Plant Guide

PEA

Pisum sativum L.

Plant Symbol = PISA6

Contributed by: NRCS Plant Materials Center, Pullman, Washington

Field of peas. Rebecca McGee, USDA-ARS

Alternate Names

Common Alternate Names: garden pea, field pea, spring pea, English pea, common pea, green pea (*Pisum sativum* L. ssp. *sativum*); Austrian winter pea (*Pisum sativum* L. ssp. *sativum* var. *arvense*)

Scientific Alternate Names: Pisum arvense L., *Pisum humile* Boiss. & Noe, *Pisum sativum* L. ssp. *arvense* (L.) Poir., *Pisum sativum* L. var. *arvense* (L.) Poir., *Pisum sativum* L. var. *humile* Poir., *Pisum sativum* L. var. *macrocarpon* Ser., *Pisum sativum* L. ssp. *sativum*, and *Pisum sativum* L. ssp. *sativum* var. *arvense* (L.) Poir.

Uses

Commercial crop: Peas are a cool-season crop grown for their edible seed or seed pods. Different types of peas are grown for various purposes. Garden or green peas are harvested before the seed is mature for the fresh or fresh-pack market (Elzebroek and Wind, 2008). Sugar snap peas and snow peas lack the inner pod fiber and are also harvested early for the fresh or fresh-pack market (McGee, 2012). Field peas, including fall-sown Austrian winter peas, are harvested when seeds are mature and dry, and are primarily blended with grains to fortify the protein content of livestock feed. Dried peas are also sold for human consumption as whole, split or ground peas. Peas are a nutritious legume, containing 15 to 35% protein, and high concentrations of the essential amino acids lysine and tryptophan (Elzebroek and Wind, 2008).

Forage crop: Peas are grown alone or with cereals for silage and green fodder (Elzebroek and Wind, 2008). Peas can also be grazed while in the field. Young Austrian winter pea plants will regrow after being grazed multiple times (Clark, 2007).

Rotational crop: Peas and other legumes are desirable in crop rotations because they break up disease and pest cycles, provide nitrogen, improve soil microbe diversity and activity, improve soil aggregation, conserve soil water, and provide economic diversity (Veseth, 1989; Lupwayi et al., 1998; Biederbeck et al., 2005; Chen et al., 2006).

Green manure and cover crop: Peas are grown as green manures and cover crops because they grow quickly and contribute nitrogen to the soil (Ingels et al., 1994; Clark, 2007). Pea roots have nodules, formed by the bacteria *Rhizobium leguminosarum*, which convert atmospheric nitrogen (N_2) to ammonia (NH_3). Peas also produce an abundance of succulent vines that breakdown quickly and provide nitrogen (Sarrantonio, 1994, as cited by Clark, 2007). Austrian winter peas are the most common type of pea used as a green manure or cover crop because they are adapted to cold temperatures and fit in many rotations.

Status

Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g., threatened or endangered species, state noxious status, and wetland indicator values).

Description

General: Legume family (Fabaceae). The pea is a cool-season annual vine that is smooth and has a bluish-green waxy appearance. Vines can be up to 9 ft long, however modern cultivars have shorter vines, about 2 ft long. The stem is hollow, and the taller cultivars cannot climb without support (Elzebroek and Wind, 2008). Leaves are alternate, pinnately compound, and consist of two large leaflike stipules, one to several pairs of oval leaflets, and terminal tendrils (McGee, 2012). Many modern cultivars have a semi-leafless or 'afila' leaf type in which the leaflets are converted into additional tendrils (McGee, 2012).

Inflorescences occur in the leaf axils, and consist of racemes with one to four flowers. Flowers have five green fused sepals and five white, purple or pink petals of different sizes. The top petal is called the 'standard', the two small petals in the middle are fused together and called the 'keel' (because of their boat-like appearance), and the bottom two petals taper toward the base and are called the 'wings' (Elzebroek and Wind, 2008). Within the keel there are ten stamens; nine form a tube that surrounds the pistil, and there is one loose stamen. The ovary contains up to 15 ovules, and the fruit is a closed pod, 1 to 4 inches long that often has a rough inner membrane. Ripe seeds are round, smooth or wrinkled, and can be green, yellow, beige, brown, red-orange, blue-red, dark violet to almost black, or spotted.

