



Figure 1. Canola field ready to swath.

Canola is a major economic oilseed crop in North Dakota and northwestern Minnesota. Proper harvest management in terms of selecting the proper maturity stage for swathing and combining are very important. As a canola crop nears maturity, it may ripen very quickly. Selecting the correct time to swath and combine canola demands more observations and care than it does for small grains.

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Swathing and Harvesting Canola

Reviewed by

Hans Kandel, Agronomist, NDSU Extension Service

Bryan Hanson, Agronomist, Langdon Research Extension Center

Proper Stage to Swath Canola

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 (Figure 1), examine plants from different parts of the field. The stage of maturity in an evenly maturing field will vary from plant to plant and area to area in 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 (Figure 2). 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 to 35%, about 30 to 40% 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 (Figures 3 to 6).

Most of the seeds that have changed color will be from the bottom third of the stem. When seeds in the bottom pods slightly turn color, seeds in the top, last-formed pods are filled or nearly filled. At this time, most of the seeds will be firm and roll, as opposed to break, when pressed between the forefinger and thumb.

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

Effect of Swathing Time on Yield, Green Seed and Oil

Studies in North Dakota and Minnesota have been conducted to show the relationship of seed color change at swathing time to yield, seed size, green seed and percent of oil (Table 1).

The average green seed at the 0 to 5% seed color change at swathing time resulted in 3.5% green seed content, which is higher than the 2% allowed in the marketplace before a discount will occur. Approximately 180 to 200 pounds per acre (lbs/A) of yield gain was noted when swathing was

Table 1. Canola Swathing Research Results.

Seed Color Change at Swathing (% change)	Number Seeds/lb	Seed Yield (lbs/A)	Green Seed (%)	Oil (%)
0-5	160,800	1,603	3.5	39.5
15-20	144,400	1,785	1.4	40.0
30-35	138,500	1,795	1.1	40.1
LSD .05	8,077	130	1.4	0.4

*Locations averaged – Langdon, Minot, Carrington, N.D. and Roseau, Minn.

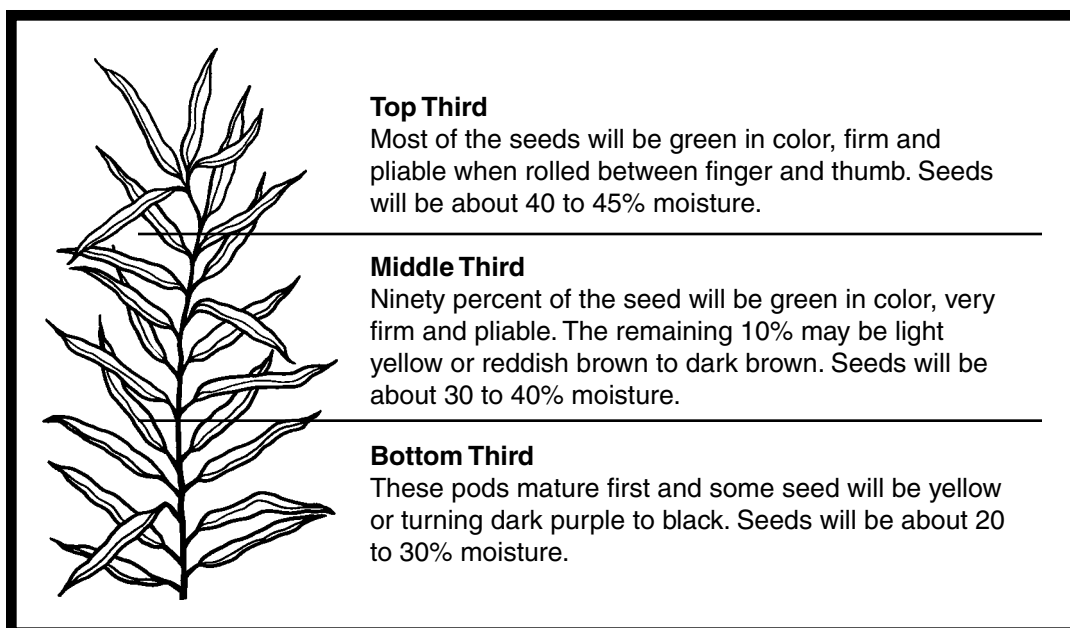


Figure 2. Optimum moisture stage for swathing canola.

