TAXONOMY
Brief description of Family leguminosae (Pea or Pulse family).

Origin and distribution

The oldest agricultural records available indicate that leguminous crops have been cultivated for centuries and that they were valued for food and soil enrichment long before their ability to work symbiotically with bacteria was understood. Fossils of leguminosae have been traced back to the Cretaceous or last division of the secondary or Mesozoic era, 95-120 million years ago (Fred et al., 1932).

The leguminosae form one of the largest families of flowering plants, ranking third in terms of world-wide occurrence with about 600 genera and 18,000 species.

Taxonomic characters

Herbs, shrubs and trees, many of which show climbing habits. Leaves mostly alternate, rarely opposite, compound (mostly pinnately so, but sometimes palmately compound) or simple by suppression of leaflets, stipulate or infrequently exstipulate; Flowers rarely solitary, usually in axillary or terminal clusters; commonly in recemes, panicles, spikes or heads, occasionally in umbels and rarely in cymes, often subtended by bracts and bractlets. Flowers almost always bisexual, actinomorphic (regular) or more commonly zygomorphic (irregular) and usually with complete perianth, typically hypogynous or somewhat perigynous. Calyx usually gamosepalous, usually 5-parted, often unequal, sometimes combined in 2 lips. Corolla almost, always present, rarely lacking or reduced to a single
petal, typically 5-parted, distinct or the lower 2 partly or completely adherent along one side or all gamopetalous, imbricate or valvate. Stamens usually 10, occasionally 5 or rarely even fewer, but sometimes numerous, distinct, monadelphous or diadelphous; anthers usually 2-celled, usually dehiscing by longitudinal slits or less commonly by apical pores. Pistil 1 (very rarely 2-15), 1-carpellate, usually 1-loculate, the placentation parietal along the ventral suture; the ovary superior, sessile or stalked. Fruit usually a legume dehiscing along both sutures (or rarely follicular and then splitting only along one side) or variously modified - sometimes a loment (the fruit constricted between the seeds and breaking into 1-seeded indehiscent segments) and sometimes fleshy or membranous and occasionally indehiscent. Seeds usually with little or no endosperm, usually exalbuminous; Testa usually hard or leathery, occasionally strophiolate; Cotyledons fleshly or leafy; the radicle straight or accumbent.

Economic importance of Family leguminosae

Economically, the leguminosae is one of the most important family of flowering plants. Legumes are cultivated to produce food-seeds of high protein content, as well as valuable fodder. They are also a source from which secondary plant products like dyes, gums, resins and oils are extracted. Many of them are grown domestically as ornamentals. Legumes can help spearhead the fight to stop the erosion now prevalent in the tropics and can help to rebuild the already damaged and degraded soils. Economically important plants of this family can be grouped as per their use.
Food value: Common bean (Phaseolus vulgaris), Lima bean (Phaseolus lunatus), Cowpea (Vigna unguiculata), Lentils (Lens esculenta), Pigeon pea (Cajanus cajan), Chick-pea (Cicer arietinum), Soya bean (Glycine max), Green gram (Phaseolus aureus) Black gram (Phaseolus mungo).

Cover crop, Green manure and Fodder:


Oils:

Groundnut (Arachis hypogaea) and Soya bean (Glycine max).

Dyes:

Indigofera arrecta, I. sumatrana and I. tinctoria.

Ornamentals:

The golden shower (Cassia fistula), The pink-and-white shower Cassia nodosa), Pride of Barbados (Caesalpinia pulcherrima), Orchid trees (Bauhinia spp.), Cock's comb coral tree (Erthrina crista-galli), Raintree (Samanea saman), Sweet pea (Lathyrus odoratus), Wisteria (Wisteria spp), Laburnum (Laburnum spp.) and Butterfly pea (Clitoria ternatea).
Other products:

Sunnhemp (Crotalaria juncea) is an important fibre crop in India. Derris spp. and Lonchocarpus spp. are a source of rotenone and are used as insecticides and as fish poisons. Tonka bean (Dipteryx spp.) is used for flavouring. Liquorice is obtained from the roots of Glycyrrhiza glabra and gumtragacanth from Astragalus gummifer. Seeds of Trigonella foenumgraecum are used in curries in India. Senna pods from Cassia angustifolia are used for their laxative properties.

