



Camelina Production in the Dryland Pacific Northwest

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Description

Camelina (*Camelina sativa* L.) is an ancient crop found in northern Europe, which was largely displaced by the major oilseed crops in the latter half of the last century. It is also known as false flax, or gold-of-pleasure. Camelina (Figure 1) is a member of the mustard family, like canola. In recent years, there has been increased interest in camelina as an oilseed crop for biofuels in dryland agricultural regions of the western U.S. and the Great Plains. There is additional interest in camelina oil because of its unique fatty acid profile, which could make it useful for both industrial and nutritional purposes.



Figure 1.
Camelina
beginning to
flower.

Camelina is generally grown as a summer annual oilseed crop, but it can also be grown as a winter annual in the Pacific Northwest (PNW). It is a short-season crop that matures in 85 to 100 days, and is often grown on marginal land. The plants grow 1 to 3 feet tall and have branched stems that become woody as they mature. Their leaves are 2 to 3 ½ inches long, and arrow-shaped, that is, pointed with smooth edges. Camelina seedlings have excellent cold

tolerance, similar to that of winter wheat, and the crop also performs well under drought conditions.

Camelina produces teardrop-shaped seed pods, and the seeds have a rough surface (Figure 2). They are quite small, with approximately 350,000 seeds per pound, depending on the variety and growing conditions. Camelina seeds show little if any dormancy, but volunteers can be expected the next year, or even after two years if the seed is buried by tillage.



Figure 2. *Camelina* pods and seeds.

Current uses

Camelina is an emerging biofuel oilseed crop for the dryland farming regions of the Pacific Northwest. Biofuel user groups are interested in camelina because the oil is suitable for fuel production. Camelina has lower fertilizer, water, and pesticide requirements compared to other crops currently used to make fuel, such as corn, and it can be used to make high-energy density fuels, such as biodiesel and jet fuel. Camelina oil has higher levels of polyunsaturated fatty acids compared to soybean or canola oil, which may limit its value for certain fuel uses, but it can still be valuable for other industrial applications. Cropping systems researchers are interested in determining whether camelina has the potential to improve the overall sustainability and productivity of the predominantly cereal-based dryland

cropping systems. For example, researchers want to determine whether a wheat–camelina–fallow rotation could be more productive than a wheat–fallow rotation. Good camelina yields have been achieved when camelina follows cereal crops on fields that would otherwise have remained fallow (see table below).

The oil content of camelina ranges from 32%–46% on a dry matter basis, with higher oil content varieties currently under development. The meal left after crushing is nutritionally comparable to soybean or canola meal, but is more than 40% protein, and has a moderately low glucosinolate content. Researchers are investigating various high value uses for camelina meal but because it is a new crop in North America, FDA approval is critical to large-scale use. Camelina meal is currently approved for use in feed rations for broiler chickens, laying hens, and confined cattle feeding operations. Recent research has shown that high levels of omega-3 fatty acids and tocopherols (a type of antioxidant) are transferred to food products, such as eggs and meat, adding value to these products. To gain FDA approval, research that demonstrates the benefits of camelina meal for other feed uses, such as feed for dairy cows, is currently underway.

Planting dates and methods

Studies on planting dates and methods were conducted at four locations in the PNW over three years. Overall, the highest grain yields were achieved with a late winter (i.e., February 15–March 1) planting (Figure 3). Both direct drilling and broadcast seeding were found to be effective planting methods. Growers can pull a tine harrow or other light implement behind the broadcast applicator to help incorporate camelina seed into the soil. If planting with a drill, place seed no deeper than 1/4 inch into the soil because camelina seed is very small and will not emerge if planted too deep. Typical planting rates are 3–5 lb/acre, but rates may be increased in difficult seeding conditions or in fall plantings. Drilling or broadcasting camelina seed directly into the standing stubble of previous crops works



Figure 3. Camelina spring planting date trials near Moscow, Idaho. The early planting had the highest yield and the late planting had the lowest yield.

well. Extensive seedbed preparation is not necessary or recommended.

Weed control

Camelina production in the PNW has mainly been done without applying broadleaf herbicides during the growing season since none have been registered. Establishing dense plantings early on helps camelina crops compete with weeds, and planting in clean fields and controlling weeds just prior to late winter or early spring planting are important (Figure 4). Camelina's short growing season allows harvest before some weeds have produced viable seeds. Swathing the crop before threshing can make harvesting easier and can also prevent weed seed production in heavily infested fields.



Figure 4. Weed control prior to planting camelina is important in controlling broadleaf weeds, such as tumble mustard shown here.

The herbicide sethoxydim (Poast®) has recently been registered for postemergence application to control grass weeds. Spring applications of Poast in fall-seeded camelina can control winter annual grasses and volunteer wheat that have not yet germinated before planting. However, Poast is not effective for broadleaf weeds. Winter annual broadleaf weeds can be a particular problem for fall plantings, so fields with low weed pressure should be selected. If actively growing weeds such as Russian thistle are present during harvest, apply herbicide soon after camelina harvest to prevent excessive seed production and continued uptake of soil moisture by the weeds.