The flowers are primarily self-pollinating, which enables breeders to create true breeding lines (Gill and Vear, 1980). The plant is a diploid (2n = 14) (Hancock, 2004).

Pea flower. Rebecca McGee, USDA-ARS

The centers of origin of *Pisum sativum* are Ethiopia, the Mediterranean, and central Asia, with a secondary center of diversity in the Near East (Vavilov, 1949). Humans have likely been eating peas for approximately 9,500 years, and cultivating them for 8,500 years (Elzebroek and Wind, 2008). Greek and Roman writers mentioned peas, but varieties were not described until the sixteenth century (Simmonds, 1976).

Distribution: *Pisum sativum* is currently grown in temperate regions, at high elevations, or during cool seasons in warm regions throughout the world (Elzebroek and Wind, 2008). Major pea producers are China, India, Canada, Russia, France and the United States (Food and Agriculture Organization, 2012). In the United States, the most production occurs in Washington, Montana, and North Dakota (USDA-National Agricultural Statistics Service, 2011). For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site.

Adaptation

Peas are adapted to many soil types, but grow best on fertile, light-textured, well-drained soils (Hartmann et al., 1988; Elzebroek and Wind, 2008). Peas are sensitive to soil salinity and extreme acidity. The ideal soil pH range for pea production is 5.5 to 7.0 (Hartmann et al., 1988). Peas grow well with 16 to 39 inches annual precipitation (Elzebroek and Wind, 2008).

Uncovered pea plants may tolerate temperatures as low as 14°F, and if covered with snow, may tolerate temperatures as low as -22°F (Elzebroek and Wind, 2008). Bourion et al. (2003) discovered the freezing tolerance in winter and spring pea genotypes is related to the concentration of soluble sugars in the leaves. Peas are more tolerant of cold if they are a winter-hardy cultivar such as 'Melrose', 'Granger' or 'Commonwinter', planted early to ensure adequate growth before the soil freezes, and planted into a rough seedbed or grain stubble where they have a protected environment (Clark, 2007).

Peas are most productive at temperatures of 55 to 64°F (Hartmann et al., 1988). High temperatures during flowering may reduce seed set (Elzebroek and Wind, 2008), and high temperatures during seed development may cause an increased starch and fiber content, lowering pea quality (Hartmann et al., 1988).

Establishment

Peas are established by seed in the spring or fall. Seed should be inoculated with *Rhizobium leguminosarum* prior to planting in fields where peas have not been previously grown to ensure root nodule formation and the fixation of atmospheric nitrogen. Seeding rates vary with cultivar, soil type, seed size, climate, disease pressure and seeding method. Typical seeding rates range from 50 to 80 lb/acre when drilled and 90 to 100 lb/acre when broadcast (Clark, 2007).

Seed is planted at a depth of 1.5 to 3 inches in rows spaced 6 to 12 inches apart (Elzebroek and Wind, 2008). Peas emerge in 10 to 14 days. Spring-planted peas flower 30 to 50 days after planting, and fall-planted peas flower approximately 250 days after planting. Flowering lasts 2 to 4 weeks. The length of the growing season for spring-planted peas is 60 to 150 days (Elzebroek and Wind, 2008) and for fall-planted peas, 300 to 320 days (McGee, 2012).

Management

Peas grown as commercial crop: Peas grow well on soils with moderate fertility levels, but on soils with low fertility, application of 45 lb/ac nitrogen and 90 lb/ac phosphorus and potassium can be advantageous (Hartmann et al., 1988). Nutrients applied in excess or at the wrong time may promote vegetative growth and be detrimental to pod development. A soil test will provide accurate information about nutrients needed.

