Vegetable Fava Bean Growing Guide for Western United States

Kyle Brasier and Hossein Zakeri, California State University- Chico

This guide is intended to provide gardeners and small-farm growers with a brief overview of fava bean cultivation practices. Fava bean dry grain production has been extensively described in the literature, here we describe management strategies to grow vegetable fava for fresh pod within the western United States. Because of its unique potentials for biological nitrogen fixation (BNF), we have included a brief overview of the cover crop aspects and benefits of vegetable fava bean, but a deeper look into fava bean cover crop can be found in the Fava Bean Plant Guide by the USDA Natural Resources Conservation Services at https://www.nrcs.usda.gov/plantmaterials/capmcpg13528.pdf.

Vegetable fava bean plant with pods at horticultural maturity stage

Introduction

Fava bean (*Vicia faba*) was domesticated in the Southern Levant roughly 10,000 ago where archeological excavations revealed that the crop was grown under intensive agricultural methods and consumed by Neolithic peoples. Since domestication, fava bean spread throughout the world and grew to become a significant crop until the mid-20th century. The Roman grammarian, Athenaeus, wrote in his third-century cookbook, Deipnosophistae, that the green pods and immature seeds (fresh fava bean) were common components of exquisite meals and desserts. Given its significance to several distinct cultures, fava bean has unsurprisingly taken on many names (e.g. faba bean, horse bean, bell bean, and broad bean) and end uses (e.g. food, feed, and cover crop). Due to its superior nutritional values including protein, carbohydrates, B group vitamins, and minerals, fava bean is considered one of the most important pulse crops in the world. In recent years, cultivation of fava bean has received attention in USA, Canada, and Europe.

As a cool-season legume, fava bean can be included in various cropping systems in shorter-growing season regions such as Northeastern USA. Fava bean tolerates cold better than other cool-season legumes, which contributes to fava bean's popularity as an autumn planting around the world. The most recent FAO STAT report shows that global production of fava bean (labeled as horse bean) grain from 2019 to 2021 ranged 7.1 to 7.7 mt (million tons) while its global fresh production during this time was 1.8 to 2.0 mt. Within the parts of the United States, winter fava bean is typically grown as a grain legume, green manure, or vegetable crop where it is autumn sown, overwinters as a young plant at the three to six node stage, and is harvested or terminated in spring. Compared to growing fava bean to full maturity for dry grain harvest, fava bean as a vegetable crop is harvested at full-pod stage, before pods dry and reach agronomic maturity.

Cultivar Choice

Factors that are important to consider when selecting a fava bean cultivar are seed size and color, growth habit, and maturing date.

Seed size: Fava bean is very diverse in seed size and seed color (**Figure 1).** In terms of seed size, fava bean is classified in three types: small-seeded (<500 g/1000 seed), medium-seeded (500-800 g/1000 seed), and large-seeded (>800 g/1000 seed). Traditionally, large-seeded fava is preferred as vegetable crop while medium-seeded is grown for dry grain. Small-seeded fava has recently gained popularity for cover cropping, as an effort to reduce the cost of cover crop seeding. Nevertheless, our observations of small-seeded genotypes suggests they may have market values for fresh pod production similar to green bean.

Figure 1. Diversity of seed size and seed color of fava bean collection at the U.S. National Plant Germplasm System (https://npgsweb.ars-grin.gov/gringlobal/search) (left) and a selection of vegetable fava bean varieties (right)

Seed Color: Fava bean seed coat color varies from clear-beige, grey-beige, grey-green, grey or dark-grey, black, brown, red, violet, green, yellow or beige. The seed coat color, which starts developing by aging and toward maturation, are known to have a direct relationship with seed tannin content. Nevertheless, vegetable fava is picked before seed coat color starts to develop (seeds are still green), and seed color is not an important factor in selecting vegetable fava cultivars.

Growth Habit: Both determinate and indeterminate fava bean genotypes are available. In a right environment, indeterminate cultivars continue flowering and producing pods (similar to indeterminate tomato), while determinate types produce a set of flowers and pods and reach

maturity. The majority of large-seeded vegetable fava bean cultivars in the market are indeterminate, meaning that the length of flowering and pod production is controlled by environmental factors such as heat and water availability. Early maturing indeterminate cultivars are generally preferred for fresh pod production, as they demand a higher unit price by reaching the market early, while allowing for multiple harvests and have the benefit of avoiding some pest pressures.