Brief description of Subfamily Papilionoideae

Origin and distribution

The subfamily papilionoideae is the largest, heterogenous with members equally distributed in tropical and temperate zones. The most primitive, woody genera are found mostly in the tropics while the herbaceous more advanced ones occur in temperate region. About 482 genera and 12,000 species are distributed throughout the world (Hutchinson, 1964).

Taxonomic characters

Herbs, shrubs, trees or climbers. Leaves alternate, simple or digitately or pinnately compound, rarely bipinnate, sometimes ending in tendrils. Flowers typically perfect and zygomorphic. Hypanthium very small. Calyx gamosepalous, 5-toothed or-lobed or the upper lobes more or less connate, or bilabiate the 2 upper opposed to the 3 lower, rarely apatheaceous. Petals typically 5, unequal, imbricate, papilionaceous (i.e. the uppermost or odd petal (the
"standard") the largest and external in bud, the two lateral (the "wings") exterior to the two lowermost (the "Keel") which are weakly are coherent and usually enclose the stamens and pistil), borne on the upper rim of the very short hypanthium. Stamens usually 10, their filaments separate or more typically with their filaments united into a sheath partially enveloping the pistil, most commonly diadelphous or monadelphous; anthers typically opening by a lateral slit. Ovary sessile or stipitate, typically 1-celled or occasionally partially or completely 2-celled through the intrusion of the sutures or transversely segmented and with 1 to many ovules. Endosperm absent, cotyledons accumbent, embryo with an inflexed radicle.

Taxonomic history of Canavalia

The genus Canavalia belongs to subfamily Papilionoideae, of the family leguminosae. The generic name Canavalia is the Latinized version of the word "Canavali", which was used by Rheede (1688) as one of the vernacular Malabar name. Rheede's name was validated as a genus by Adanson (1763) who supplied a Latin diagnosis based on Rheede's plant. Some authors therefore preferred to use the generic name Canavali Adanson. It was De Candolle (1935), who actually used the word Canavalia as against Canavali of Adanson.

From Paleobotanical studies, Sauer (1964) expressed the opinion that this genus probably diverged from other phaseoleae during the Cretaceous period. The Wilcox flora, which grew on Eocene sea beaches on the Tennessee-Mississippi region, included plants whose fossile leaves are strikingly like those of Canavalia maritima, the pantropical beach species that grow
on the Gulf Coast today. These fossils were named *C. eocenia* (Berry, 1916) and *Leguminosites andiraformis* (Berry, 1930); the difference in leaf shape between the two forms is within the range of variation of the living species. A very similar form from the Miocene of Trinidad, which also may be inseparable from *C. maritima*, was named *L. canavaliformis* (Berry, 1925).

The wilcox flora includes other leaves that may represent Eocene members of a different subgenus, *Wenderothia*, one form not separately named by Berry, resembles the living *C. altipendula* of Jamaica (Berry, 1930). Another form that resembles the living *C. dura* of Mexico and *C. picta* of South America was named *C. acuminata* (Berry, 1916). Unfortunately, this name is a later homonym of *C. acuminata* Rose, belonging to a different, living species.

A third subgenus, *Catodonia*, is evidently represented by fossils from the Miocene of Trinidad, named *Canavalia miocenica* (Berry, 1925). These leaflets are an excellent match for the living *C. nitida*, not known from modern Trinidad but widespread elsewhere in the West Indies.

The fourth subgenus, *Maunaloa*, endemic to Hawaii, is not represented by any known fossils.

The only known report of fossil *Canavalia* material from outside the Americas is a statement by Menzel (1920) that leaves of *C. ensiformis* were found in tuff of uncertain geologic age on the coast of Camerouns.
Sauer (1964) suggested that *Wenderothia* is the most primitive subgenus, where it includes the species, such as *C. dura*, which are morphologically closest to the other genera of *Diocleinae*. From the *Wenderothia* stock, the subgenera *Catodonionia* and *Canavalia* may have independently initiated and *Maunaloa*, an endemic to the Hawaiian islands may be comparatively late off-shoot of the last.