delayed to the 15 to 20% or greater seed color change. Swathing during the 0 to 5% color change resulted in a problem with seed size shrinking and a tendency to have a lower oil percent.

The research results suggest that canola swathing can start when a minimum of 15 to 20% seed color change has occurred. This management practice will help ensure maximum yield potential, acceptable green seed content and percent of oil. The early start is particularly important when large acreage of one canola hybrid is involved or all of the crop was seeded during a short period of time.

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% seed color change. Polish canola should be left until the 20 to 25% seed color change.

Swathing Canola

Canola is harvested with the same swather and combine equipment as cereal grains, although the crops are quite different. Canola is tall and branchy, with thick spongy stems. However, with a few basic adjustments to most modern swathers, a good windrow of canola can be formed.

Cutting Height

The swather should be run just low enough to get all the seed pods, leaving the maximum amount of stubble in which 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. This allows good anchoring of the windrow and drying (Figure 7).

To keep the swather moving forward without bunching, a few low pods may have to be missed. Such windrows tend to settle into the stubble and escape wind damage. This also minimizes the amount of material that must be handled by the swather and combine. Additional material only will delay the drying process.



Figure 3. Plants at various maturity stages.

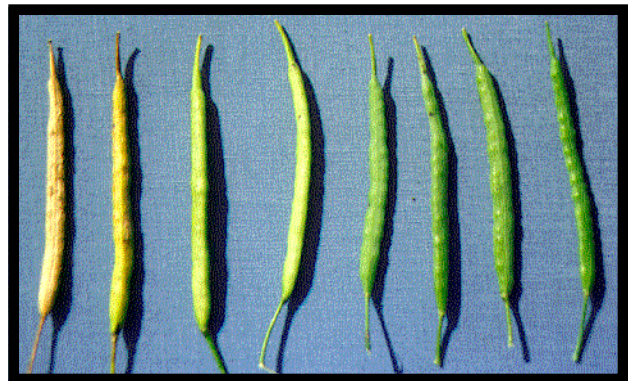


Figure 4. Change in pod maturity.



Figure 5. Change in pod and seed maturity.

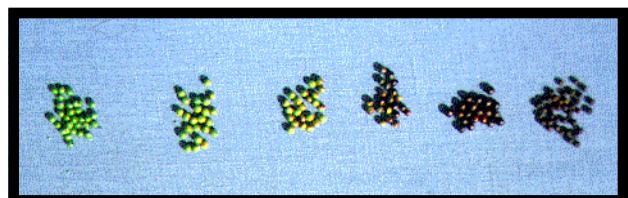


Figure 6. Seed color and maturity changes.

Swather Table and Throat

The average crop of canola is handled quite readily with most swathers. However, stands that are exceptionally tall (4 to 5 feet), thick, or lodged and tangled make laying an unbunched windrow difficult. 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. The opening should be at least as wide (40 to 54 inches) as the distance between the two swather canvasses on center delivery swathers. It should have a vertical clearance for the windrow of at least 30 to 40 inches.

The throat opening should be free of projections that may catch and bunch the windrow as it passes through the machine. A large throat opening is important, particularly for wider swathers, to ensure the swath will be of a size and shape that will dry and cure properly.

The table canvas should be strong enough to carry the heavy load of cut material and should be run just fast enough to keep the table clean. If possible, the 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.