Flowering and Pod Formation: In our autumn planted study, the USDA fava bean collection showed a wide range of flowering dates (90 to 125 days after planting). Similarly, the five vegetable cultivars that we grew had different flowering dates, which resulted in different time of maximum pod production (**Figure 2)**. For example, 'Aguadulce' and 'Grano Violetto' produced the same pod yield (~20 t/ha), but 'Aguadulce' yield was spread equally throughout three harvests, and 'Grano Violetta' produced the highest yield (70%) in the first harvest. A similar variation was observed between 'Vroma' and 'Windsor'.

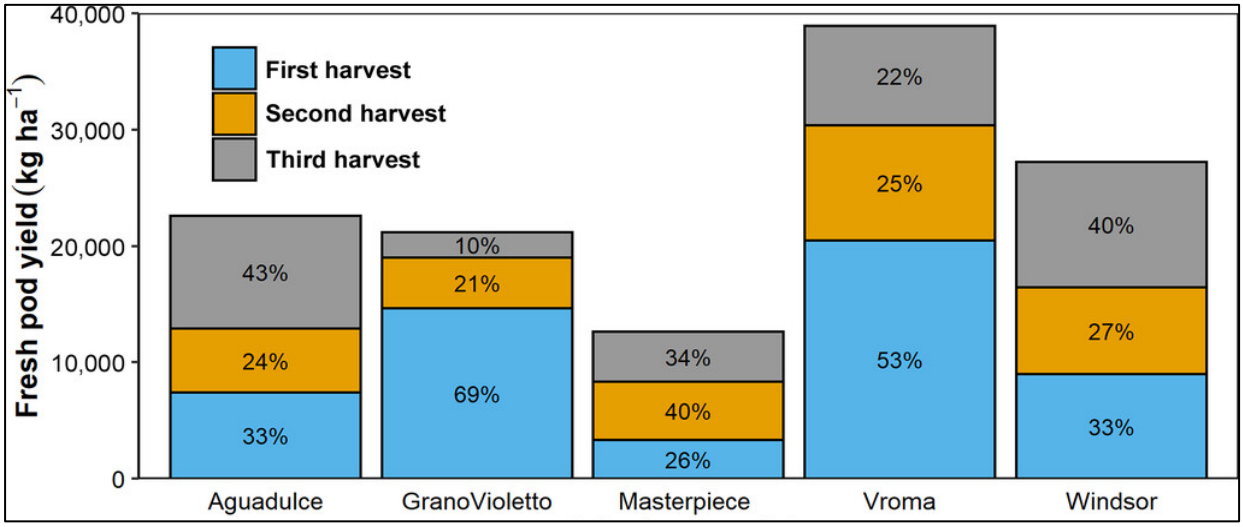

Figure 2. Average fresh pod production of five vegetable fava bean varieties in in three environments, from Brasier et al. (2023). https://doi.org/10.21273/HORTSCI16843-22

Seed availability in the market, especially in large volume seeds, is an important factor in variety selection. Despite the diverse collection of vegetable varieties (**Figure 1**), seeds of most varieties are hard to purchase in bulk. Windsor and Vroma are the only varieties that we found in 50 lb. bags from local seed companies. Other varieties are found online in small quantities (see **Table 1** for more information). When information is available, it helps to check on a variety's pest and disease resistance, and pod quality. Although fava bean is a hardy plant and easily survives winter in California and other similar climates, it's helpful to select cold tolerant varieties (when information is available) for colder regions. Finally, most gardeners and small-farm fava bean growers prefer to take advantage of fava bean N fixation ability and improve soil N. Our studies

suggest that fava bean residual N after pod harvests is affected more by environmental conditions (such as rain and temperature) and soil fertility conditions than by variety.

Table 1. List of some fava bean varieties and characteristics, and seed vendors

End-use	Variety	Seed size	Maturity time	Places to order seed
Cover crop	Bell Bean	Medium	Late	Bulk: Most seed companies (Lockwood seed, Hearne Seed …)
Vegetable	Windsor	Large	Moderate	
Vegetable	Vroma	Large	Early	Bulk: Osborn Quality seed
Vegetable	Grano Violetto	Large	Very early	oroseeds.com
Vegetable	Aguadulce	Large	Late	organic-heirloom-seed.com
Vegetable	Masterpiece	Large	Early	Sand Hill Preservation Center

Cultivation Practices

Temperature and Planting Date: Fava bean germinates better than most grain legumes in low temperatures. Attempts to select for improved seed germination at low soil temperatures (below 15 °C) have shown some degree of success, especially in large-seeded cultivars. We tested a selection of USDA's fava bean collection for germination during the cold months in Chico, CA. The collection was sown on Jan 20th and germinated 10 to 25 days after, during the period of Feb 1st to Feb 15th (120 to 210 growing degree days, T_b=5).

