



# Camelina

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## History

Camelina (*Camelina sativa* L.) is native from Finland to Romania and east to the Ural Mountains. It was first cultivated in northern Europe during the Bronze Age. The seeds were crushed and boiled to release oil for food, medicinal use, and lamp oil. It is still a relatively common weed in much of Europe, known as false flax or gold-of-pleasure.

Although it was widely grown in Europe and Russia until the 1940s, camelina was largely displaced by higher-yielding crops after World War II. Its decline in Europe was accelerated by farm subsidy programs that favored the major commodity grain and oilseed crops.

In recent years, camelina production has increased somewhat due to heightened interest in vegetable oils high in omega-3 fatty acids (a principle component of camelina oil). Very little plant breeding or crop production improvement has been done on camelina, so the full potential of this crop has not yet been explored.

Since it can be grown with few input costs and under marginal conditions, there is currently a major effort in Montana to produce camelina on a large scale in dryland production as a low-input-cost oilseed. Since canola production is currently prohibited in many parts of Oregon state, Oregon growers are considering growing camelina as an alternative oilseed crop.



Camelina field in eastern Washington.

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## Description

Camelina is generally grown as a summer annual oilseed crop, but it can be grown as a winter annual in milder climates. It is a short-season crop that matures in 85 to 100 days. The plants grow 1 to 3 feet tall and have branched stems that become woody as they mature. Their leaves are 2 to 3½ inches long, arrow-shaped, and pointed with smooth edges.

Camelina produces seed pods that resemble flax bolls. The seeds have a rough surface and are quite small, with 1,000-seed weight in the range of 0.8 to 2.0 grams. There is no seed dormancy in camelina.



Camelina flowers and pods.



Camelina rosettes.



Camelina seeds.

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## Uses

Camelina oil can be used in both edible and industrial products. Reported seed oil content ranges from 29 to 41 percent. There is considerable variation in oilseed content among camelina plants from wild collections and old European varieties, and varieties with higher oilseed content are under development.

A comparison of the typical fatty acid composition for several oilseed crops is shown in Table 1 (page 3). Because camelina oil is relatively high in omega-3 fatty acids and low in saturated fatty acids, camelina is considered a high-quality edible oil. The oil also contains gamma tocopherol (vitamin E), which acts as an antioxidant and increases the stability and shelf life of camelina oil compared to other omega-3 oils. The erucic acid (22:1) content of many camelina oil samples is higher than the maximum allowed in canola oil (2 percent), but camelina breeding lines have been identified that have no erucic acid, and lower erucic acid lines are being developed.



**Table 1. Typical fatty acid content of camelina, canola, linseed, and sunflower oils.**

|            | 16:0 <sup>a</sup> | 18:0 | 18:1 | 18:2 | 18:3 | 20:0 | 20:1 | 22:1 |
|------------|-------------------|------|------|------|------|------|------|------|
| Oil source | ----- % -----     |      |      |      |      |      |      |      |
| Camelina   | 7.8               | 3.0  | 16.8 | 23.0 | 31.2 | 0    | 12.0 | 2.8  |
| Canola     | 6.2               | 0    | 61.3 | 21.6 | 6.6  | 0    | 0    | 0    |
| Linseed    | 5.3               | 3.1  | 16.2 | 14.7 | 59.6 | 0    | 0    | 0.9  |
| Sunflower  | 6.0               | 4.0  | 16.5 | 72.4 | 0    | 0    | 0    | 0    |

<sup>a</sup> Fatty acid profiles show the percentage of each fatty acid component in a vegetable oil. The first number in the notation at the top of each column in the profile (i.e., 18:3) indicates the number of carbon atoms in the fatty acid. The number after the colon indicates the number of double bonds in the fatty acid. Although fatty acid profiles vary somewhat from sample to sample, they are generally used to characterize vegetable oils from particular species or varieties of plants.

Camelina is being marketed in Europe in salad dressing and as cooking oil (it is not suitable as a deep-fat fry oil). It is also used in cosmetics, skin care products, soaps, and soft detergents. The oil has been used successfully as an adjuvant in agricultural spraying applications and is suitable for biodiesel.

Camelina meal is low in glucosinolates, and has been used in animal feed rations. Camelina meal is similar to soybean meal, with 45 to 47 percent crude protein and 10 to 11 percent fiber.

Since camelina oil and meal are relatively new food and feed ingredients, there are no current commercial uses approved for camelina or any camelina products in the United States. Camelina meal is currently undergoing tests to receive FDA approval for animal feeding in this country. The initial approval process should be completed in 2008. Initial animal feeding trials with camelina meal show increases in omega-3 levels in animal products.

## Adaptation

### Climate

Camelina is a short-season crop (85 to 100 days) that is well adapted to production in the temperate climate zone. It germinates at low temperature, and seedlings are very frost tolerant. In Montana, no seedling damage has been seen at temperatures as low as 12°F.

### Soil

Camelina is often grown on marginal land. It responds well under drought stress conditions and may be better suited to low rainfall regions than most other oilseed crops.



Oilseed Crops



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## Cultural practices

Camelina is relatively easy to grow and requires few agricultural inputs compared to other crops. It can establish successfully through broadcast seeding on frozen ground in winter or early spring, even in previous crop stubble. Germination occurs after soil temperatures reach 38°F. Planting with grain drills works well, but results are generally no better than surface broadcasting when there is adequate moisture on the soil surface.

