# FAVA BEAN

## *Vicia faba* L.

### Plant Symbol = VIFA

*Common Names*: English: bell bean, broadbean, faba bean, faba, fava, field-bean, horse bean, horsebean tick-bean, Windsor bean. Spanish; haba. Portuguese: fava.
*Scientific Names: Faba bona* Medik., *Faba vulgaris* Moench, *Faba vulgaris* var. *paucijuga* Alef., *Vicia faba* subsp. *paucijuga* .Muratova
Recognized conspecific taxa: *Vicia faba* L. var. *equina* St.-Amans, *Vicia faba* L. var. *faba* and *Vicia faba* L. var. *minuta* (Hort. Ex Alef.) Mansf.

*Figure 1. Fava bean plants in bloom. USDA-NRCS Lockeford, CA Plant Materials Center.*

**Description**
*General*: Fava bean is a member of vetch genus in the Fabaceae Family. The plants are erect, cultivars with both indeterminate and determinate growth are known, and those with determinate growth are between 2 and 7 feet tall (De Costa et al., 1997; Hickman and Canevari, 2012; Preston and Isely, 2012). Stems are square and hollow, there may be a single stem or several branching from the base to form a bushy habit. Leaves are compound 4 – 7 inches long with 3 - 7 leaflets and no tendrils. The leaf stipules have an extrafloral, purple nectary on the undersurface. Flowers are fragrant, borne in clusters on short stalks in the axils of the leaves, petals range from white to purple and may have black, dark brown or purple blotches. The flowers have 10 stamens, nine of these are fused and the tenth is free, the ovary is positioned above the stamens, and the style is angled upwards bearing a cluster of hairs near the stigma. The pod's exterior is smooth, green, and cylindrical in shape with a wooly coated interior that can contain up to 10 seeds (Figure 2). Once the seed is mature, the pods dry to dark brown or black. Seeds vary greatly in size, and colors of mature seeds may vary from cream, brown, reddish, greenish and purple with a large dark colored hilum (Figure 3). The root system consists of several lateral roots in addition to a broad and shallow taproot, though variation in root architecture among cultivars is known to exist. Fava bean cultivars with deeper root systems generally experience improved drought tolerance. (Ingram et al., 1997; Zhao et al., 2017). An association with the symbiotic nitrogen fixing bacteria, *Rhizobium leguminasarum bv. vicae*, develops nodules on the roots, which are variable in size, with a white exterior and reddish interior in actively fixing nodules (Jensen et al., 2010). Mycorrhizal associations develop on the roots of fava beans (Kopke and Nemecek. 2010). Chromosome number 2n=12, the genome size (~13 Gb) of fava bean is about double that of closely related species due to many repetitive sequences (Duc, 1997).
Three sub species are recognized: *V. faba* var *faba*, broad bean or Windsor bean is a large seeded form with one or two large pods, *V. faba* var *equina*, field bean or horse bean has more numerous pods and smaller seeds, and *V. faba* var *minuta*, bell bean or tick bean, has the smallest seeds with numerous pods in the leaf axils (UCANR, 2019; USDA Agriculture Research Service (ARS), 2018).

*Distribution*: The center of domestication for fava bean is the Middle East, with seed remains found in northern Israel: demonstrating that the plant was cultivated and that seeds were stored and consumed up to 11,000 years ago (Caracuta et al., 2015). Although the ancestor of fava bean remains unknown, many closely related species have a small seed size and small seeded fava bean cultivars still predominate in this region (Cubero, 1974). Secondary areas of domestication are recognized in southern and northern Europe, Ethiopia and southern China where it remains a staple food. Large seeded cultivars were developed in both Europe and southern China where most populations are relatively homogenous (Torres et al., 2006). However, there is also evidence of distinct large seeded fava bean populations developing in Ethiopia and China (Serradilla et al., 1993). Fava bean is now widely distributed around the world, with production in temperate and subtropical areas in addition to the high elevations in the tropics of the Old World and the New World including South America and Mexico. The

main producing countries in 2017, in order of production, were China, Ethiopia, Australia, UK and Egypt, with Australia as the largest exporter, selling mainly into China and North Africa (FAOSTAT, 2017: Pulse Australia, 2016). There has been a steady decline in fava bean production over the past century, especially in Asia and the Mediterranean region. There are several reasons for this decline, including the use of land races that may have low yields and susceptibility to pests and diseases, and the greater availability of nitrogen fertilizers which have reduced the need for fava bean as a fertilizer source (Torres et al., 2006). For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site.

