Plant Diversity Website

Phaseolus vulgaris Linnaeus

FAMILY: Fabaceae, the Pea Family

Common Names: Bean, French bean, garden bean, kidney bean, haricot bean, navy bean, runner bean, salad bean, snap bean, string bean, wax bean, red peas, frijol, dry bean, cai dou (pinyin, China) (1,5).

Etymology: *Phaseolus* is the diminutive of the Latin word *phaselus*, which means kidney-bean, while v*ulgaris* is Latin for common (4).

Botanical synonyms (1):
Phaseolus aborigineus Burkart
Phaseolus communis Pritz.
Phaseolus esculentus Salisb.

Quick Notable Features (2,7)**:**
¬ Alternate, trifoliolate leaves
¬ Broadly ovate leaflets with acuminate apices, the petiole of the terminal leaflet longer than those below
¬ Zygomorphic flowers with spiraled keel petals and bracteoles as long as the calyx
¬ The raceme shorter, or as long as, the petiole of subtending leaf

Plant Height: Usually up to 2 meters (8,9).

Subspecies/varieties recognized (1):
P. vulgaris var. *aborigineus* (Burkart) Baudet
P. vulgaris subsp. *aborigineus* (Burkart) Burkart & H. Bruecher
P. vulgaris subsp. *vulgaris*

Most Likely Confused with: other legumes, like *Phaseolus polystachios*, *Strophostyles helvula*, *Amphicarpaea bracteata*, *Pueraria montana*, *Vigna* spp.

Habitat Preference: *P. vulgaris* rarely persists when it escapes from cultivation due to its tropical origins. It prefers moist, well-drained soils, with neutral to basic pH, and it is shade intolerant (8,11).

Geographic Distribution in Michigan: *P. vulgaris* is not commonly found escaped in Michigan. It was recorded in only five counties: Bay, Cheboygan, Midland, Wayne, and Washtenaw (2).

Known Elevational Distribution: The species was found at elevations up to 2600 meters above sea level in China (Yunnan) and Ecuador (Chimborazo, Penipe) (1).

Complete Geographic Distribution: *P. vulgaris* is native to tropical Americas. In the United States, it is found CT, DC, FL, KY, MA, ME, MI, MO, MT, NC, NH, NY, OH, PA, RI, SC, UT, VA, WY, PR, and VI. The species also occurs in Canada, Mexico, Cuba, Leeward Islands, Windward Islands, El Salvador, Costa Rica, Honduras, Belize, Guatemala, Nicaragua, Panama, French Guiana, Suriname, Colombia, Peru, Argentina, Venezuela, Ecuador, Brazil, India, eastern Africa, and China (1,5,6,7).

Vegetative Plant Description: *P. vulgaris* is an annual trailing, climbing, or erect branching herb, with glabrescent to pubescent stems (uncinate hairs on young parts). The stipules are lanceolate to triangular and about 4 mm long. The petiole and rachis are grooved. The leaves are alternate, pinnately compound, and trifoliolate. The leaflets are broadly ovate to elliptical, entire, acuminate, thin, glabrous to pubescent, 4-16 cm long and 2.5-11 cm broad. There are 2 stipels at the base of the terminal leaflet, and only 1 stipel at the base of each lateral leaflet; the stipels are 1-3 mm long. Pulvini are present on the petiolules. The lateral leaflets are asymmetrical (2,7,9,12).

Climbing Mechanism: Twining (7) in a dextral orientation (Burnham, pers. obs.).

Flower Description: The perfect, zygomorphic flowers are borne in axillary 3 to 8 (occasionally more) flowered racemes. The peduncled raceme rarely exceeds the length of the petiole of the subtending leaf, and the pubescent rachis is minutely uncinate. Each flower is subtended by 2 large ovate bractlets that enclose the emarginate 5-parted calyx (3-4 mm long). The lower lobes of the calyx are shorter than the tube, and the 2 upper lobes are fused. The corolla is white, yellow, purple, or red, and composed of a standard, two wings, and two fused keel petals. The standard petal (9-12 mm wide) is orbicular and bent, the same length or slightly shorter than the wings that are adherent to the keel. The keel petals (about 10 mm long) are coiled around the reproductive organs. The stamens are grouped as 9+1. The single pistil is superior, pubescent at the ovary and at the apex of the persistent style, below the oblique or lateral stigma (a generic characteristic of *Phaseolus*). The ovary has numerous ovules (2,7,9,11,12,13).

