A-686 (Revised)

# Canola Production

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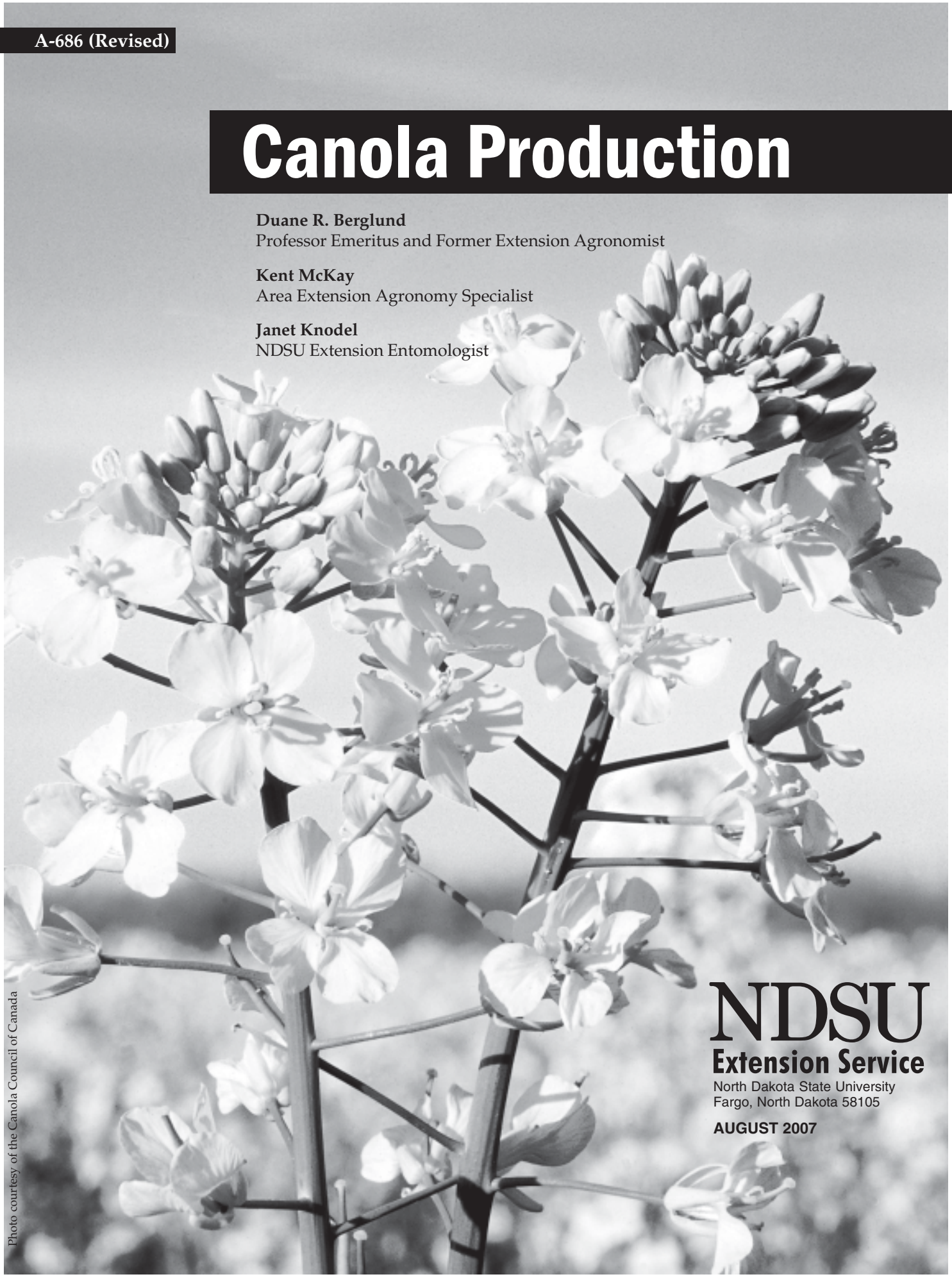

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## Canola has become a popular oilseed crop for North Dakota.

The state leads the U.S. in canola production, with approximately 92 percent of domestic production. Canola is a specific edible type of rapeseed, developed in the 1970s, which contains about 40 percent oil. The term "**canola**" is a name registered by the Western Canadian Oilseed Crushers Association.

Canola varieties must have an erucic acid content of less than 2 percent and also have less than 30 micromoles of glucosinolates per gram of seed. Canadian and U.S. farmers mostly grow low erucic acid and low glucosinolate varieties. High erucic acid oil rapeseed is grown and used for industrial lubricants. This type of rapeseed mostly is grown in Europe, although some production occurs in Canada and the U.S.

In January 1985, the U.S. Food and Drug Administration granted canola oil GRAS (Generally Recognized as Safe) status for use in human foods. This has led to greatly increased sales and demand in the United States, with only part of the demand being met by U.S. production. Canola oil has achieved worldwide commodity status and is used extensively in Japan, Canada and Europe.

## Adaptation

Canola *(Brassica napus L.)* varieties have been developed as both spring and winter annuals. The spring type is best adapted to North Dakota conditions. The winter types have not survived consistently in trials in North Dakota, northwestern Minnesota or in the Prairie Provinces of Canada. Canola can be grown on most soil types. It is best suited to clay-loam soils that do not crust. If grown on soil with poor internal drainage, good surface drainage is essential because it cannot tolerate standing water or waterlogged soils. Canola is less tolerant to drought than small-grain crops. It could be considered as a crop to plant on fallow if moisture recharge on recrop land is limited.

