — presence of numerous flowers in small space, hence several flowers are pollinated by a single insect.
3) Presence of both unisexual and bisexual flowers in a single inflorescence — thus self pollination is avoided as bisexual flowers are protandrous but if cross pollination fails, self pollination may be possible by curling of stigmas to pollen from their own anther.
4) Presence of calyx in form of pappus which helps in dispersal of seeds by wind
5) Reduction of carpels to 2 with 1 ovule in each, inferiorly placed ovary, basal placentation are advanced characters.
6) Floral buds are well protected by involucre of bracts.

Orchidaceae

Habit: Perennial, epiphytic, terrestrial herb;

Root: Epiphytic root with velamen, velamen found in aerial roots;

Stem: Often modified into tubers, rhizome or pseudobulb;

Leaf: Succulent, opposite, whorled or alternate;

Inflorescence: Raceme like panicle, spike or solitary, may be terminal or axillary;

Flower: Bracteate, bisexual, rarely unisexual, zygomorphic, epigynous, showy, ornamented and beautifully coloured;

Perianth: Tepals 6, in 2 whorls of 3 each, outer whorl of 3 tepals sepaloid, inner whorl of 3 tepals petaloid of which posterior median tepal highly modified projected laterally into a spur, called labellum or lip. [This labellum becomes anterior due to 180° twist in inferior ovary or pedicel during development — this twist is called resupination, the labellum thus form an effective landing platform for pollinating insect & thus has a role in pollination.]

Androecium: Stamen 1 or 2, shows great complication due to adnation of the filament with gynoecium to form a column known as gynostemium, pollen grains connate in a waxy mass called pollinia. [Each pollinium bears a caudicle which ends in a sticky disc or gland called viscidia]

Gynoecium: Carpels 3, syncarpous, ovary inferior, placentation parietal, stigma 3 of which 2 are fertile and 1 sterile. In most orchid, the anterior sterile stigma is modified into a small pocket called rostellum which lies between the anther and the other 2 fertile stigmas. A portion of rostellum is modified into viscoid disc to which the pollinia are attached (viscidia). Stigma, style and stamen adnate together to form a single highly complex structure called gynandrium or column;

Fruit: Usually capsule;

Seed: very small, non-endospermic, embryo undifferentiated;

Floral formula: Br % ♀ P_{3+3} $A_{1 or 2}$ $\underline{G}_{(3)}$

Common Plants :

Vanda sp.

Dendrobium sp.

Orchis sp.

Economically important plants :

Orchis latifolia (food)

Vanilla fragrans (flavouring agent)

Vanda sp.
Dendrobium sp
Cymbidium sp
} (Ornamental)

Advanced characters of Orchidaceae :

1) Orchidaceae is one of the largest families of the flowering plants represented by almost 1000 genera and more than 20000 species.

2) Zygomorphic flower with inner posterior member of perianth modified as labellum serves as a device for insect pollination.

3) Epiphytic habit with production of aerial epiphytic root with velamen, clinging roots, pseudobulb for storage of water are advanced features.

4) Epigynous and inferior ovary, reduction in number of stamens, union of much reduced style ensure pollination.

5) Out of 3 stigmas, 2 are fertile while the third one is sterile and forms a structure called rostellum which is an adaptation for ensuring cross pollination by insects.

6) Great variety in 1 type of flower with diversity in shape and forms of the flower.

7) Highly specialised pollination mechanism by development of pollinia.

8) Seeds with mycorrhizal fungal association for germination of non-endospermic seeds.

Poaceae (Graminae)

Habit: Annual, biennial or mostly perennial herbs;

Stem: Aerial stem called culm, differentiated into nodes and internodes, internodes hollow;

Root: Tuft of fibrous and adventitious roots;

Leaf: Simple, linear to lanceolate, rarely ovate, sheathing leaf base enclosing the internode, ligulate, ligules may be pubescent, half alternate or distichous;

Inflorescence: Spikelet [several spikelets arranged as panicle (Avena) or spike (Triticum)]

Flower: Small, bisexual, hypogynous, zygomorphic, chasmogamous, each spikelet consist of one to many flowers;

Perianth: represented by a lodicule, lodicules 1, 2 or 3 or ~~many~~ may be absent;

Androecium: Stamens 3 or 6, usually arranged in 2 whorls (3+3), anthers free versatile, dithecous, odd stamen anterior;

P.T.O.

Gynoecium: Carpel 1 or 2 or 3, syncarpous, ovary superior, unilocular, single ovule, basal placentation, style simple, stigma 2 or 3, feathery;

Fruit: Caryopsis, nut in some bamboos;

Seed: Endospermic, lateral embryo;

Floral formula: $\oplus \; ♀♂ \; P_{0 \text{ or } 2-3} \; A_{3 \text{ or } 3+3} \; \underline{G}_{1-(3)}$

Common Plants: Bambusa sp, Chloris barbata, Cynodon dactylon, Eusine indica

Economically imp. plants: Cereals: Oryza sativa
Avena sativa
Zea mays
Triticum aestivum

Sugar: Saccharum officinarum

Bamboo: Dendrocalamus sp
Bambusa sp
Arudinaria sp

volatile oil: Cymbopogon citratus (lemon gram).