*Figure 2. Developing pods of fava bean held upright in the leaf axils. Note black spots on leaves are chocolate spot.*

*Figure 3. Fava bean seeds are variable and different cultivars vary markedly in size. Upper left is a Windsor cultivar, lower right a bell bean.*

Adaptation

There are large numbers of locally adapted cultivars and land races of fava bean due to its long history of domestication, and selection pressure in separated geographic areas. Some cross pollination occurs and falls between 4 to 84% (Torres et al., 2006). Fava beans can grow on heavier soils than vetch (*Vicia* spp.) and peas (*Pisum* spp.) (UCANR, 2019) and generally tolerate a variety of soil types but grow best on well drained clay and silt soils in addition to sandy soils with adequate moisture. The pH range for fava bean growth is between 6.5 and 9. Poor performance on poorly drained and acidic soils is often attributed to failures in nodulation (Jensen et al., 2010). The relatively shallow root system means that fava bean depends on water availability in the top 12-18 inches of soil (Caracuta et al., 2015). Drought tolerance varies considerably between cultivars with those from northern Europe exhibiting less drought tolerance and shallower lateral roots compared to cultivars from southern Europe (Zhao et al., 2017). Sensitivity to drought is most severe at bloom and during pod fill (UCANR, 2019).

Fava bean is a long day plant that is grown as a winter annual in warm temperate and subtropical areas, and as a warm season crop in cooler areas. Optimum soil temperatures for germination are between 60 and 65˚ F. Germination will not occur at temperatures below 40˚ F or above 76˚ F though there are differences between cultivars (Jensen et al., 2010). Hardier cultivars from the Mediterranean can tolerate winter temperatures as low as 14˚ F and the hardiest European cultivars have a floor of 5˚ F. Cold tolerance is a problem in some regions of the Continental United States and selection of cultivars to tolerate a wider temperature range is a goal of the USDA-ARS Fava Bean Research Program, along with selection of small seeded cultivars that can be easily planted with corn and cover crop planters (Hu et al., 2009; Landry et al., 2015b). The optimum temperatures for growth range from 65-85˚ F while temperatures above 90˚ F will restrict growth and yields (Landry et al., 2015a; Jensen et al., 2010).

**Uses**

*Commercial Crop- Human Consumption:* The pods, beans, and shoots of the plant are edible, and the part(s) consumed depend on region and culture. Fava beans are a staple food around the Mediterranean area and across Eurasia, including Egypt, Syria, Iraq, Iran, Northern India, Pakistan, and Southern China. In Europe and the United States, the large seeded

immature beans are eaten fresh with or without the seed coat. In Egypt and other Arab countries, small seeded fava beans are used in the national dish, *ful medames*. In Southern Europe and Southeast Asia, beans are eaten fresh, dried in a variety of dishes, or roasted for use as a snack food. The fresh shoots and newly unfolded leaves are consumed fresh or in stir-fries in some Asian cultures. Nutritional quality of dry beans is 24% protein, 2% fat and 50% carbohydrate with about 700 calories per cup. Tannin concentrations vary between cultivars, and those with lower tannin levels often have higher levels of protein (Crepon et al., 2010; Hickman and Canevari, 2018). Fava beans contain high concentrations of the amino acid L-DOPA, the amino acid is used in the treatment of Parkinson's Disease and dopamine responsive dystonia (Crepon et al., 2010).