## Rotations

Canola best follows cereal grains or fallow in rotation. A preferred crop rotation would have canola planted at least two cropping years between plantings. However, if planting canola after one cropping year, we strongly recommend growing a variety that is moderately resistant or resistant to blackleg. Canola is susceptible to sclerotinia stem rot.

Infection risk increases if canola is planted closely in rotation with other highly susceptible crops, such as sunflower, dry edible beans or crambe. At least two years should separate canola and sugar beet plantings. If planting canola within three years of susceptible crops, a fungicide application may be needed.

Less susceptible crops that could be planted successfully in a close rotation with canola are rowed soybeans, flax, semileafless field pea or lentil. In years when ideal environmental conditions favor air-borne spore movement, all canola plantings without fungicide applied, regardless of rotation intervals, may have economic losses due to sclerotinia.

Canola is certain to shatter seeds, and volunteer plants are a probability the next season. Cereals should follow canola to allow the use of certain broadleaf phenoxy herbicides for control. Production of canola and tame mustard on the same farm should be avoided. A mixture of the two crops reduces the market value of both. In addition, conventional canola should not be planted on fields with heavy infestations of wild mustard. Roundup Ready, Liberty Resistant and Clearfield canola all could be planted on highly infested wild mustard fields.

The persistence of herbicide residue remaining from application to prior growing crops and weeds can injure new canola seedlings. These include but are not limited to sulfonylurea, imidazolinone and triazine classes of herbicides. Always refer to the herbicide label information pertaining to crop rotation restrictions following their use. The "North Dakota Weed Control Guide," publication W-253, includes information on rotation restrictions for certain crops, including canola following herbicide applications.

## Varieties

Canola varieties are of two types: the Argentine type of the species *Brassica napus* and the Polish type of the species *Brassica rapa*. Argentine varieties have a higher yield potential and are also taller and have a higher oil content than Polish varieties. Argentine varieties require about 95 days to reach maturity, while Polish varieties need approximately 80 days to reach maturity. Variety trial results are available from NDSU Research Extension Centers. See NDSU Extension publication A-1124 for the most recent variety yield results.

# Seed Preparation and Planting

Canola is very susceptible to soil crusting. The seedbed must be firm to seed canola. Seed and soil moisture contact is critical for rapid emergence, so seeding canola into dry soil is not recommended. The seedbed should be prepared in such a manner to minimize wind erosion so seedlings are not damaged by drifting soil. Harrowing canola seedlings is not recommended.

Canola can be planted with a variety of seeding equipment. The optimum depth to seed canola is ½ to 1 inch. Seeding depth should not exceed 1 inch. Canola typically is seeded in 6- or 7-inch rows with a grain drill or air seeder if uniform depth control can be obtained.

# Planting and Seeding

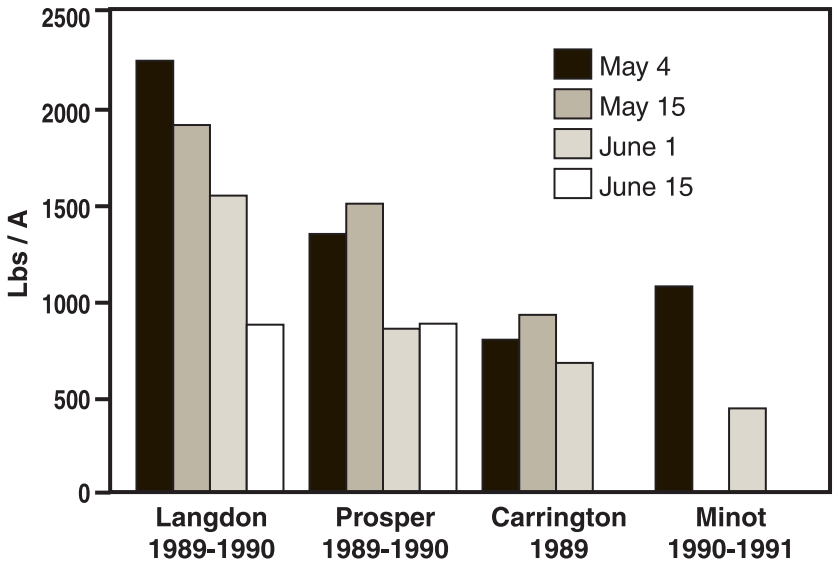
## Dates

Canola should be planted late April to early May to achieve the highest yields. Planting dates delayed beyond May 15 will result in yield reductions (Figure 1). Significant yield reduction can be expected if seeding is delayed into June. Canola is very susceptible to heat and drought stress during flowering. Planting in early May will reduce the risk of heat and drought stress on the crop. Canola seedlings are frost tolerant and can tolerate temperatures as low as 24 degrees Fahrenheit.

Dormant seeding – Dormant seeding of canola can be defined as seeding canola in cold, nearly frozen soil, which will inhibit germination that fall. The objective is that the seed remains dormant after planting until early spring. As conditions become favorable in the spring, the canola germinates and emerges.

Determining when to seed is difficult because growers can't go by a specific calendar date. The soil needs to be cold, if not frozen (below or near 32 F in the top 2 inches). If soil temperatures warm to 38 F or higher, the seed will germinate and will be killed once the soil freezes. In the past, growers have found dormant seeding canola is difficult as the soil temperatures approached freezing, but before the first snow.