Fresh and dry peas are mechanically harvested by cutting the plants and threshing them to remove the seeds from the pods and vines. Prior to harvesting fresh peas, pea quality and maturity is evaluated with a pressure test (Hartmann et al., 1988). The moisture content of dry peas must be less than 13% (Elzebroek and Wind, 2008). Garden peas are also harvested by hand before the seed matures for the fresh market.


Mature pea plant with pods. Rebecca McGee, USDA-ARS

Peas are poor competitors with weeds. Rapid seedling emergence, adequate crop density, pre- and post-plant tillage, and herbicides help reduce weed pressure (Elzebroek and Wind, 2008).

Peas grown as green manure or cover crop: Peas produce large amounts of biomass, especially when grown in cool temperatures (Clark, 2007). The biomass, however, breaks down very quickly due to the plant's low C:N ratio, and may not improve soil organic matter over the long-term (Russell, 1973). The decomposition of pea residue can be slowed by growing peas with a grain crop (Ranells and Wagger, 1997).

Austrian winter peas can produce 90 to 150 lb/acre nitrogen (Clark, 2007). The actual amount of nitrogen available for plant uptake depends on timing and method of incorporation, soil temperature, moisture, and other factors (Sullivan, 2003).

Peas are easily killed with herbicides, mowing, or disking. This should be done at full-bloom stage to optimize the N contribution (Clark, 2007).

Peas do not suppress weeds as well as other cover crops (Clark, 2007). Weed suppression can be improved by growing varieties with long vines (Clark, 2007) and normal leaves (McGee, 2012), and growing with annual grains such as wheat, triticale, barley or rye.

Numerous researchers have evaluated peas as a green manure or cover crop. Specific uses and results vary by geographic region:

<u>California:</u> In the mild-winter areas of California, fall-planted winter peas produce about twice the amount of biomass as spring-planted peas (Clark, 2007). Austrian winter peas planted in the Sacramento Valley in October can produce 150 lb/acre nitrogen by early April.

<u>Inland Pacific Northwest:</u> The short growing season and winter-spring precipitation pattern in the Inland Pacific Northwest region limit the use of green manures and cover crops. Austrian winter pea has the greatest potential as a green manure or cover crop in this region because it can grow in cool temperatures.

Auld et al. (1982) found Austrian winter peas seeded in early September produced the highest yields of organic matter and vine N compared to other seeding dates. Delaying seeding by one month reduced the values by 50%. Six spring pea cultivars produced a high organic matter yield but matured too late for plow-down in dryland conditions. The authors stated Austrian winter pea could produce a minimum of 160 lb/acre vine N.

Murray and Swensen (1985) evaluated the yields of Austrian winter pea in monocultures and intercropped with 25, 50, and 75% winter wheat or winter barley. Winter pea yields with 25% winter cereals were equal to or 27% greater than monocropped winter peas. The authors attributed the benefit to the intercropped peas to reduced lodging, better light capture, and reduced incidence of *Sclerotinia* infection.

Mahler and Auld (1989) compared N fertilizer equivalent values and winter wheat yields following Austrian winter pea green manure, Austrian winter pea harvested, summer fallow and spring barley in northern Idaho (Table 1). They found the agronomic benefit of Austrian winter pea harvested was similar to Austrian winter pea green manure, but the economic benefit of Austrian winter pea harvested was greater because it could be sold as a crop. They concluded the rotation with Austrian winter pea harvested was the most efficient.

Crop Year 1	N Fertilizer Equivalent Value	Crop Year 2 Winter Wheat Yield
Austrian winter pea green manure	84 lb/ac	99 bu/ac
Austrian winter pea harvested	67 lb/ac	96 bu/ac
Summer fallow	61 lb/ac	94.5 bu/ac
Spring barley	N/A	70.5 bu/ac

Table 1. Comparison of N fertilizer equivalent values and winter wheat yields following Austrian winter pea green manure, Austrian winter pea harvested, summer fallow, and spring barley. From Mahler and Auld (1989).