Planting date is highly dependent on the growing region and cropping system. In most parts of the western United States (including California, Arizona, Nevada, Oregon, and the western part of Washington), autumn-planted fava bean is very common. Our observations in northern California suggest that early planting in the fall (or even late summer) can help early crop establishment and improve yield. In mild climates, like those around Los Angeles and California's Central Valley, planting can occur at almost any time of year. Plantings between early October and mid-November are very successful in producing high pod yields and biomass. Nevertheless, most CA growers wait until the first rains of November to plant their fava beans.

Hot desert climates like those in Arizona should avoid planting too close to summer to avoid hot temperatures. This may create some garden scheduling problems for those that want to focus on production of leafy or brassica crops. Areas that have harsh winters (including those in Nevada's Great Basin) should plant in late September and irrigate their plants throughout the germination stages to ensure success. Cold climates like those experienced in Idaho and Montana should consider a spring planting date.

Land Preparation: Fava bean is a very robust crop that can be established in cultivated and no-tilled soils. In our work, we often disked the field, shaped beds, and sown fava bean seeds, but also tested the feasibility of growing vegetable fava bean with minimum or no tillage. **Figure 3** shows the steps of establishing fava bean on a summer cover crop residues. The only cultivation in this field was done after plant flowering (photo D) when weed suppression effects of crop residues gradually disappeared. The crop has a strong taproot that often breaks through tough

clay soils and thrives in silt loams. Interestingly, fava bean tolerates long-term water standing and continues to grow and produce effective nodules in hypoxic and waterlogged clay soils.

Seed Inoculation:

Figure 3. Land preparation and planting vegetable fava after summer cover crop: A: mowing sorghum sudangrass, B: hand-planting in residues- C: drip tape irrigation, D: early plant stage in sorghum residues, E: weeding between rows with rotary tiller, and F: pod stage and harvesting.

As a legume crop, fava bean develops symbiotic relationship with rhizobia bacteria and obtains most of its nitrogen through biological nitrogen fixation. Ideally, seed inoculation with effective rhizobia strains should improve the N fixation. Currently, a specific rhizobia inoculant for fava bean is not marketed, but fava bean can be inoculated with pea inoculants. **Figure 4** shows root nodules and a few marketed rhizobia inoculants that are available for purchase from different sources. The choice of formulation depends on planting method. Peat-based (powder) is a good formulation to utilize with the slurry inoculation method, whereas granular formulation is mainly mixed in the seed tank and placed in seeding zone at the planting. Nevertheless, we noticed good nodulation and growth of fava bean without inoculating seeds with rhizobia. In a particular experiment in a field that did not have a recorded history of legume cultivation, our inoculated

and non-inoculated treatments had similar nodulation, growth, and pod production - most likely due to adequate levels of preexisting native soil rhizobia.

Direct sowing is strongly encouraged for simplicity, low cost, and high success rate compared to

Figure 5. Fava bean nodules (A), and some marketed rhizobia inoculants for pea, vetch, and lentils in granular (B) and peat-based powder formulations (C and D).

transplanting. In direct sowing, gardeners should plant the seed roughly 1-2 inches deep in soils of tilled or no-till farms and gardens. Transplanting is an alternative that is used in colder climates that rely on spring planting to promote earlier establishment and harvest. It is essential to irrigate for the first two weeks after planting.

Plant Spacing: Row spacing has significant impacts on fava bean growth and production. Because of its indeterminate growth habit, fava bean adjusts its growth based on density and plant spacing. Wide-open spacing can result in large plant sizes that are prone to lodging (falling on the ground). On the other hand, narrow spacing limits the ability to traverse the field for cultivation practices and hand-harvesting of pods. A common row spacing in northern California is 4 x 1 (4ft row spacing x 1ft plant spacing on the row). Different spacing arrangements are

Fava bean row spacing on prepared 4ft beds between orchard trees (left), two sides of 5ft beds+3ft furrow with drip tape irrigation (middle), and hand planted on 5ft rows (right) in northern California.

practiced in small farms to facilitate traveling with tractors and field equipment. The Maciel

Farm in northern California (one of our collaborators on this project) uses grain drill to plant fava bean. The drill is adjusted to sow on six rows and skip the 7th row (7th feeder is blocked) to leave space future traveling, cultivation, spraying, and hand-picking pods.