**Figure 1. Canola planting date (variety: Westar).**




## Seeding Rates

Rates of 5 to 8 pounds per acre for Argentine varieties and 5 to 7 pounds per acre for Polish varieties are recommended. A common rule of thumb for seeding canola is 5 pounds per acre. **A major difference can be found between seeds per pound among canola varieties**. Adjusting for these differences is very important to avoid a stand being established that is too thick or too thin.

**Knowing the number of seeds per pound of the variety and establishing a seeding rate by plant population are very important for a grower.** As a general rule for the Argentine canola, hybrids will contain approximately 75,000 to 85,000 seeds per pound, whereas open-pollinated varieties will contain a range of 135,000 to 160,000 seeds per pound. For the Polish varieties, seed count usually will be greater than 200,000 seeds per pound. An optimum plant population is 16 plants per square foot or 600,000 plants per acre. A good stand is 10 to 12 plants per acre and a minimum stand is four plants per square foot. However, with herbicide-tolerant canola, stands can be as low as two plants per square foot, providing they are all uniformly spaced.

# Fertilizer

Canola is similar to small grains in its response to fertilizer and levels of soil fertility. Nitrogen and sulfur are the key elements for high canola yields. Nitrogen and potash materials should not be placed in direct contact with the seeds but should be broadcast or applied in a band at least 2 inches away from the seed.

A soil test is recommended for proper assessment of nutrient need. See NDSU Extension publication SF-1122, "Fertilizing Mustard and Canola," for additional information.

Canola is a high user of sulfur (S). A 2,000 lb/A canola crop contains about 12 lb/A sulfur in the straw and 15 lb/A sulfur in the seed. A 40 bu/A wheat crop, on the other hand, contains only 5 lb/A sulfur in the seed and 7 lb/A in the straw. The consequences of low soil S levels are very serious in canola production. Low sulfur can make the difference between having a crop and not having a crop. Responses to sulfur fertilization have been demonstrated in North Dakota. A composite soil test for sulfur may not represent sulfur fertility variation across the field. The current S soil test tends to overestimate available sulfate-S and field variability is huge. Therefore, at medium to low sulfur soil test levels, 20 to 30 lb/A of S is recommended. At high soil sulfur levels, 10 to 15 lb/A still is recommended.

Canola takes up sulfate-S. The form of sulfur fertilizer may be ammonium sulfate (21-0-0-24S) or a blend of ammonium sulfate and degradable elemental sulfur (0-0-0-90S). A blend is recommended because in sandy soils, sulfate may leach during early season rains, while the elemental sulfur may degrade during a moist season to supply needed S later in the year.

Providing adequate sulfur before or at planting is best. However, if deficiencies are identified early in the season before significant flowering, yield responses are still possible by applying a rescue treatment of ammonium thiosulfate (12-0-0-26S) or ammonium sulfate. The earlier a treatment is made, the greater the yield response. Little sulfur is absorbed by leaves. A rescue treatment needs rainfall to move the soluble sulfate to the roots.

## Weed Control

Young canola seedlings are very sensitive to early weed competition. An effective weed control program should include cultural, mechanical and chemical methods. Once established, canola is a good competitor with most weeds. Wild mustard is a serious seed contaminant in canola and can cause price discounts or rejection in the market. Special attention should be given to controlling (prior to planting) or avoiding this weed in canola fields.

Follow cultural practices to assure a dense, vigorous developing crop that will compete well with weeds. Pay attention to seeding dates, rates and depth of seed placement. Perennial weeds should be controlled the year prior to seeding canola.

Since canola is a shallow-seeded crop, the use of a rotary hoe or springtooth harrow for weed control is discouraged. These tillage tools can injure and destroy the canola seedlings, greatly reducing stands. Trifluralin (several brands) and Sonalan (ethalfluralin) are the only preplant soil-incorporated herbicides labeled for control of weeds in canola. Use the lower rates on sandy, coarse-textured, low organic matter soils of these two herbicides.

Trifluralin and Sonalan always must be preplant-incorporated in the soil prior to planting. Both will control annual grasses and some broadleaf weeds, such as pigweed, common lambsquarters and kochia. Wild mustard will not be controlled.

Clopyralid is labeled for postemergence control of small broadleaf weeds. This herbicide also can be used to control Canada thistle and perennial sowthistle in canola. Apply clopyralid when the canola is in the two- to six-leaf stage and prior to bolting.

Sethoxydim (Poast), quizalofop (Assure II or Targa) and clethodim or Select Max are all labeled for postemergence grass control in canola. See the label for rates according to grass weed specie and size. For best control, grasses should be growing actively and crop oil adjuvants must be added.

Tank-mixing these grass-controlling herbicides with broadleaf herbicides can be done in some cases, but follow all label restrictions since reduced grass weed control may result.

Thoroughly clean and rinse any herbicide residue that may be harmful to canola prior to filling the spray tank. Sulfonylurea herbicide residue on phenoxy herbicide in trace amounts can be very injurious to canola.

Canola is extremely sensitive to drift from most broadleaf herbicides, such as 2,4-D, MCPA, dicamba, glyphosate and certain sulfonylurea herbicides. Precautions must be taken to avoid the drift of these herbicides to canola fields.

**An effective weed control program should include cultural, mechanical and chemical methods.**

## Herbicide-resistant Canolas

### Clearfield (Imidazolinone) Resistant Canola

**Beyond** (imazamox) is registered for use in Clearfield canola. Beyond at a 4 fl oz/A applied POST to Imi-tolerant canola from emergence until prior to bloom controls most annual grass and broadleaf weeds. Apply with NIS at 0.25 percent v/v alone or with UAN liquid fertilizer at 1 to 2 qt/A. Beyond will not control ALS-resistant weeds. See label or information on Beyond for use, weed control, crop rotation restrictions and other information.

