

TWENTY-FIVE ECONOMICALLY IMPORTANT PLANT FAMILIES

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Summary

Humans use species in most of the ca. 450 angiosperm families. However, a handful of these families are exceedingly vital for human existence. The selection of the most important plant families, with two exceptions, is subjective. The diets of most cultures rely substantially on species of Poaceae (grass family) and Fabaceae (legume family) and the world's three most important cultivated plants are grasses. Solanaceae (potato) and Rosaceae (rose), and Euphorbiaceae (spurge) also provide many critical resources for humans. Some families, such as Convolvulaceae, Oleaceae, and Vitaceae rank high because of the value of relatively few species.

1. Introduction

The selection of the most important plant families is subjective. Nonetheless, two are of unequivocal importance: Poaceae and Fabaceae. Solanaceae and Rosaceae, Euphorbiaceae, and Convolvulaceae also rank high in global importance. The following section provides a brief description of 25 important plant families. All are angiosperms except Pinaceae. Arthur Cronquist's 1981 treatise provides the most comprehensive treatment of all angiosperm plant families, but many of the treatments are dated. Nathan Smith et al.'s 2004 book is a good introduction to the Neotropical flowering plants, following the Cronquist system. The most current circumscriptions can be found in the third edition of a systematics text written by Walter Judd and his colleagues in 2007. The text treats around 100 families. Treatments here follow Judd et al. and APG II.

2. Top 25 Plant Families of Economic Importance

2.1 Anacardiaceae

Anacardiaceae are resinous trees or shrubs. Leaves are alternate and often trifoliolate or pinnately compound, though some species bear simple leaves. The small, often unisexual, 5-merous flowers have a prominent intrastaminal nectary disk. Fruits are usually 1-seeded drupes. Anacardiaceae comprise more than 700 species in 78 genera. *Rhus*, the largest genus has 200 species. The family is pantropical but contains some temperate members. Edible members of the family include cashew (*Anacardium occidentale*), mango (*Mangifera indica*), and pistachio (*Pistacia vera*), and hogplums and their relatives (*Spondias cytherea*, *S. mombin*, *S. purpurea*, and *S. radlkoferi*). Fruits of *Schinus molle* and *Schinus terebinthifolius* are used to adulterate black pepper (*Piper nigrum*). The latter species is an invasive shrub in many parts of the tropics and subtropics. *Toxicodendron vernicifluum* (lacquer tree) is the source of urushi lacquer. Sap from the unripe fruit of *Semecarpus anacardium* is used as a dye. *Schinopsis quebracho-colorado* and several species of *Schinopsis* *Rhus* are harvested for tannins. *Anacardium*, *Camposperma*, *Dracontomelon*, *Gluta*, *Koordersiodendron*, *Metopium*, and *Tapirira* species provide timber. Species of *Metopium*, *Rhus*, *Semecarpus*, and *Toxicodendron* are toxic.

2.2 Apiaceae (Umbelliferae)

Apiaceae are usually aromatic herbs or shrubs with sheathing leaf bases. The simple or

compound leaves are alternate. Blades often are deeply dissected. The very small 5-merous flowers have an inferior ovary composed of 2-5 connate carpels. Umbelliferae refers to the characteristic umbellate inflorescence. Fruits are usually dry schizocarps. The cosmopolitan Apiaceae contains 3,780 species in 434 genera. Genera containing more than 100 species include *Eryngium* (250), *Ferula* (190), *Pimpinella* (150), *Angelica* (110), and *Bupleurum* (100).

The family, which includes many herbs and spices, medicines, would rank among the ten most important families. Apiaceae are best known as a source of important culinary herbs and spices including anise (*Pimpinella anisum*), cilantro and coriander (*Coriandrum sativum*), cumin (*Cuminum cyminum*), dill (*Anethum graveolens*), parsley (*Petroselinium crispum*), caraway (*Carum carvi*), and cilantro (*Eryngium foetidum*). Carrots, the tuberous root of *Daucus carota*, are one of the world's top vegetables. Other edible members of the family include celery (*Apium graveolens*), fennel root (*Foeniculum vulgare*), parsnip (*Pastinaca sativa*) and the Andean crop arracacha (*Arracacia xanthorrhiza*). Most of the edible members of the family also have medicinal value. The family is noted for the presence of bioactive polyactetylenic compounds. Other well-known medicinal plants in the family are dong quai (*Angelica sinensis*) and gotu kola (*Centella asiatica*). Poison hemlock *Conium maculatum*, implicated in the death of Socrates, contains the neurotoxin coniine.