Brief description of Genus *Canavalia*

Origin and distribution

The genus *Canavalia* includes about 50 species widely distributed throughout the tropics and subtropics of the Old World and the New World and the islands of the West Indies and South Pacific. They inhabit sandy and rocky coastal seashores woodlands, and thickets (Allen & Allen, 1981). According to Guppy (1906, 1917), *Canavalia* and certain other tropical legumes might have evolved from widespread sea dispersed littoral species. This genus actually originated in America, spread around the tropics of the world spawing a large number of similar but discrete species some of which are endemic to oceanic islands and have no adaptation for long range dispersal (Sauer, 1964).

Taxonomic characters

Herbs, twining, or prostrate, slender, annual or stout, tall, woody, perennial climbers. Leaves pinnately 3-foliate; leaflets variously shaped, mostly ovate and acuminate, often large, entire, papery or leathery, undersurfaces usually hairy; stipels generally minute, caducous; stipules
small, wart like or inconspicuous. **Flowers** generally purple to violet, varying from reddish to bluish and from dark to pale, sometimes white, with yellow markings near the petal bases, often resupinate, 2-6 pedicelled at swollen nodes on short or long peduncles in axillary thyrses; bracts small; bracteoles 2, caducous, subtending each flower. **Calyx** camp-anulate, tubular at the base, bilibiate, upper lip large, truncate or 2-lobed, lower lip smaller, minutely 3-toothed or entire; standard large, broad-obovate, reflexed, calloused along the midvein above the claw; wings free, narrow, subtwisted or falcate, eared above the claw; keel wider than the wings, incurved, free at the base, bluntly beaked, sometimes gibbous, eared above the claw. **Stamens** monadelphous or vexillar stamen free at the base and connate with the other in the middle; anthers uniform. **Ovary** sessile, usually hairy, many-ovuled; style incurved or folded with keel, beardless; stigma small, capitate, terminal. **Pod** broad-linear, flattened, sometimes swollen, compressed between the seeds, with a prominent ridge or rib along the upper suture, endocarp papery, white, separating, 2-valved, valves leathery, often thinly filled between the seeds, dehiscent, sometimes explosively, or indehiscent. **Seeds** 4-20, large, ovate or orbicular, oblong to elliptic, strongly to moderately compressed, usually various shades of reddish brown, mettled, hilum linear.

Economic importance of genus *Canavalia*

The genus *Canavalia* includes 51 species distributed in the tropics and subtropics of both hemispheres (Allen & Allen, 1981). Among these species, *C. ensiformis* (L.) DC., *C. gladiata* (Jacq.) DC. and *C. plagio-
sperma Piper are grown as pulse crops. Young seeds and immature pods of these species are cooked and eaten as vegetables, but once they are matured and become hard, they are not delactable.

Nutritionally, the foliage appears acceptable, but livestock eat them with reluctance as they find it coarse and unpalatable. Young immature leaves of Canavalia species are a source of gibberellins.

Members of the genus Canavalia are grown as green manure and as cover and rotation crops favored for their rapid and heavy growth, semi-drought-resistance, deep-rooted habit, and shade tolerance. All species are excellent soil-binders and soil-improvement plants. C. maritima (Aubl.) thou. is a common pantropic strand plant.

The genus Canavalia has also a great pharmacological importance. C. ensiformis has a cooling denucent, antibilious and cordial action, while C. virosa (Roxb.) Wight et Arn. has a narcotic action. Decoction of leaves is taken for nervous disorders in Honduras (Lentz, 1986).