Hand-picking fava bean in 4ft spacing fava bean.

Seeding Rate: The optimal amount of seed varies by row spacing and seed 1000 kernel weight (KW). Because both row spacing and seed size varies, the following equations can be used to calculate the number of plants and the amount of seed needed:

$$\boldsymbol{Number\ of\ plants} = \frac{land\ size\ (ft2)}{Row\ spacing\ (ft)\ \times\ Seed\ spacing\ (ft)}$$

$$\boldsymbol{Seed\ (lbs.)} = number\ of\ plant\ \times\ \frac{\left(\frac{Seed's\ 1000\ kw}{1000}\right)}{453}$$

Considering the common range of 11,000 to 20,000 seeds per acre in the western United States, and an average 800g 1000 KW of Windsor (common vegetable variety), growers would need about 20 to 35 lbs. Windsor seed/acre. Depending on soil temperature, seeds typically germinate 10 to 21 days after planting and undergo the various growth stages displayed in **Figure 7**.

Other Cultivation Practices:

Fava bean benefits from irrigation for the first two weeks after planting. In northern California and similar climates where rain starts in mid-fall and continues until spring, fava bean can be started with no irrigation. Usually, growers do not irrigate when planting fava bean in early November, except in dry years when the rain arrives late. Fava bean pod production is strongly limited by water availability so plants should receive enough water to support pod production. Depending on the duration and amount of rain in spring, one or two irrigations after pod-set **(R4 in Figure 7)** significantly contributes to yield increase and production period. Drip tape irrigation is recommended over other irrigation methods, e.g., sprinkler and flood, to limit weeds and fava bean foliar disease.

Fertilizer may be applied to vegetable fava bean as an organic (e.g. compost) or inorganic (e.g. slow release) at the time of planting. Typically, there is no need to add nitrogen fertilizer as fava bean is a legume that can interact with soil microorganisms to source nitrogen from the atmosphere. However, other nutrients (phosphorus, potassium …) can affect fava bean pod production. Whereas most soils have enough potassium to support high yield, 40 lbs. P_2O_5 per acre (equivalent to 80 lbs. mono-ammonium phosphate or 90 lbs triple phosphate/ acre) is required for satisfactory production.

A soil nutrient test kit

High phosphorus content fertilizers are marketed as “Blooming” or “Flowering” fertilizers. Gardeners and growers that apply compost and manure should not worry about adding additional fertilizers. Soil nutrient status can be tested by sending about 100g soil sample from 0-6” topsoil to a local lab for N-P-K analysis, or tested with an inexpensive soil nutrient analysis test kit. When used properly, these kits can provide a reasonable estimation of soil nutrient status.

Weed control with rotary tiller

Weeding is essential for the success of vegetable fava bean – particularly at an early plant stage as fava bean is a poor weed competitor. Growers should consider harrowing or rod weeding roughly two weeks after fava bean germination. Small rotary cultivators are easy to operate and effective in weed control for large cultivation areas. Growers that are considering cultivation of fava bean at a large scale may look for chemicals including Poast (link to label), which is used to control narrow leaf weeds in beans. Using chemicals for weed control always requires consulting experts and the product label before application.

Two major pests are known to affect fava bean in western United States: black bean aphid and chocolate spot (**Figure 6**). Black bean aphid tends to show up near the reproductive stage of fava bean and can cause significant yield loss. Small scale gardeners may consider cutting out infected parts of the plant or use of organic pesticides such as a low concentration neem oil or a homemade insecticidal soap as described in **Table 2**. The spray should come in direct contact with the black bean aphid. Remember to always label your spray bottles and shake them well

Figure 6- Fava bean plants affected by chocolate spot caused by *Botrytis fabae* (left) and black aphid (*Aphis fabae*) (right)

before use! In larger scale and non-organic farms, Imidacloprid (link to information), which is the active ingredient of insecticides (such as Brigade) can be used. This insecticide can be delivered to plants via irrigation tapes before or during infestation for long-term protection against aphids. Pyrethrin (link to information) is the active ingredient of products such as Movento and can be sprayed on infested plants to reduce pest pressure. In addition to consulting experts, growers, and gardeners can find details information, regulations, and safety of chemical pesticides from the Resource Link of AGRIAN website (https://home.agrian.com). It is very important to use more than one pesticide in rotation to avoid building resistance.