*Animal Feed and Forage Crop:* Fava bean makes excellent forage, the plants may be grazed or used for hay and silage (Jensen, 2010; UCANR, 2019). Fava bean straw is used as a cash crop in Egypt and Sudan (Jensen et al., 2010). Analysis of nine fava bean lines grown under dryland conditions at the USDA-Natural Resources Conservation Service (NRCS) Bridger, Montana Plant Materials Center found crude protein ranged from 14 – 22% and the relative feed value (RFV) varied from 123-150%, which is comparable to the RFV of alfalfa (*Medicago sativa*) (Hensleigh, 2016; Tallman, 2016). The nutritional value of dried fava beans is high, and it is used as feed for pigs, horses, poultry and pigeons. It may also be used as a component of the diet for cattle and sheep (Crepon et al., 2010; Jensen et al., 2010).

*Cover Crop:* Fava beans can be grown either as a cool or warm season cover crop depending on location. Beneficial attributes of fava bean as a cover crop include: biomass production, high biological nitrogen fixation, upright growth habit, a strong tap root that reduces soil erosion, may suppress weeds, a good pollinator plant, increased populations of beneficial insects, and easy termination and decomposition of residue. The use of fava bean as a cover crop may lead to greater yields in the succeeding cash crop (Etemadi et al., 2018). Structurally, fava is an important component of cover crop mixes as its stout stems and upright growth habit enables vining plants such as peas and vetch to be better supported and increase the amount of biomass produced (Figure 4). Biomass production of fava bean can be higher than most legumes, with production of 20 – 40 tons of biomass per acre (Hickman and Canevari, 2018; Jensen et al., 2010). Nitrogen fixation occurs at a rate of 90 to 200 lbs. per acre (Hickman and Canevari, 2018; Jensen et al, 2010). The high levels of nitrogen in residues are suitable for succeeding crops with a high nitrogen requirement, although for crops requiring limited nitrogen, use of fava bean could lead to excess vegetative growth and even nitrate leaching (Kopke and Nemecek, 2010). Fava bean forms mycorrhizal associations and increases phosphorus availability in soils (Kopke and Nemecek, 2010). The effect of yield increases in the crops following fava bean is well documented at many locations around the world (Jensen et al., 2010; McEwen et al., 1990; Wright, 1990). Fava bean may break disease cycles when used as a break crop in a diverse rotational cropping system. Examples of fava bean's role in breaking disease cycles include the reduction of "take-all" of cereals caused by the fungus (*Gaeumannomyces graminis*) (Jensen et al., 2010; Kopke and Nemecek. 2010; McEwen et al., 1990) and lettuce drop in lettuce (*Lactuca*) production caused by *Sclerotinia minor* (Koike et al. 1996). In addition to disease control, fava beans may suppress weeds (Brennan and Smith, 2005; Ingels et al., 1998; Lopez-Bellido, 2005). Flowers are visited by a variety of pollinator species and are especially attractive to bumble bees (*Bombus* spp.). The extra-flora nectaries provide additional nectar resources to pollinators and beneficial insects including lacewings, ants and ichneumoid (parasitic) wasps (Bugg et al., 1989; UCANR, 2019). Fava bean may be added to an integrated pest management system as it is a host to some aphid species, particularly the black bean aphid (*Aphis fabae*). This insect population allows for the development and increase of generalist predators including ladybug beetles and predatory mites, which may protect cash crops given the appropriate timing of planting and cover crop termination (Stoddard et al., 2010; UCANR, 2019).

*Figure 4. Fava bean as part of a multi-component cover crop mix including pea (Pisum sativum), hairy vetch (Vicia villosa), and oats (Avena sativa). This is a typical high biomass cover crop mix for Central California. The upright stems of the fava bean act as a scaffold and allow the pea and hairy vetch to climb, increasing the biomass and nitrogen fixing ability of the cover crop mix.*

*Insectary and pollinator plantings:* Fava bean is an excellent plant for pollinators and there is a long bloom period as flowers are formed in the leaf axils over several weeks or months. Blooms are especially attractive to bumble bees, European honey bees (*Apis mellifera*), and other species of native bees. The plants have floral nectaries in the leaf axils, which provide additional floral resources to pollinators and beneficial insects. Ichneumonidae (Hymenoptera), parasites of insect pests, were found to feed on the extrafloral nectaries of fava bean in the Eastern United States from mid-September through November, likely increasing the overwintering ability of the parasitic wasps (Bugg et al., 1989). Predatory mite populations were found to increase in a mixed cover crop with the majority found on fava beans, when the crop was mowed and the clippings laid around citrus foliage, the populations of predatory mites in the citrus foliage substantially increased (UCANR, 2019).