Mahler and Hemamda (1993) incorporated baled and dried residue of Austrian winter pea, alfalfa and wheat at rates of 0.45, 0.90, and 1.34 t/acre and compared yields of spring wheat the following year. The application of 1.34 t/acre Austrian winter pea residue resulted in highest spring wheat yield. The N mineralization rate of the peas was more than double the rate of alfalfa, evidenced by the inorganic N in the soil 10 months after residue incorporation. Approximately 77% of the nitrogen from the peas was recovered, 58% by the wheat and 19% by the soil.

Peas, alone or in mixtures, are sometimes planted in vineyards in the eastern Pacific Northwest to supply short-term organic matter and nitrogen (Olmstead, 2006). The crop is grown as a winter annual and tilled or mowed in the early summer.

Northern Great Plains: Growers in the northern Great Plains sometimes plant legumes such as spring pea, Austrian winter pea, or lentils in the place of fallow (Clark, 2007). They manage the legume crop according to the growing season precipitation. If the season has below normal precipitation, they terminate the crop early. If there is normal precipitation, they terminate the crop when 4 inches of soil water remain, and if there is above normal precipitation, they allow the crop to mature for harvest (Clark, 2007). When they terminate the crop early, it still provides benefits of hay or nitrogen for the next crop (Fasching, 2006, as cited by Clark, 2007).

In a study in Alberta, Soon et al. (2005) compared soil and plant N with no-till and conventional tillage, and with previous crops of red clover green manure, field pea, and spring wheat (both harvested). They found nitrogen uptake by wheat was higher with no-till than conventional tillage, and was higher when legumes preceded the wheat crop. They attributed this to greater mineralization of nitrogen from organic matter and microbial biomass during crop growth compared to wheat monoculture.

Central Great Plains: In a study in eastern Colorado, legumes crops, such as Austrian winter pea, grown in the place of fallow depleted soil water and had detrimental effects on wheat yield the following year (Nielsen and Vigil, 2005). This occurred even when the legume crop was terminated early.

Northern Midwest: Austrian winter pea may only be useful as a spring cover crop in the northern Midwest. Creamer et al. (1997) found it did not overwinter as well as other cover crops in an Ohio vegetable production system. Akemo et al. (2000a) evaluated field pea, rye, and pea-rye combinations at three different rates as spring cover crops in tomato production. Rye planted at the highest 100% rate resulted in the best weed control, however tomatoes yielded the highest when planted into mixtures containing 50% or more pea (Akemo et al., 2000b).

Southern Midwest: In Missouri, Reinbott et al. (2004) demonstrated that growing Austrian winter pea as a cover crop may provide benefits to no-till corn and grain sorghum. Yields of corn and grain sorghum were highest following fall-sown Austrian winter pea and hairy vetch when compared to oats, mixtures with oats, and no cover crop.

South: Keeling et al. (1996) compared eight legumes, including Austrian winter pea, and two cereals for interseeding into cotton to control wind erosion in Texas. They found winter pea and hairy vetch established better than the small-seeded legumes; however, wheat and rye were the most dependable for producing soil cover.

East and Southeast: Austrian winter pea is considered an option for green manure and cover crops in the East and Southeast, but the disease *Sclerotinia* crown rot limits its use (Clark, 2007).

Austrian winter pea had better winter survival than 11 other legumes in a no-till study in Florida, but it was damaged by *Sclerotinia* during damp cool periods (Holderbaum et al., 1990). It did not yield as well as hairy vetch, crimson clover, or legume-wheat mixtures.

Carrera et al. (2005) found that Austrian winter pea and four other cover crops, alone or in mixtures, had potential in potato cropping systems with conservation tillage in Maryland and Virginia. The cover crops and conservation tillage provided the ability to enter the field earlier, and improved the soil by adding organic matter and reducing erosion. Economic analysis also demonstrated these practices were viable.

Bhardwaj (2006) discovered that Austrian winter pea as a winter legume cover crop in Virginia resulted in higher yields of muskmelon and sweet corn than 102 lb/acre N fertilizer and no fertilizer, but lower yields than white lupine and hairy vetch.