### Liberty (Glufosinate) Resistant Canola

**Liberty** (glufosinate) at 28 to 32 fl oz/A applied POST to Liberty-tolerant canola from cotyledon to bolting stage controls most annual broadleaf weeds, controls or suppresses grasses and may suppress perennial weeds. Always apply with AMS fertilizer at 2 to 4 lb/A. Liberty is a nonselective, nonresidual, contact-type herbicide with limited translocation and should be applied to small weeds. Refer to label for weeds controlled, application information and timing, tank-mix options and other restrictions. Liberty has a unique mode of action and may be used as another tool in weed-resistance management.

### Roundup (Glyphosate) Resistant Canola

**Glyphosate** applied at a rate of 1 to 1.5 pt/A of a 3 lb ae/gal concentrate with no more than two applications to glyphosate-resistant canola from emergence and prior to bolting (five- to six-leaf stage) controls most annual and perennial weeds. Apply with an AMS fertilizer. Application timing may not be appropriate for effective perennial weed control. Glyphosate is a nonselective, nonresidual, systemic herbicide. Full labeled rates are required for broadleaf weed control. Glyphosate will control weeds resistant to other herbicides. Do not apply after the six-leaf stage of canola or once bolting has begun because canola injury can occur. Refer to label for weeds controlled, application information and timing, tank-mix options and other restrictions.

## Influences of High Temperatures and Drought in Canola

Heat injury to seedlings occasionally occurs on hot, sunny days, with air temperatures in the range of 85 to 95 F and soil temperatures of 100 F. Heat injury commonly is associated with drought injury, but excessive heat also will injure or kill plants even if moisture is plentiful.

When in the blooming stages, heat blasting and/or flower abortion is a strong possibility. This can vary from field to field and is very dependent on time of flowering, soil moisture and humidity during the hot periods. Usually in this situation, one would see no or limited pod growth and thus no seed. It usually will be in patches on the main stem and branches as related to time of flowers and the heat stress. With good soil moisture under canola, flower abortion usually will be minimized to some extent.

Both low and high temperatures can adversely affect development prior to and during flowering. Low, but nonfreezing, temperatures just prior to flowering slow the rate of plant development. The start of flowering is delayed or, if begun, the rate of flower opening is slowed and the amount of pollen shed is reduced. High temperatures at flowering will hasten the plant's development, reducing the time from flowering to maturity. High temperatures during flowering shorten the time the flower is receptive to pollen, as well as the duration of pollen release and its viability. This can decrease the number of pods that develop and the number of seeds per pod, resulting in lower yields.

Once pods are formed, canola is more tolerant than at flowering to high temperatures. Cool night temperatures at this time also help the plant recover from extreme heat or dry weather. However, during this stage, a combination of heat and extreme drought will severely affect the pod and seed development, including formation of seeds, seed size and oil content. The seed oil content is highest when seeds mature under lower temperatures (50 to 70 F). High temperatures during seed maturation result in reduced oil content. High temperatures, drought and long days hasten maturity and, in combination, can reduce yield through fewer pods, with fewer and lighter seeds per pod.

## Diseases

Plant diseases can be a serious problem in canola production. Rotations must be planned carefully to keep disease incidence and levels low. The two diseases of major importance are sclerotinia wilt and blackleg. Diseases of canola less often reported are white rust or staghead, downy mildew, alternaria blackspot and aster yellows.

The **blackleg disease** occurs in two strains – a mild strain and a virulent (severe) strain. The virulent strain produces deep-stem girdling cankers near the soil line. These cankers reduce plant vigor and may cause lodging. The virulent strain of blackleg first was found in North Dakota during the 1991 growing season in 23 canola fields. The blackleg fungus is spread by rain-splashed spores, wind-borne spores and infected seed. Varieties are available that have good tolerance or resistance to this disease. As new varieties and hybrids are introduced, more will be totally resistant to this disease. Generally, the Argentine varieties are more tolerant, while the Polish varieties are more susceptible to blackleg.

In areas where the virulent strain of blackleg is present, crop rotation and selection of resistant varieties

is important to blackleg management. Quadris fungicide is labeled for control of blackleg applied at a rate of 6.2 oz/A of product at the two- to four-leaf stage of canola.

Blackleg is not a problem in mustards (yellow, brown and oriental), which are highly resistant. See NDSU Extension publication PP-1024, "Blackleg of Canola," for more information.

**Sclerotinia stem rot** or **white mold** is a canola disease that can be very destructive during periods of wet weather. The sclerotinia fungus survives up to five or six years in the soil in the form of hard, black fungus bodies called sclerotia. Whenever wet weather occurs for a week or two, with moist soil, the sclerotia germinate to produce tiny mushroomlike bodies called apothecia. These apothecia are only 1/8 to 3/16 inch across, yet they produce millions of air-borne spores. Canola primarily is susceptible during all bloom stages and shortly thereafter. The spores infect the cast-dead canola blossoms during periods of wet weather.

Infections that start on the dead blossoms spread to adjacent tissues, resulting in dead branches or dead plants, causing the plants to lodge. The rotted stems usually have a bleached appearance. Sclerotinia infections can be serious on canola if cool, wet weather occurs in the last two weeks of June and continues into early July, when blossoming occurs.