Camelina is highly sensitive to soil residues from imidazolinone or sulfonyleurea herbicides. Camelina is similar in sensitivity to canola, so the same plant back restrictions (labeled time period after herbicide application before camelina can be planted) can be used. Camelina varieties with reduced sensitivity to Group 2 herbicides are being developed but are not yet available for commercial production.

Insect and disease control

Downy mildew (*Hyaloperonospora camelinae*) has been observed in camelina fields in Oregon and Washington.

This mildew leaves a fuzzy white covering on seed stalks (racemes) (Figure 5) during flowering. In cool spring weather it may infect 5% or more of the camelina plants. In the Willamette Valley, infection rates can be much higher. Experiments are underway to determine the source of the primary inoculum, but seed-borne contamination is suspected. The infection rarely kills plants but destroys whole racemes. Until the source of inoculum is determined, seed from infected fields should not be planted.



Figure 5.
Downy
mildew on
camelina
seed stalk.

Rhizoctonia solani AG 2-1 can cause pre- and postemergence damping off of camelina and can affect stand establishment. Before planting camelina, control weeds and volunteer plants emerging from the seed of the previous crop in order to minimize “green bridge” effects (the transfer of disease from last season’s crop to the current crop). Growers should also avoid growing camelina following other camelina or Brassica crops. Reports of problems with successive plantings have been rare but may increase as camelina and canola acreage increase. Camelina is susceptible to sclerotinia stem or white rot (*Sclerotinia sclerotiorum*), but this is rarely a problem in dryland, cereal-based agriculture.

Currently there are no insecticides registered for use on camelina. However, few insect pests have been reported in the PNW, and none have been reported to have caused sufficient damage to warrant pesticide applications. Camelina is resistant to flea beetles, which attack canola, mustard, and other *Brassica* seedlings. In addition, camelina is not a host for aphids, which can be very destructive to canola.

Fertilization

Camelina establishes a 3- to 5-foot-long taproot with long root hairs, which enables it to aggressively scavenge for residual soil nitrogen (N). Soil sampling before seeding camelina can determine the amount of available N at the rooting depth that is a fertilizer credit (N from non-fertilizer sources). Camelina requires 5-6 lb of available N

per 100 lb of expected grain yield. See Table 1 for estimating yield targets. Fertilizer may not be needed if there is adequate residual available N in the soil. In research trials, camelina has not been responsive to sulfur (S). However, in these trials, test levels of S were moderate to high, so if soil tests show low or very low S levels, applying 10 lb of S per acre is recommended.

The formula for determining available nitrogen is:

$$\text{available N} = \text{residual nitrate-N} + \text{mineralizable N from organic matter} + \text{fertilizer N}$$

Harvest

Camelina is usually direct-combined (Figure 6) but can be swathed. Begin swathing when approximately two-thirds of the pods have turned from green to yellow. When swathing camelina, the crop should be cut just below the pod canopy to retain as much standing stem as possible. Standing stems assist in holding the windrow in place if conditions become windy. Mature camelina pods are dark tan or brown, and they hold seeds more tightly than other members of the mustard family. Although problems with shattering have not been as extensive in the PNW as they have reportedly been in Montana, camelina should be harvested promptly when ripe to minimize shattering due to wind. Combine settings similar to those used for canola or alfalfa seed work well for camelina, but combine fan speeds must be reduced to minimize seed losses. Small-opening screens designed for alfalfa seed are effective in separating camelina seeds from their hulls (Figure 7). Because camelina seeds are quite small, any leaks in equipment should be sealed to reduce seed loss during harvest and transport.



Figure 6. *Camelina is usually direct-combined.*

Expected yields

Camelina yields in the dryland region are heavily influenced by precipitation, as shown in research trials at several locations (Table 1). Sites with roughly 20 inches of rain, like Pullman, Washington and Moscow, Idaho, consistently

Table 1. Camelina yields from 2008 to 2011 at research sites in the PNW.

| Location | Annual precipitation (in.) | Number of trials or years | Yield range (lb/acre) | Average yield (lb/acre) |
|----------------|----------------------------|---------------------------|-----------------------|-------------------------|
| Corvallis, OR | 39.0 | 4 | 700-2200 | 1700 |
| Lacrosse, WA | 15.5 | 4 | 1740-2000 | 1800 |
| Lind, WA | 9.5 | 5 | 115-1030 | 600 |
| Moscow/Pullman | 21.0 | 6 | 1610-3070 | 2300 |
| Pendleton, OR | 16.5 | 5 | 1549-1756 | 1647 |
| Ralston, WA | 11.0 | 2 | 760-1580 | 1230 |



Figure 7. Small-opening screens should be used to separate camelina seeds from their hulls.

produce high yields, while camelina yields at Lind have gone from 100 lb/acre during an extreme drought year to as high as 1000 lb/acre during a year with 11.5 inches of precipitation. In the Inland PNW, growers can expect at least 60-70 pounds of camelina seed yield for every inch of crop-year (Sept. 1 – Aug. 31) precipitation.

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