In Georgia, Schomberg et al. (2006) compared Austrian winter pea, three other legumes, oil seed radish, rye and black oat for a cover crop with strip till and no-till before cotton. While Austrian winter pea and hairy vetch had the highest nitrogen content (71.4 lb/acre), the combination of strip-tillage with black oats was the most profitable.

Pests and Potential Problems

Common foliar pea diseases (and their causal organism) include bacterial blight (*Pseudomonas syringae* pv. *pisi*), ascochyta blight (*Ascochyta pisi*, *Mycosphaerella pinodes* and *Phoma medicaginis* var. *pinodella*), powdery mildew (*Eryisphe pisi*), downy mildew (*Peronospora viciae* f. sp. *pisi*), septoria blight (*Septoria pisi*), and white mold (*Sclerotinia sclerotiorum*). Rhizoctonia (*Rhizoctonia solani*) and Pythium (*Pythium* spp.) are common seed rot and seedling damping-off diseases. Common root rots include Fusarium root rot (*Fusarium solani* f. sp. *pisi*), Aphanomyces root rot (*Aphanomyces euteiches*), and Fusarium wilt (*Fusarium oxysporum* f. sp. *pisi*). Economically important pea viral diseases include bean yellow mosaic (BYMV), pea enation mosaic (PEMV), pea seedborne mosaic virus (PSbMV), red clover vein mosaic virus (RCVMV) and pea streak virus (PeSV). Insect pests include pea aphids (*Acyrthosiphon pisum*), pea leaf miners (*Liriomyza huidobrensis*), pea leaf weevils (*Sitona lineatus*), pea seed weevils (*Bruchus pisorum*), Lygus bugs (*Lygus* spp.), spider mites (various species), and seed corn maggots (*Delia platura*). Nematodes (various species) can also be problematic in local areas (Kraft and Pfleger, 2001; McGee, 2012).

Environmental Concerns
None.

Seeds and Plant Production
Depending on the cultivar, there can be 1,000 to 3,000 pea seeds per pound (Elzebroek and Wind, 2008). The average yields in the U.S. during the years 2007 – 2011 were: Austrian winter peas 1,319 lb/acre; dry edible peas 1,828 lb/acre, and wrinkled peas 616,800 CWT (USDA-National Agricultural Statistics Service, 2012).

Cultivars, Improved, and Selected Materials (and area of origin)
Numerous pea cultivars are available. Breeders have selected for height, vegetative growth form, season of maturity, disease resistance, pod shape and length, seed color, tenderness, sweetness, seed shape, number of seeds per pod, and pod production per node (Hartmann et al., 1988; Elzebroek and Wind, 2008).

Producers in the Palouse region of the Inland Pacific Northwest (eastern Washington, northern Idaho and northeastern Oregon) grow many different types of peas, including the following types and cultivars. Green field peas: 'Aragorn', 'Ariel', 'Banner' and 'CDC Striker'; forage peas: '40-10', 'Trapper', 'CDC Sonata' and 'Flex'; marrowfat peas (for the snack food market and mushy peas in UK): 'Micichi', 'Midlea', and '22-5'; maple peas (racing pigeon food): 'Courier', 'CDC Mosaic', and 'CDC Rocket' (McGee, 2012).

Producers in Montana, North Dakota, Alberta and Saskatchewan primarily grow yellow field peas. Cultivars include 'Bridger', 'Delta', 'DS Admiral', 'Carousel', 'CDC Agassiz', and 'Cutlass' (McGee, 2012). Fall-planted field pea cultivars in the Palouse and northern Great Plains include 'Specter', 'Windham', 'Whistler', 'Granger' and 'Melrose' (McGee, 2012).

Cultivars often planted as green manure or cover crops include 'Granger', 'Melrose', and 'Magnus' (Clark, 2007).

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Prepared By

Pamela L.S. Pavek, USDA NRCS Plant Materials Center, Pullman, Washington

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