The genus Canavalia is a potential source of Phytohaemagglutinins such as enzyme Urease (Summer, 1919), Concanavalin A, Concanavalin B (Summer & Howell, 1936) and Canavalin (Summer, 1919). Other nitrogenous constituents present are Choline, Trigonelline, Betonicine, Caneine and Ketogine. The occurrence of Canavanine C$_5$H$_{12}$N$_4$O$_3$, an amino acid (Kitagawa & Tomiyama, 1929 in the seeds of Canavalia species is of related interest as it is extensively used as a research biochemical.
Key to the *Canavalia* species studied (Fig. 2)

I. Pods 20 - 35 cm. long:
   II. Seeds white; hilum 8mm. long ... ... ... *C. ensiformis*
   II. Seeds red; hilum 15 - 20 mm. long ... ... *C. gladiata*

I. Pods 10 - 15 cm. long:
   III. Leaflet ovate to oblong-ovate, acute to subacute; Calyx distinctly pubescent; receme many flowered (12 - 20);
       endosperm not separating. ... ... *C. virosa*
Canavalia ensiformis (L.) DC. (Fig. 1a)

Synonyms:

Dolichos ensiformis L.
Dolichos acinaciformis Jacq.
Dolichos pugioniformis Gmel.
Malocchia ensiformis (L) Savi
Canavalia ensiformis (L.) DC.
Canavalia gladiata (Jacq.) DC.

Origin and distribution

The Jackbean originated in the West Indies, whence it was brought to Central and South America. After Christopher Columbus's voyage this crop was introduced into Africa, India, China and Burma (Ustimenko-Bakumovsky, 1983).

Taxonomic characters

Annual, usually bushy and erect, 1-2m. high; stem stout, terete, sparsely strigillose; petiole usually longer than the leaflets; stipules lanceolate; stipels minute, subulate. Leaflets oval to ovate, obtuse to acute, 6-12 cm. long, about 7.5 cm. wide, strigillose at first on both surfaces, later becoming glabrescent, peduncle 10-20 flowered; bracteoles orbicular. Calyx campanulate, 14-16 mm. long, upper lip emarginate, lower lip 3-lobed, lobes triangular, acute. Corolla 15 mm. long, rose coloured, fading to white towards the base; standard oblong-orbicular, notched at
the apex; claw 5 mm. long; wings oblong, obtuse basal auricle inflected; keel as long as the wings, united except at base. Stamens monadelphous, the vexillar one free near the base; all others free for the terminal one-sixth; style glabrous; stigma capitate. Pods linear, gently curved, beaked at the tip, 25-30 cm. long, 2-3.5 cm. wide, 12-20 seeded; each valve with three longitudinal ridges, one near each suture, the third, 4 mm. From the ventral suture; inner layer thin white, papery, separating. Seeds ellipsoid, compressed, shiny white, 22 mm. long, 14 mm. wide, about 8 mm thick; hilum 8 mm. long, greyish, about one-seventh the circumference, surrounded by an orange-brown border.

*Canavalia gladiata* (Jacq.) DC. (Fig.1b)

**Synonyms:**

*Dolichos incurvus* Thunb.
*Dolichos gladiatus* Jacq.
*Canavali maxima* Thouars
*Canavali incurva* Thouars
*Malocchia gladiata* (Jacq.) Savi
*Canavalia incurva* (Thunb.) DC.
*Canavalia gladiata* (Jacq.) DC.
*Canavalia loureririi* G. Don
*Canavalia machaeroides* (DC) Steud.
*Canavalia lunareti* Carriere
*Canavalia ensiformis* (L.) DC.
*Bara - mareca* Rheede
*Lobus machaeroides* Rumph.
Origin and distribution

Mostly found in cultivation in India, Burma, Srilanka and Malaysia. It is cultivated in tropical Africa and the U.S.A.. The native country is difficult to ascertain with precision but it is generally agreed that the plant is a native of the Old World tropics. Ramchandran et al., (1980) believes that this plant belongs to the Hindustan centre of origin.

