

# Angiosperm Phylogeny Group (APG) system

The Angiosperm Phylogeny Group, or APG, refers to an informal international group of systematic botanists who came together to try to establish a consensus view of the taxonomy of flowering plants (angiosperms) that would reflect new knowledge about their relationships based upon phylogenetic studies.

An important motivation for the group was what they viewed as deficiencies in prior angiosperm classifications, which were not based on monophyletic groups (i.e. groups consisting of all the descendants of a common ancestor). APG publications are increasingly influential, with a number of major herbaria changing the arrangement of their collections to match the latest APG system.

The most recent classification of flowering plants based on **phylogenetic data** was set in the last decade of twentieth century. Four versions of Angiosperm Phylogenetic Group classification (APG I, APG II, APG III & APG IV) have been published in 1998, 2003, 2009 and 2016 respectively. Each version supplants the previous version. Recognition of **monophyletic** group based on the information received from various disciplines such as gross morphology, anatomy, embryology, palynology, karyology, phytochemistry and more strongly on molecular data with respect to DNA sequences of two chloroplast genes (*atp*B and *rbc*L) and one nuclear gene (nuclear ribosomal 18s DNA).

Angiosperm classification and the APG Until detailed genetic evidence became available, the classification of flowering plants (also known as angiosperms, Angiospermae, Anthophyta or Magnoliophyta) was based on their morphology (particularly that of the flower) and their biochemistry (what kinds of chemical compound they contained or produced). Classification systems were typically produced by an individual botanist or by a small group. The result was a large number of such systems (see List of systems of plant taxonomy). Different systems and their updates tended to be favoured in different countries; e.g. the Engler system in continental Europe; the Bentham & Hooker system in Britain (particularly influential because it was used by Kew); the Takhtajan system in the former Soviet Union and countries within its sphere of influence; and the Cronquist system in the United States.



The number of species of flowering plants is estimated to be in the range of 250,000 to 400,000. The number of families in APG (1998) was 462. In APG II (2003) it is not settled; at maximum it is 457, but within this number there are 55 optional segregates, so that the diversity of flowering plants is not evenly distributed. Nearly all species belong to the eudicot (75%), monocot (23%) and magnoliid (2%) clades. The remaining 5 clades contain a little over 250 species in total, i.e., less than 0.1% of flowering plant diversity, divided among 9 families. The most diverse families of flowering plants, in their APG circumscriptions, in order of number of species, are:

Asteraceae or Compositae (daisy family): 23,600 species;

Orchidaceae (orchid family): 22,075 species;

Fabaceae or Leguminosae (pea family): 19,400;

Rubiaceae (madder family): 13,150;

Poaceae or Gramineae (grass family): 10,035;

Lamiaceae or Labiatae (mint family): 7,173;

Euphorbiaceae (spurge family): 5,735;

Melastomataceae (melastome family): 5,005;

Myrtaceae (myrtle family): 4,620;

Apocynaceae (dogbane family): 4,555.

In the late 1990s, an informal group of researchers from major institutions worldwide came together under the title of the 'Angiosperm Phylogeny Group' or APG. Their intention was to provide a widely accepted and more stable point of reference for angiosperm classification. Their first attempt at a new system was published in 1998 (the APG system). As of 2010, two revisions have been published, in 2003 (APG II) and in 2009 (APG III), each superseding the previous system. Eight researchers have been listed as authors to the three papers, and a further 33 as contributors.



The principles of the APG's approach to classification were set out in the first paper of 1998, and have remained unchanged in subsequent revisions. Briefly, these are:<sup>[2]</sup>

- The Linnean system of orders and families should be retained. "The family is central in flowering plant systematics." An ordinal classification of families is proposed as a "reference tool of broad utility". Orders are considered to be of particular value in teaching and in studying family relationships.
- Groups should be monophyletic (i.e. consist of *all* descendants of a common ancestor). The main reason why existing systems are rejected is because they do not have this property, they are not phylogenetic.
- A broad approach is taken to defining the limits of groups such as orders and families. Thus of orders, it is said that a limited number of larger orders will be more useful. Families containing only a single genus and orders containing only a single family are avoided where this is possible without violating the over-riding requirement for monophyly.
- Above or parallel to the level of orders and families, the term clades is used more freely. (Some clades have later been given formal names in a paper associated with the 2009 revision of the APG system) The authors say that it is "not possible, nor is it desirable" to name all clades in a phylogenetic tree; however, systematists need to agree on names for some clades, particularly orders and families, to facilitate communication and discussion.

The most recent updated version, APG IV (2016) recognised 64 orders and 416families. Of these, 416 families 259 are represented in India.

# The outline of APG IV classification is given below:







Angiosperms are classified into three clades early angiosperms, monocots and eudicots. Early angiosperms are classified into **8 orders** and 26 **families** (**ANA**-grade + magnoliids + Chloranthales)

# Amborellales Nymphaeales Austrobaileyales

- Seeds always with two cotyledons.
- > Presence of ethereal oils
- Leaves are always simple net-veined
- ► Each floral whorls with many parts
- > Perianth usually spirally arranged or parts in threes
- Stamens with broad filaments
- > Anthers tetrasporangiate.
- ➢ Pollen monosulcate.
- $\succ$  Nectaries are rare.



- ➤ Carpels usually free and.
- ➤ Embryo very small.

Monocots are classified into 11 orders and 77 families (basal monocots + lilioids + commelinids)

- $\succ$  Seeds with single cotyledon.
- ➤ Primary root short-lived.
- ➤ Single adaxial prophyll.
- > Ethereal oils rarely present.
- > Mostly herbaceous, absence of vascular cambium.
- > Vascular bundles are scattered in the stem.
- ► Leaf simple with parallel-veined.
- ➢ Floral parts usually in threes.
- > Perianth often composed of tepals.
- Pollen monosulcate.
- Styles normally hollow and.
- Successive microsporogenesis.

Eudicots are divided into 45 orders and 313 families (early diverging eudicots + super rosids + super asterids).

- Seeds with always two cotyledons.
- $\succ$  Nodes trilacunar with three leaf traces.
- ➤ Stomata anomocytic.
- ► Ethereal oils rarely present.
- ➢ Woody or herbaceous plants.
- > Leaves simple or compound, usually net-veined.
- > Flower parts mostly in twos, fours or fives.
- Microsporogenesis simultaneous.
- ➤ Style solid
- ➢ Pollen tricolpate.

APG system is an evolving system that might undergo change periodically based on the new sets of data from various disciplines of Botany. It is the currently accepted system across the world



and followed by all the leading taxonomic institutions and practising taxonomists. However, it is yet to percolate into the Indian botanical curriculum.



Figure 5.12: A timeline showing the history of classifying flowering plants into families. (Source: Royal Botanic Gardens Kew State of World's Plant 2017)