Reel and Dividers

The reel should be set as high and far forward as possible. The reel speed should be set to

correspond with the forward speed of the swather. This speed will just lay the cut material gently back on the table to avoid shelling. The ratio of tip speed of the reel bat in feet per minute divided by the ground speed of the swather in feet per minute should be a maximum of 1 to 1.1.

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 generally are less prone to plugging than short, abrupt types. In lodged or tangled canola, the divider tip must split the crop low in the stem area and then lift and separate the crop as the swather moves forward.

Separation of the crop should be complete just before the knife cuts the stems. 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 (Figure 8). These can cause a 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. For example, if the crop is leaning southeast, then swath from the southeast to the northwest. Canola crops do not often flatten so badly that a conventional swather will not handle them, but in severe conditions, a pickup reel set well forward and with a speed ratio of 1.1 will help in swathing. Also, install lifting guards that lift the crop so it can be cut.



Figure 7. Properly swathed canola.



Figure 8. Swather equipped with vertical cutter bar.

Swath Rollers

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 (Figure 9). 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.

The windrow should be left as high as possible in the stubble so that the combine pickup can slip under it without tearing the windrow. NDSU research has shown that swath pack density and seeding rates had little effect on green seed of canola.

Swathing Over-ripe Fields

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

Swathing Unevenly Maturing Crops

Determining when to swath unevenly maturing fields is difficult. Uneven maturity usually is the result of uneven spring germination, with two or more flushes of seedling emergence.

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 producers to make a better

decision as to how soon to swath or whether to wait until the later crop catches up. If the stand is 20 to 25% early and 75 to 80% late, then waiting to cut later may be the best strategy to reduce the amount of green seed.

Time in the Swath

Canola should be allowed to cure and ripen from 10 to 14 days in the swath before combining (Figure 10). If combined too early, the chance of increased green seed in the harvested crop is much greater.

Be in a hurry to swath on time and prevent shattering, but take your time moving the combine into the field to ensure maximum drying, maturation and quality of your harvested canola.

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

Research was conducted at various locations in North Dakota and northwestern Minnesota to determine canola seed yield and quality as influenced by the amount of time the crop is cured and ripened in



Figure 9. Rolling a canola swath.



Figure 10. Mature canola in swath.

the swath (Table 2). The results indicated that while seven days of curing in the swath was adequate for yield, it was not sufficient to allow for green seed color change (reduction in chlorophyll) or a drop in the moisture content of the seed.

Green Seed Problem

Problems with green seed have developed in North Dakota. Cool, wet and overcast weather during the growing season promotes green seed. These problems can be made worse in some instances by sulfur deficiency.

Temperatures at maturity are an important factor in chlorophyll breakdown. Cool temperatures and light frosts in August and September slow the enzyme activity that breaks down chlorophyll. Frosts from 32 to 33 F stop the chlorophyll breakdown and, in some cases, can reverse it. Differences may occur between adjacent fields that are only days apart in maturity or differ in uniformity of maturity.

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. Low stand counts can result in plants with more branching and more variability in seed maturity and are more likely to result in immature seed at swathing. Late-seeded canola may be impacted by all of these situations.

Table 2. Swathing to Harvest Days.

Average Swathing to Harvest Days	Harvest Date GDDs*	Yield lbs/A	Green Seed (%)	Number Seeds/lb	Moisture (%)
7	144-192	1,774	2.3	147,400	11.6
14	312-360	1,733	2.0	148,100	7.3
21	480-528	1,675	1.8	148,200	7.9

Locations averaged: Langdon, Carrington, Minot, N.D. and Roseau, Minn.

*GDDs – Growing degree days – base 40 F.