A minimum of a three-year rotation is recommended for fields that have a history of heavy sclerotinia or white mold infestations. During this rotation, avoid planting highly susceptible crops, including crambe, sunflower and dry beans.

The fungicides Quadris, Ronilan EG, Thiophanate Methyl (1) and Endura are all registered for use in the suppression and control of sclerotinia in canola. Information on fungicides registered is available from county Extension offices, NDSU Research Extension Centers, the Northern Canola Growers Association and NDSU Web sites.

Effective suppression of sclerotinia requires timely application of a fungicide. Quadris should be applied at 10 percent to 25 percent bloom, or three to seven days after initiation of bloom. The Argentine canola will have 10 to 18 flowers on the main stem when it is at 10 percent to 25 percent bloom. Quadris should be applied before or as the first petals begin to fall. Late application of Quadris is less effective than timely application.

Ronilan , Thiophanate Methyl (1) or Endua all should be applied at 20 percent to 50 percent bloom, or four to eight days after initiation of bloom. Fourteen to 16 flowers will be on the main stem at 20 percent bloom. The 50 percent bloom stage is the time of maximum color development in the crop. At that stage, pods will be on the lower one-third of the main stem. Once the crop is beyond 50 percent bloom, most fungicides are much less effective for sclerotinia control.

Quadris should be applied at 6.2 to 15.4 fl oz/A. The 9.6 fl oz rate has been supported by the registrant and may provide adequate control if applied before any petals begin to fall.

Ronilan should be applied at 10.6 to 16 oz/A, Thiophanate Methyl (1) at the 1 to 2 lb/A rate and Endura at the 6 oz/A rate. Extensive data indicates that the 12 oz rate of Ronilan or the 1 pound rate of Thiophanate Methyl (1) provides excellent sclerotinia suppression under severe disease pressure when applied early.

The decision to spray should be made only when: 1) yield potential is above normal (at least 40 bushels or 2,000 lb/A) when canola prices are minimal, 2) weather leading to early bloom has been wet (at least 1 to 2 inches of rain in the two weeks prior to early bloom), 3) more rain or high humidity is expected, and 4) sclerotinia has been a problem in recent years in fields currently planted to canola or in other fields nearby. A fungicide is more likely to be needed if canola is planted on tight rotations (three years or less).

See the following NDSU Extension publications on the control of sclerotinia in canola: PP-1201, "Sclerotinia Stem Rot of Canola – Biology and Management," and A-1208, "Canola Flowering and Fungicide Application Timing."

## Insects

Severe damage to canola plants can be caused by overwintering populations of flea beetles feeding on newly emerged seedlings during May through June. Adult beetles feed on the cotyledons and first true leaves, causing the typical shot-holed appearance. Severely damaged seedlings may die, and less seriously damaged plants may suffer a reduction in vigor and stamina.

Hot, sunny weather is conducive to feeding activity, while cool, damp weather slows feeding and favors crop growth. Hot and dry weather may cause seedlings to wilt and die, resulting in partial to complete crop loss.

In some instances, the infestation of a field can occur as a creeping movement from plant to plant across a field; in other instances, the entire field may become quickly and evenly infested. Severe damage usually does not occur once the crop advances beyond the four- to six true-leaf stage because vigorously growing canola plants can outgrow the beetle defoliation.

No major effects on plant vigor have been noted from the larval feeding on the plant roots. Occasionally in August, large numbers of newly emerged adults will move onto semimature canola plants and devour the epidermis of the stems, leaves and pods, and may cause pod shattering and small seeds. In most years, the crop will be sufficiently advanced to escape serious damage.

Cultural methods can help reduce plant losses caused by flea beetles. A firm seedbed that is adequately fertilized will help plants outgrow beetle damage during the susceptible seedling stage in the spring. Zero-tillage has been shown to reduce flea beetle damage per plant, and planting *B. napus* rather than *B. rapus* resulted in less crop damage. Seeding in the fall also enables seedlings to escape severe flea beetle injury because plants were in the true-leaf stage by the time flea beetle damage occurred. Other effective strategies from previous research include increasing seeding rates and planting large rather than small seeds at wide row spacings. Integrating cultural strategies can help minimize the use of insecticides for control of flea beetles in canola production.

A few flea beetles or scattered shot-holing in leaves of a seedling crop are not necessarily cause for alarm. However, if the flea beetles are numerous and feeding holes cause approximately 25 percent defoliation (economic threshold), immediate control is recommended. The key to flea beetle control is frequent monitoring during the susceptible seedling stage.

Registered seed treatments labeled for control of flea beetles in canola include Gaucho 600 (imidacloprid), Prosper/Poncho (clothianidin), Helix Lite (thiamethoxam) and Helix XTra (thiamethoxam).

All seed treatments must be applied by commercial seed treaters and are not for use in hopper-box, slurry-box or other seed treatment applications at or immediately before planting.

Foliar insecticides registered under state label for control of flea beetle, diamondback moth, Bertha armyworm and other insect pests include methyl parathion, bifenthrin (Capture 2 EC, Sniper, Binfenture EC-CA, Tundra), deltamethrin (Delta Gold), gamma-cyhalothrin (Proaxis) and lambda-cyhalothrin (Taiga Z and Warrier). Follow safe pesticide practices when spraying flowering canola to protect honeybees. Check federal and state labels for rate use on specific canola pests. For more complete information on insect control in canola, see NDSU Extension publication E-1143, "North Dakota Field Crop Insect Management Guide" (current year) or visit NDSU Web site *www.ag.ndsu.edu/pubs/plantsci/pests/e1143w1.htm*.