Flowering Time: In China, the species flowers April-July (7).

Pollinator: *P. vulgaris* is generally self-pollinated because the keel petals enclose both the androecium and gynoecium, which allows pollen to come into direct contact with the stigma. Honeybees and bumblebees also visit the flowers (9,15).

Fruit Type and Description: The fruit is a glabrous to glabrescent, slightly compressed or terete, dehiscent two-valved legume, 10-15 cm long and 1-1.5 cm broad, slightly curved, green to reddish-purple. Each legume contains 4-10 seeds. Some forms are strongly dehiscent, while other cultivated forms are essentially indehiscent (7,9,10,12).

Seed Description: The kidney-shaped seeds are 0.9-2 cm long and 0.3-1.2 cm wide. They come in many colors: white, red, brown, gray, black, and mottled are just a few possibilities. The hilum is small, oval to oblong, and generally naked. There is no endosperm. The cotyledons in the genus *Phaseolus* are thick and suffer very little alteration after germination, remaining above or below the ground; germination is epigeal (7,9,11,12,14).

Dispersal Syndrome: In wild populations, when the fruit is mature, the legumes dry and twist open to forcibly expel the seeds. The cultivation of the species for its seeds and pods resulted in forms selected not to dehisce (10,12).

Distinguished by: In *Phaseolus polystachios* the inflorescence length exceeds the petiole of the subtending leaf, which is rarely true in *P. vulgaris*. Additionally, the bractlets subtending *P. polystachios* flowers are smaller than in *P. vulgaris*, shorter than the pedicel and not enclosing the calyx. *Strophostyles helvula* has linear stipules, not lanceolate to triangular. Also trifoliate, the leaflets of *S. helvula* are slightly lobed, not entire. The racemes have few flowers (up to 10) clustered at the apex, bractlets are absent, the longest tooth in the calyx is longer than the tube, and the keel petals are only curved, not coiled. The seeds in *S. helvula* are pubescent. *Amphicarpaea bracteata* is a highly variable species with similar vegetative traits. The leaflets are slightly smaller, or the same size as a small *P. vulgaris* leaflet, and strigose on both sides. The calyx has 4 lobes instead of 5. Racemes bear perfect flowers, but also present are flowers with corolla absent, and cleistogamous flowers (flowers remaining closed and self-polinating) at the base of the plant that produces underground fruits. *Vigna* spp. flowers are distinct from *Phaseolus* in that the keel petals only slightly curve, not coiling, and the presence of auricled wings (2,11,13).

Other members of the family in Michigan: *Amorpha* (2), *Amphicarpaea* (1), *Anthyllis* (1), *Apios* (1), *Astragalus* (3), *Baptisia* (3), *Caragana* (1), *Cercis* (1), *Chamaecrista* (2), *Colutea* (1), *Crotalaria* (1), *Cytisus* (1), *Dalea* (2), *Desmanthus* (1), *Desmodium* (12), *Galega* (1), *Gleditsia* (2), *Glycine* (1), *Gymnocladus* (1), *Hedysarum* (1), *Hylodesmum* (2), *Kummerowia* (1), *Lathyrus* (9), *Lespedeza* (9), *Lotus* (1), *Lupinus* (3), *Medicago* (3), *Melilotus* (3), *Mimosa* (1), *Orbexilum* (1), *Phaseolus* (1), *Pisum* (1), *Pueraria* (1), *Robinia* (3), *Securigera* (1), *Senna* (2), *Strophostyles* (1), *Tephrosia* (1), *Trifolium* (10), *Vicia* (10), *Vigna* (1), and *Wisteria* (2) (source 2).