Practices to Reduce Green Seed

Growers can make the following management decisions to reduce green seed problems:

- Choose fields with better surface or subsurface drainage and fertility.
- Seed as early as possible in the spring to allow for the maximum ripening time.
- Provide a firm seedbed to achieve the correct depth of planting and good seed-to-soil contact for rapid and even emergence. Do not broadcast seed.
- Swath at the recommended color stage for the weather conditions.
- Maintain adequate fertility levels for canola growth and ripening. Canola stressed from sulfur nutrient deficiency will not mature evenly.
- Take soil samples for a general indication of nitrogen, phosphorus, potassium and sulfur.
- Sample plant tissue early during the rosette stage to allow time for corrective sulfur applications.
- Expect delays in maturity in fields with high fertility levels in years with below-normal growing degree day (GDD) accumulation or heat units (cool years).
- Don't swath canola if the weather forecast is for extremely hot, dry and windy conditions.
- Target all canola management decisions toward uniform crop maturity.

Combining

All combines work fairly well to harvest canola. (Figure 11). Canola in the swath is ready to pick up and thresh when the seed temperature and moisture content have dropped to a safe storage level and most seeds are mature with no green.

Before combining or after combining a small sample, use a crush strip along with a small roller to make sure the seeds are not green inside (Figures 12,13). A color chart can be used to determine the green seed content. If the crop still has some green seeds, a few more days in the swath probably will allow it time to clear the chlorophyll.

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

The 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 fast. 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 low fan speed and increase gradually until separation of chaff and seed occurs with no canola being blown over the chaffer sieve.

Storage and Drying

Canola storage and handling problems 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 to 10% moisture levels. Canola as low as 8% 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 recommended for commercial production. If a significant amount of foreign material (straw) is included with the seed, running it over a scalper before drying and binning may be advantageous.



Figure 11. Combining canola.

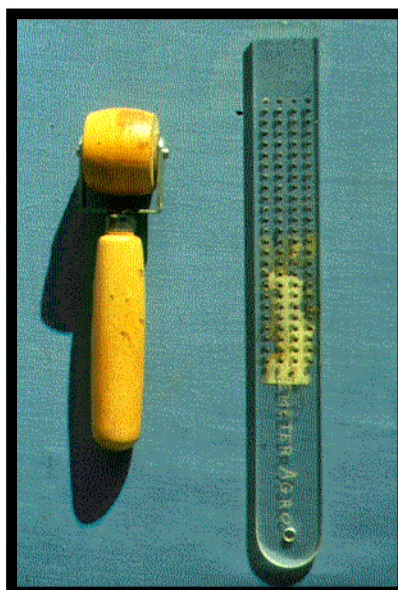


Figure 12. Roller and crush strip for testing green seed content.

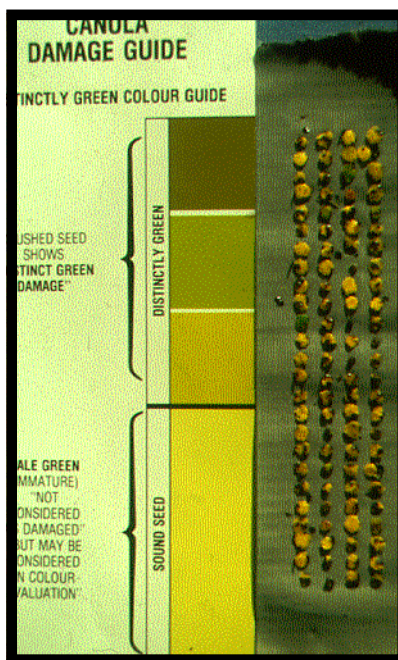


Figure 13. Green seed test guide.

Table 3. 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 ¹			
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 ²	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 is 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.

¹Conspicuous admixture is all matter other than canola that is readily distinguishable from canola and which remains in the sample after the removal of machine-separated dockage. It is not limited to ergot, sclerotinia and stones.

²**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.

This publication was authored by Duane R. Berglund, professor emeritus and former Extension agronomist, NDSU; Bryan Hanson, agronomist, Langdon Research Extension Center, NDSU; and Mark Zarnstorff, former agronomist, North Central Research Extension Center, NDSU, 1999.

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