**Warning: Favism**

Favism is a disease prevalent in Mediterranean countries and characterized by acute hemolytic anemia following ingestion of fava bean seeds by individuals who have low-activity variants of glucose-6-phosphate dehydrogenase (G6PD) (Mavelli et al., 1984: Preston and Isely, 2012). The distribution of individuals susceptible to favism is similar to that of malarial (*Plasmodium falciparum*) resistance as the genetic variant offers protection to infection (Crepon et al., 2010). The gene is carried on the X chromosome and therefore the majority of individuals who express the disease are male, although females with a single copy of the gene are carriers. The symptoms are expressed as yellowish skin, dark urine and shortness of breath. At least 14 G6PD genetic mutations have been reported in patients with favism from a range of geographic regions including North Africa, the Middle East, China, Southeast Asia, and southern Europe (Luzzatto and Arese, 2018). Two strategies are recommended to prevent future cases of favism: 1) screening persons for G6PD deficiency and 2) developing and utilizing fava bean cultivars that have low concentrations of the molecules that induce favism. The latter approach may be a viable path for future fava bean breeding efforts (Khamassi et al., 2013).

**Status**

*Weedy or Invasive:* May occasionally establish as a roadside or garden escape in the US, not considered weedy (Preston and Isely, 2012). Please consult the PLANTS Web site (http://plants.usda.gov/) and your state's Department of Natural Resources for this plant's current status (e.g., threatened or endangered species, state noxious status, and wetland indicator values).

**Planting Guidelines**

Fava beans are direct seeded in the spring or fall at a depth of 1 - 2 inches, when soil temperatures are between 42 -70˚F. Seed size is highly variable among *Vicia faba* cultivars (Figure 3), and it is common practice to plant different densities depending on seed size: 14 plants per square yard for large seeded cultivars and 28 plants per square yard for small seeded cultivars (Lopes-Bellido et al., 2005). Seeding rates tend to be lower for fall seedings rather than spring seedings as there is a longer growing season. Prior to planting, seed should be inoculated with a vetch strain of *Rhizobium* spp. to ensure root nodule formation and the fixation of atmospheric nitrogen, especially in fields where vetch has not been previously grown. For a green manure or cover crop, one fava bean grown per square foot is recommended. For seed production, a within row spacing of 8 – 10 inches with a 2 - 3 feet row spacing is appropriate (Hickman and Canevari, 2012). A typical seeding rate for fava bean is 80 – 120 pounds per acre (UCANR, 2019). Adequate soil moisture is important for germination and establishment.

**Management**

*Cover Crop and Green Manure:*

Fava bean establishes best with direct drilling. A corn planter may be used for small seeded cultivars, but larger seeded cultivars will require equipment suitable for large seeds such as lima beans. Broadcast seeding followed by harrowing can be employed as a planting strategy but will likely result in the establishment of poor stands. Plant either in spring or fall with appropriate soil temperatures and adequate soil moisture (Etemadi et al., 2018; Giambalvo et al., 2012). Spring sown fava bean will bloom in 40 to 70 days, while fall sown plants may bloom in 120 to 206 days (USDA-NRCS Great Basin Plant Materials Center, Fallon, NV, unpublished data), depending on temperatures and the selected cultivar. Fall planted fava bean in California will bloom from early February to late May (UCANR, 2019), while bloom in Nevada starts mid to late April. The plants may be mowed during the immature growth phase with a high mow, while a low mow will kill the plants. The cover crop can be terminated by mowing, roller crimping, disking, or herbicide application prior to or during bloom - when nitrogen starts to be translocated to the developing seeds. The plant is subject to rapid decomposition due to its high nitrogen content.