## Swathing and Harvest Management

**Swathing** canola at the optimum stage of ripening reduces green seed problems and seed shatter losses and ensures the quality required for top grades and prices. Inspect fields every two to three days when some color change occurs in the first formed pods on the bottom of the main stem.

To determine when a field of canola is ready to swath, examine plants from different parts of the field. The stage of maturity in an evenly maturing field will vary from plant to plant and from area to area within the field. When examining the plants, take into account varying soil types, low-lying areas, available soil moisture and exposed early ripening areas.

Examine only those pods on the main stem. Seeds in pods on the bottom third of the main stem were formed earlier and will turn color much sooner than seeds in the pods on the top third of the plant. When the overall moisture content of seed from the total plant averages 30 percent to 35 percent, about 30 percent to 40 percent of the seeds in pods on the main stem will have changed color or have started to change color. Seeds with only small patches of color should be counted as color-changed. Remember, the color of the seed is more important than the overall color of the field in determining the stage of maturity.

Most of the seeds that have changed color will be from the bottom third of the main stem. When seeds in the bottom pods slightly turn color, seeds in the top, last-formed pods are filled or nearly filled.

Seeds in all pods on a plant complete filling (physiological maturity) at about 40 percent moisture and then slowly turn from green to light yellow, or reddish brown, brown or black, depending on the variety. In hot (90 F), dry weather, canola seed can go from 10 percent to 50 percent seed color change in just three to five days or less. Once filled, the seeds rapidly lose moisture at about 2 to 3 percentage points or more each day, depending on the weather.

Swathing early can be beneficial if a hard fall frost is expected. Frost fixes the chlorophyll, or green color, in immature seed, making it difficult to remove during processing. Fall frosts rarely freeze to ground level. A swathed crop will not only lie below the coldest night temperatures, but much of the seed will benefit from the insulating properties of the swath and residual soil heat, preventing or reducing frost-fixed chlorophyll.

Another sign of canola being very near the swathing stage is the natural yellowing and senescence of leaves and leaf drop. When canola plants consist only of stems, stem branches and pods, the crop is probably very near the optimum time for swathing. Swathing can begin in Argentine canola at 15 percent seed color change. Polish canola should be left until 20 percent to 25 percent seed color change.

## Cutting Height

The swather should be run just low enough to get all the seed pods, leaving the maximum amount of stubble to anchor the windrow and ensure adequate air circulation through the windrow. Most stubble height varies from 10 to 12 inches in canola fields after swathing.

## Swather Table and Throat

The windrow must flow smoothly through the swather without bunching. Bunching leads to uneven drying and combine plugging. Therefore, a good swather must have enough depth of table (40 inches) to handle the crop material. It also should have a large throat opening – at least as wide (40 to 54 inches) as the distance between the two swather canvases on center-delivery swathers. It should have a vertical clearance for the windrow of at least 30 to 40 inches.

The table canvas should be strong enough to carry the heavy load of material cut and should be run just fast enough to keep the table clean. If possible, canvas speed should be varied depending on the maturity of the crop cut. A fast canvas tends to produce a hollow, twisted windrow; a slower canvas produces a more compact windrow, but it may bunch and sit high on the stubble. Increase the canvas speed until the windrow is pressed into the stubble.

The reel should be set as high and as far forward as possible. Reel speed should be set to correspond with the forward speed of the swather. Finger reels work best in canola to help bring the material back onto the table and gently handle the ripened canola. For a lodged or leaning canola crop, finger reels are highly recommended for ease of swathing.

Ordinary end dividers that are long and gently sloping are generally less prone to plugging than short, abrupt types. When the crop is tall, tangled and lodged or laid across the seeded rows, divider plugging is almost inevitable unless special vertical cutter bars or power blades are fitted on the swather. These can cause minor loss of pods and whole seed tops, but they prevent stops and bunching. In badly lodged crops, swathing in a direction parallel to the direction in which the crop is leaning may be advantageous.

In areas where windrows could be lifted and blown by the wind, a light roller pulled behind the swather will help anchor the windrow in the stubble. The roller should be set so that it just anchors the windrow into the stubble without shelling any ripe pods. Excessive roller pressure will produce a windrow that is too compact to dry quickly and difficult to pick up without shelling the canola. NDSU research has shown that swath pack density and seeding rates had little effect on green seed of canola.

## Swathing Overly Ripe Fields

Swathing late, when seed moisture content is much lower (around 80 percent seed color change), will result in fluffy windrows susceptible to blowing and increased shattering. To reduce shattering losses, overripe fields should be swathed when humidity is high, such as after a rain, after a heavy dew or at night.

## Swathing Unevenly Maturing Crops

Determining when to swath unevenly maturing fields is difficult. When checking uneven stands, producers should do an early count on the ratio of early emerged canola that is bolting or starting to flower to the late emerged flush of young, more immature plants.

Knowing the ratio of early to late emerged canola plants allows making a better decision as to how soon to swath or whether to wait until the later crop catches up. If the stand is 20 percent to 25 percent early and 75 percent to 80 percent late, then waiting to cut later may be the best strategy to reduce the amount of green seed.

## Curing in the Swath

Canola should be allowed to cure and ripen from 10 to14 days in the swath before combining. If combined too early, the chance of increased green seed in the harvested crop is much greater.

While starting on the early side for swathing is better, the same doesn't necessarily hold true for combining. Hot or windy weather at or after swathing can cause canola seed to be at the appropriate moisture content for combining before it has cured and cleared the green chlorophyll. This occurs because the plant dries up before sufficient moisture can move into the seed to finish curing it.