Table 2. Recipe for a homemade soapy water spray to control aphids.

Spray bottle	Liquid soap	Powdered cinnamon	Powdered cayenne	Water
16 oz	2 tsp	1 tbsp	2 tsp	14 oz

Chocolate spot will appear as red-brown circular lesions on the leaves of your fava bean plant. This is commonly observed after long periods of high humidity and high temperature and has been a significant issue in coastal California. This risk can be mitigated by earlier planting and by increasing plant spacing in areas where high humidity conditions are common. Growers and

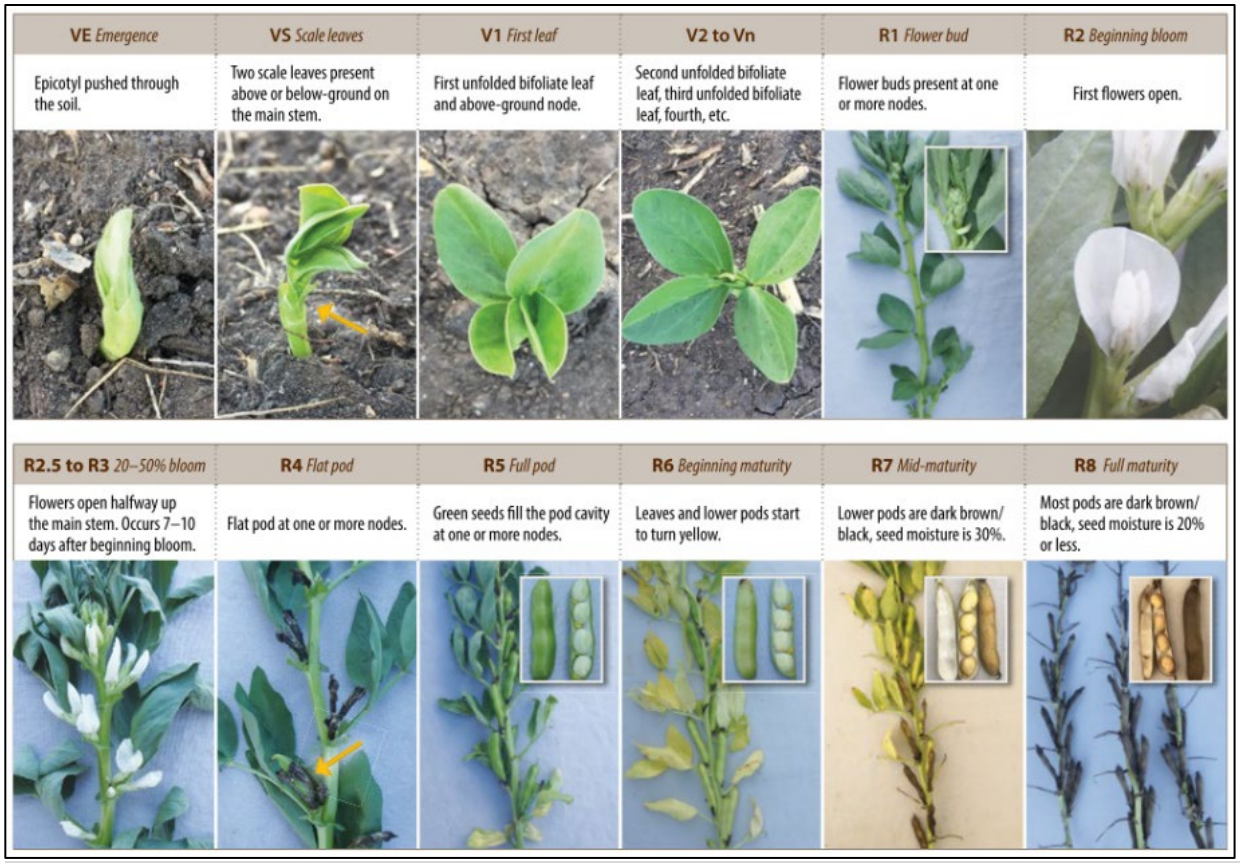

Figure 7. Fava bean growth stages from germination to matuirty from Manitoba Pulse and Soybean growers

gardeners should always keep in mind that a strong crop rotation helps keep plant pests down by reducing their buildup and benefits the yield of fava bean and other crops in rotation.