2.3 Arecaceae (Palmae)

Arecaceae are slender trees or shrubs usually with an unbranched trunk. Notable exceptions to the unbranched trunk are *Serenoa* and some *Euterpe* species. The family also includes several genera of climbers. The large, palmately or pinnately lobed, compound leaves are densely clustered at the apex of the stem. They have a well-developed basal sheath. The small trimerous flowers are often unisexual. The gynoecium is usually syncarpous, with 3 carpels united to form a superior ovary. Fruits commonly are fleshy, though sometimes dry, drupes. Palm inflorescences typically are large, branched, and subtended by a spathe. Arecaceae includes 2,500 species in 191 genera. The pantropical family is most diverse in equatorial regions but also occurs in warm-temperate regions.

Palms have been called the trees of life. Date palms and coconut palms probably have more individual uses than any other species in the world. In addition to those two species, African oil palm (*Elaeis guineensis*) ranks among the most widely cultivated species. Date palms (*Phoenix dactylifera*) are among the oldest cultivated tree crops. Today production estimates are as high as 4,000,000 tons of fruits per year. African oil palms can produce 250 kg of quality palm kernel oil and 500 kg of kernel meal per hectare. Coconuts (*Cocos nucifera*) are symbolic of the multiple uses for which palms can be employed. The hard endosperm of the seed is edible fresh. It can also be dried to produce copra. The liquid endosperm or coconut water is potable. Coconut milk is made by grating coconut with hot water. The fruits also supply food for domesticated animals, especially pigs. Where coconuts are grown in large quantities, non-edible parts of the fruit are used for fuel and are a good source of charcoal. The hard endocarp is used for bowls. Sap from the inflorescence is tapped to produce sugar or it may be fermented to produce an alcoholic beverage. Coir is derived from the mesocarp fibers that surround

the seed and is used to manufacture mats, brushes, twine and rope. Coconut leaves are split longitudinally for roof thatch. Baskets, back pats, and hats are woven from the leaf. The plant also is employed in medicines and cosmetics.

In addition to the tree species mentioned above, many other palms are important food sources. Peach palm (*Bactris gasipaes*) is a major staple for many cultures in Central and Northern South America. In Amazonian Ecuador, the Shuar refer to the palm as uwe, and celebrate its annual harvest with a festival. The doum palm (*Hyphaene thebaica*) was considered to be a sacred tree in ancient Egypt. Where the sago palm (*Metroxylon sagu*) grows in Indonesia, it is said “nobody ever goes hungry.” Starch is obtained by soaking pieces of the stem in water. Sugar palm (*Arenga pinnata*) is the source of jaggery or palm sugar. The apical meristems of several *Euterpe* species are among the preferred sources of palm hearts.

Palms also are important fiber sources. For example, Wounaan and Emberá weave baskets from the leaves of *Astrocaryum standleyanum*. The Seminoles of southern Florida are famous for their dolls, made from the petiole fibers of *Serenoa repens*. *Raphia* spp. from Africa are commercially important sources of fiber used for crafts.

One of the most valuable non-food palm product is rattan, used a structural material for furniture known by the same name. Rattans are Old World climbers in the genus *Calamus* and related genera. Species from the New World genus *Desmoncus* are used similarly. Palms provide a plethora of other products. Carnauba wax is extracted from the leaves of *Copernicia cerifera*. *Phytelephas aequatorialis* and other species in the genus are the source of tagua or vegetable ivory. Betel nut palm (*Areca catechu*) is chewed to produce a stimulating effect due to arecoline and other muscarinic agonistic alkaloids. Palms also have medicinal value. Most notably, saw palmetto (*Serenoa repens*) is effective in treatment of benign prostatic hyperplasia. Finally palms are highly valued ornamentals, serve as the quintessential symbol of the tropics.