Canola requires at least 20 percent moisture in the seed for the maturing process to take place and eliminate the green seed color. Checking both moisture content and green seed count before starting to combine is important. Delayed combining can help clear the green color, particularly if the swath sits through several heavy dews or light rain showers.

## Combining Canola in Swaths

All combines work fairly well to harvest canola. Combines should be checked thoroughly before starting on canola. Cover any holes or worn spots in the table/platform or within a combine with duct tape or caulking compound. Leakage can occur easily in the stone trap, top feeder housing or through lower inspection doors.

Travel speed of the combine should be equal to that of the pickup so a gentle lifting of the swath occurs without tearing or pushing. Set the pickup to rub just under the swath.

Cylinder speeds will depend on canola crop conditions. Speeds of one-half to two-thirds of that used for small grains often are used for canola. The speed should be just fast enough to break open the pods. Speed reduction is important to prevent overthreshing of pods and stems and overloading the sieves. Cracked canola is caused by impact when the cylinder speed is too high. Examine the threshed seed for cracked canola. Push your arm into the seeds and observe if cracked canola seed pieces stick to your skin or hair on your arm. Reduce cylinder speeds if excessive cracking does occur.

Fan speed should be set low to avoid blowing canola seed out with the chaff. This will allow large amounts of pods in the return. Start with a low fan speed and increase gradually until separation of chaff and seed occurs with no canola being blown over the chaffer sieve. See NDSU Extension publication A-1171, "Swathing and Harvesting Canola," for more detail.

### Direct Combining Canola

Current recommendations and guidelines are to swath at the optimum stage to reduce green seed and seed shatter losses. The canola swath is allowed to cure and ripen for a minimum of 10 to 14 days before harvesting.

Small-scale and field-scale studies were conducted from 2004 to 2006 by NDSU Research Extension Center agronomists comparing direct combining canola with traditional methods of swathing and harvesting. The results of this research indicate that canola can be successfully direct combined. All combine headers – rigid, flex and draper – all performed well with direct combining canola and did not cause any harvest loss, compared with the pickup head. When harvested at the optimum time, direct combining canola can be successful with equal to higher yield than traditional harvest methods of swathing and combining.

Straight combining also results in less green seed and generally higher oil content and test weight than swathing and combining. One important consideration with direct combining is that it is more vulnerable to seed and shatter loss when harvest is delayed past the optimum. When direct combining canola, harvesting at the optimum time is very important. The optimum harvest time is identified as the first time the harvest moisture falls below 10 percent. Research trials indicate that seed loss due to shattering increases significantly with direct combining approximately 10 days after the optimum harvest time is reached.

Spodnam/Biovital is a spray polymer that has been developed and labeled to reduce the seed shatter loss in pod-bearing crops. Spodnam or Biovital was evaluated at many trial locations. No difference was found in yield with the direct combining treatments with and without Spodnam/Biovital when canola was harvested at the optimum time or when harvest was delayed past the optimum.

## Practices to Reduce Green Seed

Problems have occurred with green seed in North Dakota. Cool, wet and overcast weather during the growing season promotes green seed problems in all canola varieties, and these problems can be made worse by sulfur deficiency in some cases.

Temperature at maturity is an important factor in chlorophyll breakdown. Cool temperatures and light frosts in August and September slow the enzyme activity that breaks down chlorophyll. Frost from 32 to 33 degrees Fahrenheit disrupts that system; more specifically, it can reverse it and restart the synthesis process. This is very sensitive in the seed development stage, and the window is very narrow. This can cause differences between adjacent fields that are only days apart in maturity or differ in uniformity of maturity.

Even canola swathed four to six days before a frost will retain relatively high levels of chlorophyll. Two or more germination flushes and growth stages result in immature seed at swathing and green seed at harvest. Thin stand counts can result in plants with more branching and more variability in seed maturity, and crops are more likely to have immature seed at swathing. Late-seeded canola may be impacted by all these situations.

**Growers can make management decisions to reduce green seed problems in the future:**

- Choose fields with better surface drainage and fertility.
- Seed as early as possible in the spring to allow for the maximum ripening time.
- Provide a firm seedbed to achieve correct depth of planting and good seed-to-soil contact for quick and even emergence.
- Swath at the recommended color stage for the weather conditions.
- Maintain adequate fertility levels for canola growth and ripening. Canola stressed from nutrient deficiency will not mature evenly.
- Take soil samples for a general indication of nitrogen, phosphorous, potassium and micronutrient levels.
- Sample plant tissue early during rosette stage to allow time for corrective micronutrient applications.
- Fields with high fertility levels can be expected to delay maturity in years with below-normal growing degree days' accumulation or heat units (cool years).

## Storage and Drying

Storage and handling problems of canola are similar to those of flax. The seed is round, small, heavy and runs freely. Very tight truck boxes and storage bins are required. The seed can sweat for up to six weeks after harvest, so heating and spoilage can occur, even at 9 percent to 10 percent moisture levels. Canola as low as 8.5 percent moisture should be examined for heating at regular intervals.

If harvested at high moisture, natural air drying or artificial drying can be used. To maintain seed quality, a drying temperature of 110 F or less is maximum for commercial production. If a significant amount of foreign material (straw) is included with the seed, running it over a scalper may be advantageous before drying and binning.

## Canola Products

Canola varieties produce meals having about 38 percent protein. The amino acid distribution is very complementary to soybean oil meal, and the two meals often are included in the same ration. Feeding trials have shown that animals perform better when fed a mixture of the two meals than when fed either alone.