Taxonomic characters

Annual or biennial climber, climbing to a height of several meters; stem terete, glabrous. Petioles usually shorter than or equalling the leaflets. Leaflets ovate, or broadly ovate, acute, sub-acute, or shortly acuminate, base sub-acute, or shortly acuminate, base sub-truncate, 10-18 cm. long, 7-12 cm. wide, both surfaces glabrous; petiolule 8-10 mm. long, slightly flattened and ridged on two sides; stipules lanceolate; stipels subulate, deciduous; peduncle 10-25 cm. long, 12-16 flowered; flowers usually borne singly and arranged laxly on the peduncle; bracteoles minute ovate, caducous. Calyx campanulate, 15-20 mm. long, upper lip slightly shorter than the tube, with two rounded lobes, hardly emarginate, distinctly reticulate veined; lower lip 3-lobed, lobes 2-3 mm. long, broadly ovate, acute. Corolla usually lilac, or pale pink, 20-25 mm. long; standard orbicular, emarginate, with two small semi-lunar processes near the base; wings about 3 cm. long, oblong-spatulate, slightly curved, auricled at base; claw 14 mm. long with a rounded protruding appendage on dorsal edge; keel as long as wings, blong, obtuse, falcate limb united near the tip, auricled
EXPLANATION OF PLATE - 2

Fig. 1 (c) *Canavalia virosa* (Roxb.) Wight et Arn.

Fig. 2 Seeds of three *Canavalia* species.
Fig 1. (c)

C. ENSIFORMIS

C. GLADIATA

C. VIROSA

Fig. 2
near the base; claw about 7 mm. Stamens monadelphous; ovary linear, pubescent, 15 mm. long, style 12-13 mm. long; stigma capitate. Pod linear-oblong, compressed, slightly curved, beaked, straw-coloured when mature, 20-35 cm. long, 2.5-4 cm (rarely 5 cm) wide, 8-10 seeded, each valve with a longitudinal ridge close to each suture; and a third, prominent one, about 4-7 mm. from the ventral suture; inner layer thin papery, white separating. Seeds ellipsoid, compressed, 22-35 mm. long, 16-20 mm. wide, 5-6 mm. thick, red or dull red; hilum 15-20 mm. about one-third of the circumference.

*Canavalia virosa* (Roxb.) Wight et Arn. (Fig. 1c)

**Synonyms:**

*Dolichos polystachios* Forsk.
*Dolichos virosus* Roxb.
*Canavalia polystachya* (Forsk.) Schweing.
*Canavalia ensiformis* (L.) DC.
*Canavalia africana* Dunn
*Canavalia ferruginea* Piper
*Canavalia mollis* wall. ex wight et Arnott
*Dolichos cienkowskii* Schweinf.
*Katu - Baramareca* Rheede

**Origin and distribution**

It is believed to be a native of India, from which the cultivated species may have been derived (Chatterjee, 1948). It is also found in China, Siam, Mauritius, Tropical Africa, Madagascar and Arabia.
Taxonomic characters

A large biennial climber with glabrous or pubescent leaflets. Petiole longer than the leaflets with a few irregular longitudinal streaks. **Leaflets** membranous, ovate or broadly-ovate, sometimes orbicular, subulate or obtuse, with a very short mucronate tip; base usually cuneate or sub-truncate, 8-14 cm. long, 5-9 cm. wide, glabrescent to hirsute on both surfaces; petiolule 6-8 mm. long, pubescent; stipules and stipels subulate, caducous; peduncle very variable, 20-40 cm. long, with 10-20 flowers borne usually in pairs, are closely aggregated in the upper third or upper fourth. **Calyx** narrowly campanulate, 15 mm. long, upper lip of two rounded slightly overlapping lobes, about as long as the tube, lower lip of three short ovate-acute lobes, central tube longer than the lateral pair. **Corolla** rose-purple, or lilac, about 3 cm. long; standard obcordate, with two thick callosites near the base, 3 cm. long, 2 cm. wide, appendage short and obtuse, claw 5-7 mm. long; wings falcate, obtuse, with two appendages on the dorsal side, claw filiform, about 7 mm. long; keel as long as the wings, but broader, gently curved, with a sharp acute base appendage, 2.8-3 cm. long, including 7-8 mm. long claw. **Stamens** monadelphous, 2.5-3 cm. long; ovary linear, 2 cm. long, strigose; style glabrous, 5-6 mm. long; stigma capitate. **Pod** elliptic-elongate compressed, sparsely hairy or glabrous, 4-8 seeded, 10-14.5 cm. long, 2-2.5 cm. wide, beak short. **Seed** ovoid or ellipsoid, 1.8-2 cm. long, 10-11 mm thick, amber with gamboge streaks; hilum 10 mm. long, broader near the micropyle.