2.4 Brassicaceae (Cruciferae)

Brassicaceae are shrubs or herbaceous plants with acrid juice. The latter is due to glucosinolates, which are responsible for the distinctive taste of many members of the family. The alternate leaves are simple, or pinnately lobed, and often forming basal rosettes. Flowers have four clawed petals that are cross-shaped, hence the original family name Cruciferae. Stamens often are distinctly tetradynamous, with 2 short and four long filaments. The carpel, which is borne on a gynophore, mature into capsular fruits called siliques or silicles. Brassicaceae include more than 3,700 species in 338 genera. The family is cosmopolitan but most diverse in the Mediterranean. Genera containing more than 100 species include *Draba* (365), *Cardamine* (200), *Erysimum* (225), *Lepidium* (230), *Alyssum* (195), *Arabis* (120), and *Physaria*.

The many varieties of *Brassica oleracea* include broccoli, cauliflower, cabbage, collard greens, Brussel sprouts, kale, and kohlrabi. Turnip (*Brassica rapa*) has an edible taproot and edible leaves. Rutabaga (*Brassica napus*) and daikon and radish (*Raphanus sativus*) are other members of the family with edible taproots. Maca (*Lepidium meyenii*) is an important crop in the Andes. Brassicaceae is the source of several well known

condiments including mustard (*Brassica nigra* and *Sinapis alba*), horseradish (*Armoracia rusticana*), and wasabi (*Eutrema wasabi*). Watercress (*Nasturtium officinale*) leaves are edible. Rapeseed (*Brassica napus*) is the world's third most important oil seed crop.

2.5 Convolvulaceae

Convolvulaceae are mostly vines, though the family includes some herbs and a few arborescent taxa. *Cuscuta* and its relatives are parasitic vines. Sometimes treated separately, molecular data supports their inclusion in Convolvulaceae. Milky latex is characteristic though not always obvious. The alternate, simple, are often cordate. Margins are generally entire, but some species have divided margins. The five-merous corolla is usually large showy, funnellform, plicate and convolute. The gynoecium is composed of 2 connate carpels, with a superior ovary. Fruits are capsules with 2 ovules per locule. The family, which includes about 1600 species in 57 genera, is most common in the tropics, though temperate members are common. Genera bearing more than 100 species include *Ipomoea* (600), *Convolvulus* (250), *Cuscuta* (150), and *Jacquemontia* (120).

The most important species in the family is sweet potato (*Ipomoea batatas*), which ranks among the 10 most important world crops. *Turbina corymbosa* (olouqui) and *Ipomoea tricolor* (badoh negro) are rich in alkaloids, along with many other members of the family. Ololiqui contains the alkaloid d-Lysergic acid amide to d-lysergic acid diethylamide, commonly known as LSD. Several species in the family are employed as purgatives. *Ipomoea* and *Convolvulus* species are significant weeds in agricultural fields. The two preceding genera along with *Evolvulus* and *Jacquemontia* are sometimes cultivated as ornamentals.

2.6 Cucurbitaceae

Cucurbitaceae are coarse vines with spirally coiled tendrils at the base of the petiole. The alternate pinnately lobed or compound leaf blades are often scabrous. Corollas are five lobed, actinomorphic and often large. Flowers are unisexual. Staminate flowers appear to have 5 stamens but appear to have 3 as two pairs are fused. The gynoecium consists of 3 connate carpels with an inferior ovary. Fruits are modified berries, known as pepos or capsules. Cucurbitaceae are cosmopolitan but most species occur in the tropics or subtropical regions. The family includes 845 species in 118 genera. Major genera include *Cayaponia* (60), *Momordica* (45), *Gurania* (40), *Sicyos* (40), *Coccinia* (30), and *Cucurbita* (27).

Squashes (*Cucurbita* spp.) along with beans and corn were the “three sisters” of Meso-American cultures. *Cucurbita argyrosperma*, *C. maxima*, *C. moschata*, and *C. pepo* are the sources of pumpkins, squashes, and zucchini. *Cucumis melo* is the source of cantaloupes and honeydew melons. Cucumber (*Cucumis sativus*) and watermelon (*Citrullus lanatus*) are other important member of the family. All are grown throughout the tropics and subtropics. Chayote (*Sechium edule*) and achocha (*Cyclanthera pedata*) are cultivated in the New World tropics for their edible fruits. The bitter melon (*Momordica charantia*) is common in Asian markets. Mature *Luffa cylindrica* fruits are

the source of a vegetable sponge. Dried *Lagenaria siceraria* fruits are called bottle gourds. *Fevillea cordifolia* seeds are a potential oil crop. Several species of Cucurbitaceae have medicinal value. *Momordica charantia* has been shown to be effective in treating diabetes.