In Canada, canola meals are recommended for up to 10 percent to 20 percent of the ration for chickens, turkeys, ducks, geese, pigs, dairy and beef animals. Edible rapeseed oil or canola oil has been used in some countries for the past two decades and was approved for human consumption in the U.S. by the Food and Drug Administration in 1985.

Canola oil usually is blended with other vegetable oils for the production of various solid and liquid cooking oils and salad dressings. Canola oil is high in oleic acid relative to other vegetable oils and has been competitive in price with other cooking oils.

## Marketing

Most canola is not grown under contract. The U.S. farm program has a good support loan program for canola oilseed production.

U.S. grain standards for grading canola and rapeseed were established Feb. 28, 1992, by the U.S. Grain Inspection Service. (See Table 1.)

Factors of most importance in the determination of grades are admixtures and soundness. Grading admixtures include such factors as foreign material, common wild mustard seed, tame brown and yellow mustard seed, earth pellets, sclerotinia, ergot and stones. Soundness refers to broken seed not assessed to dockage, seeds distinctly green after cracking, heat damage and odor.

**Table 1. USDA Grade and Grade Requirements for Canola.**

| U.S. Grades | 1 | 2 | 3 |
|---|---|---|---|
| Grading factors maximum percent limits of: | | | |
| **Damaged kernels** | | | |
| Heat damaged | 0.1 | 0.5 | 2.0 |
| Distinctly green | 2.0 | 6.0 | 20.0 |
| Total | 3.0 | 10.0 | 20.0 |
| **Conspicuous admixture*** | | | |
| Ergot | 0.05 | 0.05 | 0.05 |
| Sclerotinia | 0.05 | 0.10 | 0.15 |
| Stones | 0.05 | 0.05 | 0.05 |
| Total | 1.0 | 1.5 | 2.0 |
| **Inconspicuous admixture**** | 5.0 | 5.0 | 5.0 |
| Maximum count limits of: | | | |
| Other material | | | |
| Animal filth | 3 | 3 | 3 |
| Glass | 0 | 0 | 0 |
| Unknown foreign substance | 1 | 1 | 1 |

**U.S. sample grade** – canola that:
- does not meet the requirements for U.S. Nos. 1, 2 or 3, or
- has a musty, sour or commercially objectionable foreign odor, or
- is heating or otherwise of distinctly low quality

* Conspicuous admixture is all matter other than canola that is readily distinguishable from canola and remains in the sample after the removal of machine-separated dockage. It is not limited to ergot, sclerotinia and stones.

** Inconspicuous admixture. Any seed that is difficult to distinguish from canola. This includes, but is not limited to, common wild mustard (Brassica kaber and B. juncea), domestic brown mustard (Brassica juncea), yellow mustard (B. hirta) and seed other than the mustard group.

## Grower Considerations

1. Don't grow canola varieties without knowing where to deliver to a market.
2. Plant recommended varieties of good quality and good yield potential.
3. Plant early for more profitable yields.
4. Select weed-free fields and control weeds prior to planting.
5. A firm seedbed preparation is critical; therefore, take time to prepare a proper seedbed.
6. Manage canola to avoid green seed.
7. Monitor fields for flea beetles.
8. Swath at proper maturity. Swathing early reduces yield; delays allow excessive shattering.
9. Monitor seed in storage for heating and spoilage because canola requires more attention than cereal grains.
10. Don't put canola and other sclerotinia (white mold)-susceptible crops in the rotation closer than every three years.
11. Promote the use of canola oil to consumers.
12. Consider joining the Northern Canola Growers Association.

# Canola Information Resources

## North Dakota State University

Oilseeds and Row Crops
*www.ag.ndsu.nodak.edu/plantsci/rowcrops/main.htm*

North Dakota State University Extension
*Procrop: www.ag.ndsu.nodak.edu/aginfo/procrop/procrop.htm*

Sclerotinia Risk in Canola Forecast Program
*www.ag.ndsu.nodak.edu/aginfo/sclerotinia/sclerotinia.htm*

Canola Insects Information
*www.ag.ndsu.nodak.edu/aginfo/entomology/entupdates/index.htm#Cano*

## Northern Canola Growers Association

2718 Gateway Drive, #301
Bismarck, ND 5850
Telephone: (701) 223-4124 or toll-free (877) 585-1671
*Web address: www.northerncanola.com*

## U.S. Canola Association

600 Pennsylvania Ave. S.E., Suite 320
Washington, DC 20003
Telephone: (202) 969-8113
*Web address: www.uscanola.com*

## Canola Council of Canada

400 167 Lombard Ave., Winnipeg, MB R3B 0T6
Telephone: (204) 982-2109
*Web address: www.canola-council.org/*

## Publications

Canola Growers Manual
Canola Council of Canada

## NDSU Extension Service Publications

| | |
|---|---|
| A-1124 | Canola Variety Trials |
| SF-1122 | Fertilizing Mustard and Canola |
| W-253 | North Dakota Weed Control Guide |
| PP-1024 | Blackleg of Canola |
| PP-1201 | Sclerotinia Stem Rot of Canola |
| A-1208 | Canola Flowering and Fungicide Application Timing |
| A-1171 | Swathing and Harvesting Canola |
| E-1143 | North Dakota Field Crop Insect Management Guide |
| PP-622 | North Dakota Field Crop Fungicide Guide |



**For more information on this and other topics, see: www.ag.ndsu.edu**

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