Harvesting and Usage

Harvesting Time: Fava bean pods are hand-picked at the full pod (R5) stage **(Figure 7)**. Our autumn-sown vegetable fava reached horticultural maturity (pods ready for harvest) in mid-April. We harvested pods three times in early April, mid-April, mid-May in Chico and Pomona. Our survey of California farmers markets shows that fava bean availability in the farmers market starts to increase from March, maximizes in May, and declines in August (**Figure 8)**.

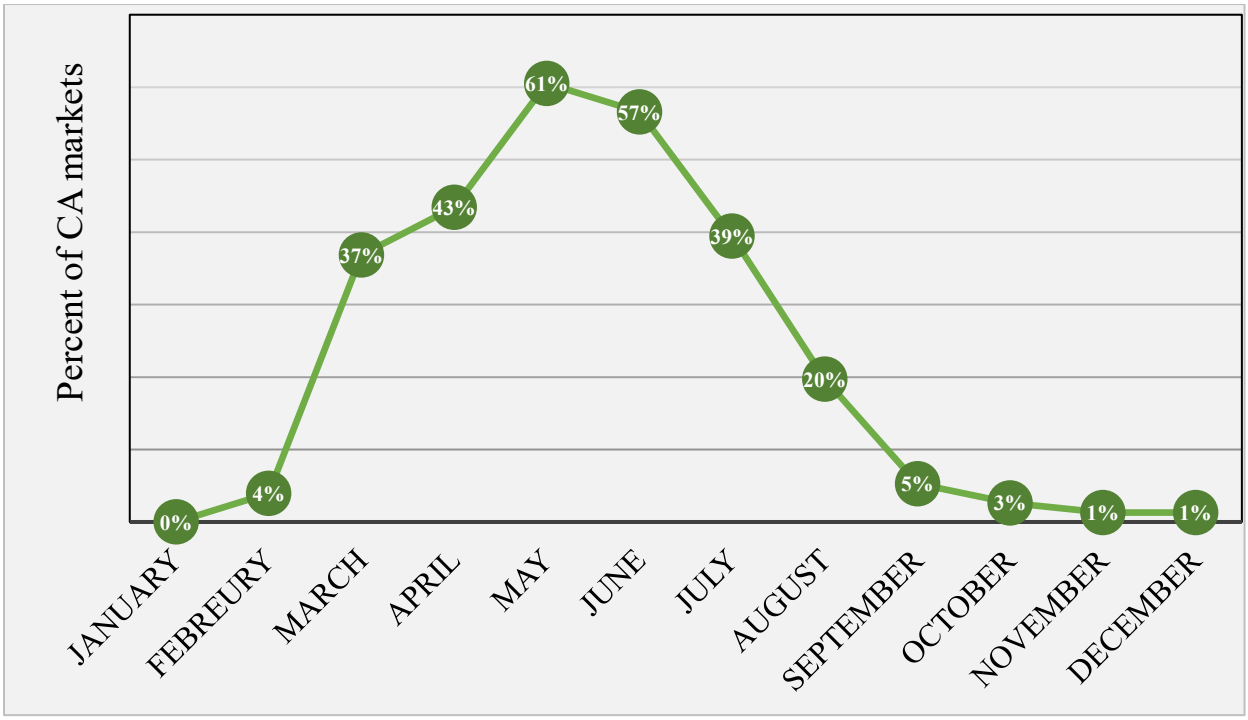

Figure 8: The percent of surveyed CA farmers' markets where fresh fava bean pod is sold in different months of the year.

Harvesting Method: Currently, no mechanical harvester is available in the market for fava bean fresh pod harvest. The pods are hand-picked and boxed in the field to be delivered for further processing or sale in local markets. Fava bean green pods are consumed as a whole or shelled for consumption of fresh beans in the pod. When immature seeds (beans) are used for cooking, additional processing is required to remove the pod shell (shucking or peeling) and seedcoat of immature seeds (shelling).