Ethnobotanical Uses: The leaves, green pods, and seeds are edible. The pods and leaves can be consumed raw or cooked, however, large quantities of raw seeds are toxic and may cause

nausea and diarrhea. When properly cooked, the seeds are a great source of protein. The young or dried mature pods are diuretic and can aid with the treatment of diabetes, helping to reduce blood sugar levels. The seeds, also diuretic, can be powdered and applied directly to open sores, and is used to treat leukemia. A tea can be prepared with *P. vulgaris* seeds and garlic to treat coughs. The roots have narcotic properties. The whole plant is used in homeopathic treatments of urinary tract disorders, rheumatism, and arthritis. The red seeds can be made into a brown dye (8).

Phylogenetic Information: *Phaseolus* is a member of the subfamily Faboideae in the Fabaceae family, which is in the order Fabales, part of the Rosids I, Core Eudicots. Members of the Fabaceae are distributed worldwide, and the family contains approximately 9.4% of all eudicots and 16% of all known woody plants found in neotropical rainforests (3).

Interesting Quotation or Other Interesting Factoid not inserted above: A population genetics study showed that multiple paternity can occur within the fruits of *P. vulgaris* (15). The common bean contains a substance called phaseolin, a natural fungicide (8). Fennel and *Allium* inhibit the growth of *P. vulgaris* (8). The species, like many Fabaceae, has a symbiotic relationship with nodule forming bacteria that fixes nitrogen from the atmosphere into the soil, which also provides nitrogen for surrounding plants (8). The stems can double-twine, that is, the branches twine around the stem, which in turn twines around the support (9). There is a positive correlation between the size of the leaves and the size of the seeds (10). Latin America is responsible for 47% of the global production of *P. vulgaris*, and Africa 24% (5). One mature plant can bear as many as 240 legumes (12).

Literature and websites used:

1. Tropicos.org. Missouri Botanical Garden. 07 Nov 2012 <http://www.tropicos.org/Name/13031753>
2. *Michigan Flora Online*. A.A. Reznicek, E.G. Voss, & B.S. Walters. February 2011. University of Michigan. Web. November 7, 2012. http://michiganflora.net/species.aspx?id=1339.
3. Stevens, P.F. Angiosperm Phylogeny Website. Version 12, July 2012. http://www.mobot.org/mobot/research/apweb.
4. Brown, R.W. 1956. *Composition of Scientific Words*. Washington, D.C.: Smithsonian Institution Press.
5. Velasquez V.L.B. & P. Gepts 1994. RFLP diversity of common bean (*Phaseolus vulgaris*) in its centres of origin. *Genome* 37(2): 256-263.
6. USDA, NRCS. 2012. The PLANTS Database (http://plants.usda.gov/java/profile?symbol=PHVU, 11/07/12). National Plant Data Team, Greensboro, NC 27401-4901 USA.
7. Wu D. & M. Thulin 2010. *Flora of China Vol. 10: Fabaceae* (online). http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=200012279
8. Plants For A Future, 1996-2012. *Phaseolus vulgaris*. http://pfaf.org/user/Plant.aspx?LatinName=Phaseolus+vulgaris
9. Centro Internacional de Agricultura Tropical 1986. *Morphology of the Common Bean Plant Phaseolus vulgaris*. Cali, Colombia: CIAT. http://books.google.com/books?id=0TI0awmpNs0C&printsec=frontcover&dq=phaseolus+vulgaris&hl=en
10. Van Schoonhoven, A. & O. Voysest 1991. *Common beans: research for crop improvement*. Oxon, UK: C.A.B. International.
11. Fernald, M. L. 1950. *Gray's Manual of Botany,* 8th ed. New York: American Book Company.

12. Gentry, H.S. 1969. Origin of the common bean, *Phaseolus vulgaris*. *Economic Botany* 23(1): 55-69.
13. Britton, N.L. & H.A. Brown 1970. *An Illustrated Flora of the Northern United States and Canada: Volume II*. New York, NY: Dover Publications, Inc.
14. Torrey, J. & A. Gray 1838-1840. *A flora of North America: containing abridged descriptions of all the known indigenous and naturalized plants growing north of Mexico; arranged according to the natural system Vol. I*. New York, NY: Wiley & Putnam.
15. Ibarra-Perez, F.J., N.C. Ellstrand, & J.G. Waines 1996. Multiple Paternity in Common Bean (*Phaseolus vulgaris* L., Fabaceae). *American Journal of Botany* 83(6): 749-758.

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