### Seeding timing

Camelina can be seeded earlier than other spring crops due to its frost tolerance. Early seeding seems to favor increased seed yields and higher oil content. Seeding date trials at Moscow, Idaho show a 25 percent yield reduction when seeding was delayed from 19 March to 19 April, 2007 (a normal seeding date for other spring crops).

### Seedbed preparation

Minimal seedbed preparation is needed to establish camelina, and good crops can be produced from broadcast seeding or shallow drilling into small grain stubble.

Very little is currently known about direct seeding camelina into grass seed stubble or residue. Herbicide carryover from previous crops may inhibit camelina production, and initial herbicide tolerance work suggests responses similar to canola.

### Seeding rate

In Europe, camelina is normally seeded at 6 to 8 lb/acre, but recent trials in Montana indicate that 3 to 5 pounds of seed per acre will produce adequate crop stands. Higher seeding rates should be used under difficult establishment conditions.

### Variety selection

Since only limited plant breeding has been done on camelina, seed of commercial varieties has been difficult to find in the United States. In France, Group Limigrain has released the winter variety 'Epona' and the spring variety 'Celine'. Many other European varieties are being grown



Camelina planting date trial. Plots show camelina planted on March 19 (the most mature), April 5, and April 19, 2007 near Moscow, Idaho.



experimentally in the Pacific Northwest. The European variety 'Calena' has performed well in early regional trials.

Montana State University recently released two camelina varieties developed by their breeders, 'Blaine Creek' and 'Suneson'. 'Blaine Creek' (Montana 0301) is a short-season, high-yield line particularly adapted to high-yield environments. 'Blaine Creek' is also high in omega-3 fatty acids.

'Suneson' (Montana 0305) is a mid-season, average-yield line. 'Suneson' is typically 2 to 3 percent higher in oil content than 'Blaine Creek'. 'Suneson' is high in  $\alpha$ -linolenic acid (C18:3n3).

## Fertilizer

Like other crops in the mustard family, camelina responds to nitrogen, sulfur, and phosphorus fertilizer application. Montana trials have shown a yield response with up to 50 lb/acre of nitrogen and up to 60 lb/acre of phosphorus. Application of sulfur tends to increase oil content but not seed yield. Areas with higher yield potential (more available moisture) may respond to increased fertilizer rates.

## Weed control

Camelina has generally been grown without the use of herbicides. Winter-seeded camelina germinates earlier than many weed species and is very competitive when seeded at high density. Camelina has also been shown to have allelopathic properties (ability to inhibit growth of other plants), and many weeds are suppressed until leaf drop occurs in the crop. Perennial weeds may be difficult to control in camelina.

Camelina is similar to canola in its sensitivity to residual soil herbicides. Check all previously applied herbicides for plantback restrictions to canola, and use these as a guideline for suitability when planting camelina.

No herbicides are registered currently for use on camelina, but efforts are underway to obtain registrations.

## Diseases

Camelina is highly resistant to blackleg (*Leptosphaeria maculans*), a major disease of canola and other Brassica crops.

Camelina is susceptible to sclerotinia stem rot (*Sclerotinia sclerotiorum*), but reports of major outbreaks are uncommon. Infection weakens the plant stem, causing losses from lodging and early ripening. This disease infects many other crops, including sunflower, potatoes, safflower, beans, peas, and alfalfa, and is usually managed by crop rotation. Grow susceptible crops only once every 3 to 4 years in the same field.



## Insects

Few insects appear to cause damage to camelina, and use of insect control measures are rarely reported. The canola-damaging insects—including flea beetles (*Phyllotreta cruciferae*, Goeze), cabbage seed pod weevil (*Centorhynchus obstrictus*, Marsham), and Brassica aphid complex—have not been found to cause economic damage to camelina.

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## Harvest

Camelina can be harvested with unmodified combines and is usually direct-combined standing but can be swathed. Start swathing when about two-thirds of the pods turn from green to yellow. Most camelina cultivars are resistant to shattering. Combine settings similar to those used for canola or alfalfa seed work well with camelina, but combine fan speed must be reduced to minimize seed losses. Small-opening combine screens designed for alfalfa seed are effective in separating camelina seed and hulls.

Mature pods are dark tan or brown. Unlike other members of the mustard family, camelina pods hold their seeds tightly, and seed shattering is not generally a problem.

Because camelina seeds are quite small, be sure to seal any leaks in equipment to reduce seed losses during harvest and transport.



Camelina near harvest.



Mature camelina.



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## Yield

Camelina has yield potential similar to many other members of the Brassica family. While the yield of other Brassicas has been significantly increased in recent decades through plant breeding and agronomic improvements, camelina's potential remains unexploited.

Under dryland conditions in Montana, camelina is expected to yield 1,800 to 2,000 pounds of seed per acre in areas with 16 to 18 inches of rainfall, and 900 to 1,700 lb/acre with 13 to 15 inches of rainfall. Under irrigation, seed yields of 2,400 lb/acre have been reported. Three years of yield trials at Moscow, Idaho show a 2,100 to 2,400 lb/acre seed yield potential with 25 inches of rainfall.

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