In California's coastal areas and Central Valley, fava beans are a common component of a "plow-down" mix that typically includes other legumes such as winter pea (*Pisum sativum*) , hairy vetch (*Vicia villosa*), and a cereal such as oats (*Avena sativa*), triticale (× *Triticosecale Wittmack*), or wheat (*Triticum aestivum*)(Figure 4). These are planted in fall and germinate with fall rains. However, additional irrigation after planting fava bean may be necessary in the southern Central Valley. Typical values of 50 – 200 pounds of nitrogen fixed per acre were reported in fava bean. Less nitrogen fixation occurred in the southern part of the state and better adapted cultivars may be needed for these areas (UCANR, 2019). In organic rice

production fields in the Sacramento Valley, fall planted fava beans are used as a cover crop to add nitrogen and reduce compaction (UCANR, 2019).

In the Mid-Atlantic, United States, Etemadi et al. (2018) evaluated the potential of fava bean as a cover crop in a rotation with sweet corn (*Zea mays*). The authors compared decomposition rates of winterkilled fava bean in conventional and no-till systems to assess the contribution of nitrogen from the fava bean to the succeeding sweet corn crop. Fava beans planted two weeks earlier in the summer produced significantly more biomass than a planting two weeks later and fixed an additional 111 pounds of nitrogen per acre compared to the later planting. Breakdown of residues and nitrogen release occurred more quickly under conventional tillage, in which 50% of the accumulated nitrogen was released from residues by the end of May, compared to the end of June for the no-till system. The authors concluded that for fava bean the no-till system is more suitable for sweet corn production than the conventional system.

In an investigation of warm season cover crops in Montana, Tallman (2016) found that a small seeded cultivar of fava bean performed as well as forage pea (*Pisum sativum*) when grown with a single species or as a multi-species cover crop under dryland and irrigated conditions. In a semiarid environment in North Dakota, fava bean performed as well as or better than forage pea depending on spring and summer planting date, and exhibited good water use efficiency (Power, 1991).

Wright (1990) in a study of the effect of fava beans in a cereal rotation in the northern prairies of Saskatchewan, Canada, found that in the cereal crops succeeding the fava bean, yields were increased by an average of 21% in the first year and 12% in the second year.

Giambalvo et al. (2012) report on an 18-year study of fava bean in a rainfed cereal legume rotation under the Mediterranean conditions of Palermo, Italy. They compared no-till with conventional tillage and found that on average cereal grain yield was 31% higher under the no-till system and the yield difference was most pronounced when rainfall was scarce and nitrogen fixation was higher. The main problem was that while overall weed diversity decreased, those remaining weeds were hard to control.

McEwan et al. (1990) found that a spring planted fava bean in a wheat rotation in Rothamsted, UK, contributed an average of 30 lbs. nitrogen per acre to the following winter wheat crop.

**Pests and Potential Problems**

Fava beans are susceptible to several pests and diseases, although resistance and susceptibility varies widely between cultivars. Aphids are the most important and damaging pests of fava bean worldwide, causing damage by feeding on the phloem and damaging all growth stages (Stoddard et al., 2010). In the United States, black bean aphid (*Aphis fabae*), cowpea aphid (*Aphis craccivora*) and pea aphid (*Acrythosiphon pisum*) are prevalent (Hickman and Canevari, 2018; Stoddard et al., 2010). These pests may be a problem with succeeding crops, but also allow for increased populations of beneficial insects and generalist predators, such as ladybugs and lacewings, and should be considered as part of an IPM program (Stoddard et al.; 2010). Fungal diseases include: Aschochyta blight (*Aschochyta fabae*), chocolate spot (*Botrytis fabae*), which causes brown spotting on leaves and pods, Faba bean rust (*Uromyces vicia-fabae*), which causes orange brown pustules with golden haloes on the leaves, downy mildew (*Peronospora viciae*) and foot rots (*Fusarium* spp.) (Torres et al., 2006). Fava bean is susceptible to several species of the weedy parasitic plant broomrape (*Orobanche* spp.) which are major pests in the Mediterranean Basin and North Africa. This parasitic weed causes severe yield loses on a variety of hosts and five species are listed as Federal Noxious Weeds in the United States. Currently, branched broomrape (*Orobanche ramose)* is listed as present in limited areas under quarantine in California, Texas, and several other states (USDA, NRCS 2019). Fava bean is affected by plant parasitic nematodes, including the three most important global nematode pests: root knot nematode (*Meloidogyne* spp.), root lesion nematode (*Pratylenchus* spp.), and the stem nematode (*Ditylencus dipsaci*) (Stoddard et al. 2010). Bacterial diseases are transmitted by seed and caused by two species: *Pseudomonas syringae* and *Xanthomonus campestris*. These may affect fava bean by causing leaf blights and severe defoliation. In view of the potential pest and disease problems with fava bean, only clean, non-infested seed should be used in conjunction with an Integrated Pest Management (IPM) Program (Stoddard et al., 2010).