Seed coat removal is the most time-consuming part of fresh fava bean processing, and is a significant culinary hindrance preventing more widespread use in cooking. Although some manufacturers advertise industrial size fava bean peeler on their websites and YouTube, an affordable small-size peeler for household use yet to be built. For easier seed coat removal, bring

a pot of water to a boil with a pinch of salt then submerge the fresh beans in the boiling water for 5 minutes or until the seed coat looks inflated. Remove the seedcoat for immediate use or freezing for future use. Storage of fresh pods can be a bit difficult but fresh beans can be easily stored after blanching in the freezer. Fresh pods stored in your refrigerator will benefit from increased humidity by placing beans in a sealed bag and can last up to 2 weeks without issue. In additions to green pods and immature seeds, fava bean green leaves also used in different dishes.

This photo is from SpruceEats

Marketed fava bean leaves, green pods and beans (left), and hand-picking fresh pod, shucking (peeling) and shelling or removing seed coat (left)

Consumption: The young pods can be eaten whole at the early podding stage, whereas more mature pods should be harvested when bumps begin to form in the pod where the beans are located. Leaves can be harvested and consumed once the plant has reached the branching stage.

Fresh fava beans, young leaves, and pods are used as a primary dish that is cooked and salted, brewing and baking adjunct, protein source in bean dips, spreads on toasted breads, companion to carbohydrates (e.g. rice and pasta), fried bean cakes, meat substitutes, cooked or raw sprouts, and as components of salads, soups, stir fry, and desserts. For those seeking culinary inspiration, please check out our recipe book (https://www.favabeanresearch.com/recipes).

Quality and Favism: From a classical take on nutritional quality, fava bean is a great source of protein (20.0 to 31.0%), fat (1.1 to 2.0%), carbohydrates (42.0 to 58.0%), and dietary fiber (12.0 to 24.0%). Fava bean is also known to host antinutritional factors, vicine and convicine, that may result in red blood cell damage (i.e. hemolytic anemia) upon consumption of fresh fava bean for consumers with a genetic deficiency for glucose-6-phosphate dehydrogenase (G6PD). Though reported cases are rare, this interaction between red blood cells and fava bean is most commonly observed in areas where G6PD deficiency and consumption of the fresh beans are common. G6PD deficiency is most common in regions of malarial endemicity, as the inherited enzyme deficiency provides some resistance to malaria and is most commonly observed in peoples of southern European, Southeast Asian, and the Middle Eastern descent.

Fava Bean Residues

Faba bean is used not only as staple food but also integrated into various crop rotation systems to minimize the occurrence of cereal cyst nematode (*Heterdera avenae*) and soil-borne pathogens. Faba bean is partially a self-pollinating plant, however, it's flowers attract various pollinators, specifically honey bees. Current reports indicated that honey bees and other natural pollinators can increase the incidence of pollination and thus grain yield in fava bean. Our study demonstrated that genotypes of the USDA fava bean collection vary in reaching specific phenotypic stage, likely due to evolving in different photo-thermal regimes. Such variation can be used to increase the benefits of winter cover crop. For example, a combination of multiple fava bean genotypes in winter cover crop mixes can provide habitat for pollinators during cold months.

Faba bean has been identified for its efficient N fixation capacities which is the highest among the cool season legumes. Reports indicated that faba bean can fix up to 180 lb N ac^{-1} depending on cultivation management and environmental conditions. Our studies showed that after harvesting vegetable pods, the remaining fava bean biomass can provide up to 80 lbs of nitrogen per acre to the following crop in rotation. Fava bean residues decompose very fast, even when they are left on the soil surface and not incorporated to soil. However, it must noted that soil residual N has an important impact on N fixation rates of legumes, including fava bean. In soils with relatively high N, legumes prefer using soil N rather than engaging in symbiosis

with rhizobia. Nevertheless, the use of fertilizer is strongly discouraged for fava bean grown as a cover crop or green manure.

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Additional photos

Fresh pod, and seed size and shape of five fava bean varieties grown in Chico State University Farm, April 2020

Shucking , shelling, and roasting faba bean pods and seeds, and faba bean and food demonstration during Fava Bean Festival , Solano Garden, Los Angelse, April 2022

Fava bean is grown as a vegetable crop (left) and as a component of a winter cover crop mixture (right).

Mowing a winter cover crop mix for termination at Chico State University Farm (left) and grazing a winter cover crop during a field day demonstration at Colusa, CA (right).

Faba bean and oat mix (left) and faba bean in orchard cover crop mix (middle and right) in Lockeford, Pomona and Chico, CA- Fall 2022

Alternate rows of fava bean and fiber flax at Chico Flax, April 2020 (left) and expansion of winter cover crop roots in topsoil, Peoria, AZ, February 2023 (right)