2.7 Dioscoreaceae

Dioscoreaceae are twining vines or lianas with thick rhizomes. The alternate leaves usually alternate and cordate. Flowers are small and mostly unisexual with six tepals, 6, stamens 6, connate carpels with an inferior ovary. Plants are dioecious. Fruits are mostly 3-winged loculicidal capsules. Dioscoreaceae are mostly tropical with a few temperate and subtropical members. The family has 870 species in three genera, though most species are found in *Dioscorea*. The tubers of several species (*Dioscorea alata*, *D. bulbifera*, *D. cayenensis*, *D. dumetorum*, *D. esculenta*, *D. glabra*, *D. hispida*, *D. opposita*, *D. pentaphylla*, *D. rotundata*, and *D. trifida*) are cultivated for their edible tubers. They are the most important staple for many tropical cultures. Of equal importance, Mexican species of *Dioscorea* (including *D. mexicana*) were the source of diosgenin, which was employed to synthesize progesterone for the first synthetic birth control pills.

2.8 Euphorbiaceae

Euphorbiaceae are herbs, vines, shrubs or trees often with milky latex. Leaves are mostly alternate and simple, though some taxa have compound leaves and a few have opposite leaf arrangements. Inflorescences are cymose and sometimes arranged in cyathia. Flowers are unisexual (plants monoecious or dioecious). The perianth is mostly inconspicuous or absent. Stamens are 5 to many or sometimes reduced to one. The gynoecium usually consists of 3 connate carpels with 1 ovule per locule (taxa with two ovules per locule that formerly were included in Euphorbiaceae are now placed in Phyllanthaceae and Picrodendraceae). Fruits are usually schizocarps. Euphorbiaceae contains 5,970 species in 222 genera. Major genera are *Euphorbia* (2,000), *Croton* (750), *Acalypha* (400), *Macaranga* (250), *Manihot* (150), *Tragia* (150), and *Jatropha* (150). The family is cosmopolitan but best developed in the tropics and subtropics.

Manioc or cassava (*Manihot esculenta*) roots are the major staple for many people in the tropics. Leaves of *Cnidoscolus aconitifolius* and *C. chayamansa* are sources of leafy vegetables. *Caryodendron orinocense*, an Amazonian species, produces an edible seed and has the potential for commercial development. Euphorbiaceae species are significant sources of oils (candlenut - *Aleurites fordii*, tung oil - *A. moluccanus*, castor oil - *Ricinus communis*) and waxes (*Euphorbia antisiphilitica* and *Sapium sebiferum*). Ranking with manioc in terms of human value is para rubber (*Hevea brasiliensis*). The family also is an important source of medicines including castor oil, sangre de grado (*Croton* spp.). Recently ethnobotanical leads from Paul Cox's work in Samoa led to the development of the AID's drug prostratin from *Homalanthus nutans*. *Hura crepitans* and *Hippomane mancinella* are notoriously toxic. The family also provides many ornamentals, most notably *Euphorbia pulcherrima*.

2.9 Fabaceae (Leguminosae)

Fabaceae are herbs, shrubs, trees, lianas or vines usually bearing alternate, pinnately compound, pulvinate, stipulate leaves. N-fixing bacteria are common in two subfamilies: Mimosoideae and Papilionoideae. The androperianth is 5-merous with 10 to numerous stamens (Mimosoideae). The gynoecium consists of a single carpel with 2 to many ovules. Fruits are usually legumes, splitting along two sutures but sometimes indehiscent. The cosmopolitan family contains an estimated 18,000 species in 630 genera. Twenty genera account for nearly half of the species in the family and 16 contain more than 200 species each: *Astragalus* (2,000), *Acacia* (1,000), *Indigofera* (700), *Crotalaria* (600), *Mimosa* (500), *Desmodium* (400), *Tephrosia* (400), *Trifolium* (300), *Chamaecrista* (260), *Bauhinia* (250), *Senna* (250), *Inga* (250), *Dalbergia* (200), *Lupinus* (200), *Phaseolus* (200), and *Pithecellobium* (200).