**Environmental Concerns**

None

**Control**

Please contact your local agricultural extension specialist or county weed specialist to learn what works best in your area and how to use it safely. Always read label and safety instructions for each control method.

**Seeds and Plant Production**

Ensure that a cultivar is adapted to your area for seed production. Ideally, the selected cultivar is kept free from the major pests and diseases of fava bean. Soil fertility should be adjusted prior to planting, typically additional nitrogen is not required but soil phosphorus and zinc may be limiting. Irrigation may be required prior to planting in dry areas (Pulse Australia, 2016; UCANR, 2019). Seeding rates for different locations may be optimized, but a typical spacing might be 30 inches between rows and 6 inches within row spacing (UCANR, 2019). Harvest when nearly all pods are black, but before the stems are completely dry and black. With the correct combine harvester header and settings, the pods will thresh easily and yield whole clean seeds with minimal spitting and cracking. With delayed harvest, yields will be lower as some cracking of pods and stem lodging are likely to occur.

**Cultivars, Improved, and Selected Materials (and area of origin)**

Numerous cultivars are grown at different locations around the world and several are available in the US for specialty vegetables. The Agricultural Research Service is conducting research and trials to develop small seeded cultivars suitable for cover crop production (Landry et al., 2015a; Landry et al., 2015b; Pulse Australia, 2016; USDA, ARS, 2019). Cultivars should be selected based on the local climate, resistance to local pests, and intended use. Consult with your local land grant university, local extension or local USDA NRCS office for recommendations on adapted cultivars for use in your area**.**

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**Citation**

Smither-Kopperl, M. 2019. Plant Guide for fava bean (*Vicia faba*). USDA-Natural Resources Conservation Service, Lockeford Plant Materials Center. Lockeford, CA 95237.

Published: Jan, 2020

Edited:

For more information about this and other plants, please contact your local NRCS field office or Conservation District at http://www.nrcs.usda.gov/ and visit the PLANTS Web site at http://plants.usda.gov/ or the Plant Materials Program web site: http://plant-materials.nrcs.usda.gov.

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9992 to request the form. You may also write a letter containing all of the information requested in the form. Send your completed complaint form or letter to us by mail at U.S. Department of Agriculture, Director, Office of Adjudication, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410, by fax (202) 690-7442 or email at program.intake@usda.gov. Individuals who are deaf, hard of hearing or have speech disabilities and you wish to file either an EEO or program complaint please contact USDA through the Federal Relay Service at (800) 877-8339 or (800) 845-6136 (in Spanish).

Persons with disabilities who wish to file a program complaint, please see information above on how to contact us by mail directly or by email. If you require alternative means of communication for program information (e.g., Braille, large print, audiotape, etc.) please contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

For any other information dealing with Supplemental Nutrition Assistance Program (SNAP) issues, persons should either contact the USDA SNAP Hotline Number at (800) 221-5689, which is also in Spanish or call the State Information/Hotline Numbers. For any other information not pertaining to civil rights, please refer to the listing of the USDA Agencies and Offices for specific agency information.