Fabaceae rank second to Poaceae with respect to human importance. Members of the subfamily Papilionoideae are significant non-animal protein sources. They include beans (*Phaseolus* spp., especially *P. acutifolius*, *P. coccineus*, *P. lunatus*, and *P. vulgaris*), broad bean (*Vicia faba*), cowpea (*Vigna unguiculata*), lentils (*Lens culinaris*, syn. *L. esculenta*), peas (*Pisum sativum*), peanut (*Arachis hypogaea*), soybean (*Glycine max*). *Inga* spp. (Mimosoideae) and *Tamarindus indica* (tamarind – Caesalpinioideae) are tree legumes cultivated for their edible fruits. Resins from balsam of Peru (*Myroxylon balsamum*), copaiba (*Copaifera* spp.) and coubaril (*Hymenaea courbaril*) are globally important commodities. Gum Arabic (*Acacia Senegal*) has a diverse array of culinary and industrial uses. Clovers (*Trifolium* and *Medicago* spp.) are commonly cultivated as forage plants or to improve soil fertility. Indigo (*Indigofera tinctoria*) and logwood (*Haematoxylum campechianum*) are major sources of dyes. Fabaceae are rich in alkaloids. In addition to their medicinal value (e.g., physostigmine from *Physostigma venenosum*) some species are hallucinogenic (yopo - *Anadenanthera peregrina*). *Lonchocarpus* (esp. *L. nicou*) and related species are the source of rotenone, which is used as a fish poison and insecticide. The legume family also is rich in timber species. Black Locust (*Robinia pseudoacacia*) is one of the most commonly cultivated timber trees in the temperate zone. Rosewood (*Dalbergia* spp.) from Brazil, India, and Honduras is prized for the construction of musical instruments, especially guitars. The most highly valued species is Brazilian rosewood (*Dalbergia nigra*). Many legumes are planted as ornamentals. Royal Poinciana (*Delonix regia*), native of Madagascar, is ubiquitous in the tropics.

2.10 Lamiaceae (Labiatae)

Lamiaceae, as now circumscribed, includes aromatic herbs, shrubs or trees, with opposite, leaves and square stems. Many were formerly placed in Verbenaceae. Another legitimate name for Lamiaceae *sensu strictu* is Labiatae. Inflorescences are determinate, often of paired cymes. Flowers are zygomorphic to occasionally actinomorphic, perfect, often with a nectariferous disk. The 5-merous calyx is synsepalous; the 5-merous corolla is sympetalous and typically bilabiate. The epipetalous stamens are 4 (didynamous or equal) sometimes reduced to 2. The gynoecium consists of 2 fused carpels united to form a 2-locular (but appearing 4 locular), superior ovary. The style is gynobasic. Fruits are schizocarps that split into 4 nutlets or are drupes. The cosmopolitan family comprises 7,136 species in 236 genera. Genera with 250 or more species include *Salvia* (800), *Hyptis* (400), *Clerodendrum* (400), *Thymus* (350),

Plectranthus (300), *Scutellaria* (300), *Stachys* (300), *Nepeta* (250), and *Vitex* (250).

The family is best known as a source of culinary herbs including basil *Ocimum basilicum*, marjoram (*Origanum majorana*), mint (*Mentha* spp.), oregano (*Origanum vulgare*), rosemary (*Rosmarinus officinalis*), sage (*Salvia officinalis*), savory (*Satureja hortensis*), and thyme (*Thymus vulgaris*). Cuban oregano (*Plectranthus amboinicus*) is cultivated widely in the tropics, both as a culinary herb and a medicine. The roots or tubers of Chinese artichoke (*Stachys sieboldii* var. *sieboldii*, syn. *Stachys affinis*), gala dinich (*Coleus edulis*), Huasa potato (*Plectranthus rotundifolius*), and Kaffir potato (*Plectranthus esculentus*) are edible. Teak (*Tectona grandis*, formerly Verbenaceae) is one of the world's most important timbers, valued for its use in marine applications. *Gmelina arborea* and species of *Vitex* (both genera formerly in Verbenaceae) also are timber sources. Several mint species are common in cosmetics and perfumes (e.g., lavender - *Lavandula angustifolia* and patchouli - *Pogostemon cablin*). All of the edible mints are valued for their medicinal uses. Many other species are employed for therapeutic purposes including Holy basil (*Ocimum sanctum*), hyssop (*Hyssopus officinalis*), lemon balm (*Melissa officinalis*), motherwort (*Leonurus cardiaca*), peppermint (*Mentha x piperita*), and wild thyme (*Thymus serpyllum*). *Salvia divinorum*, native to Mexico, is a potent hallucinogen. Lamiaceae also provide many ornamentals.

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Biography Sketch

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