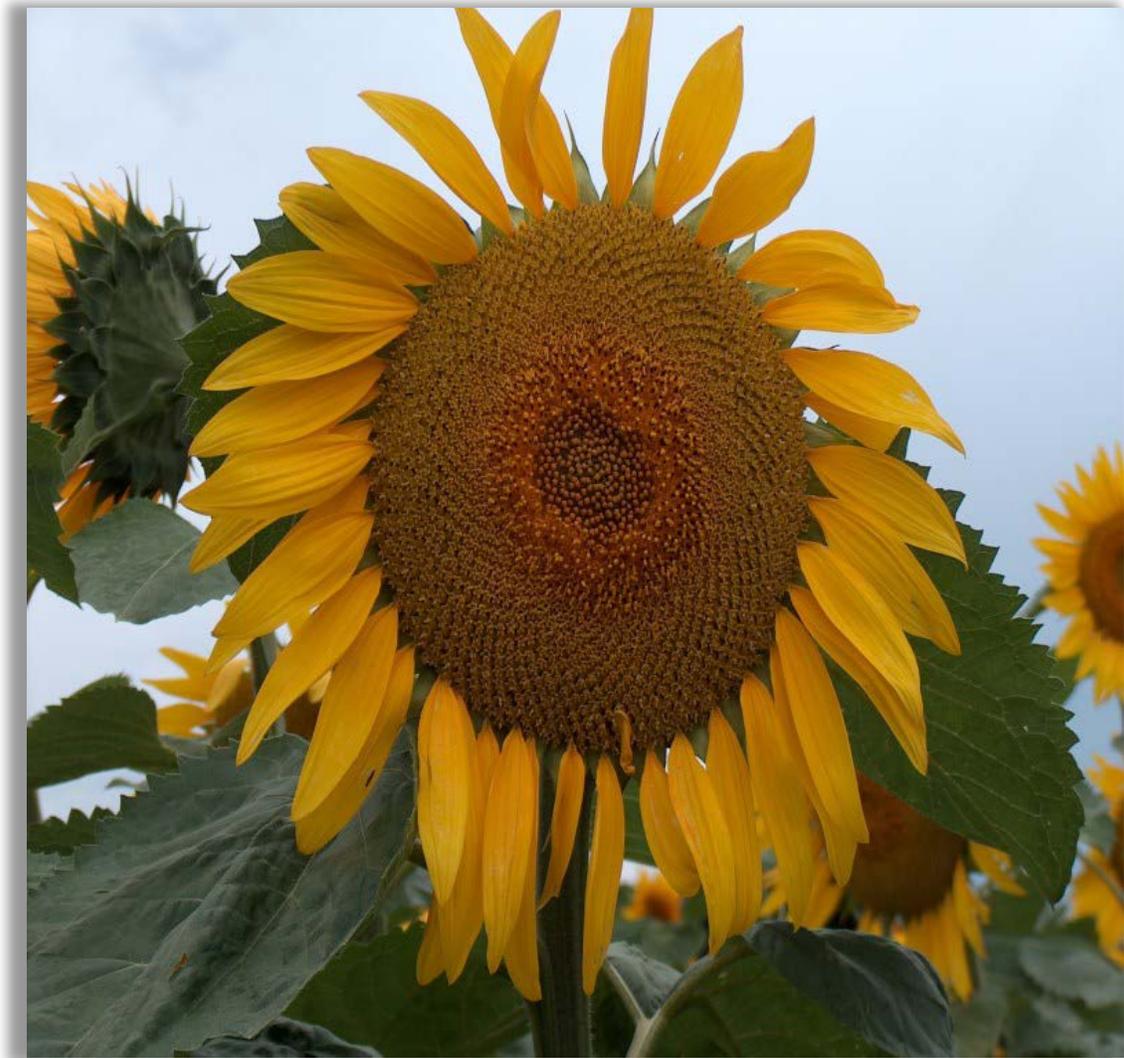


Saskatchewan No-Till Sunflower Production Guide



Saskatchewan Sunflower Committee



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Saskatchewan No-Till Sunflower Production Guide

**W.E. May, G.P. Lafond, C.H. Holzapel, S. Roberts,
I.E. Moats, J. Thorson, D. McKenzie and W. Cowan.**

Background

Sunflower (*Helianthus annuus* L.) is the only oilseed crop native to the North American Great Plains and has been commercially grown in Canada since the 1940's. There are two different types of sunflower grown: confection and oil. Confection sunflower seed is consumed as roasted snack food in the shell or as dehulled seeds used in the baking industry. While there are a few confection sunflower growers in the southeast corner of Saskatchewan, confection sunflowers are best grown under irrigation in Saskatchewan. The oilseed types can be crushed for high quality vegetable oil, used in the preparation of snack foods or as a bottled product used in the home. Oilseed types are also marketed for wild bird feed or in specialty livestock feeds. Sunflower meal is often fed to beef and dairy cattle.

World production of sunflower was 39.42-million tonnes in 2015/2016 (USDA 2016). The top three producing countries were: Ukraine, Russian Federation, and the European Union. Canada's production level for 2015/2016 was 73,000 metric tonnes.

In Canada, production is currently centered in southern Manitoba and scattered throughout Saskatchewan and Alberta. In Manitoba, sunflower acres averaged 139,204 from 2001 to 2015. These acres ranged from a high of 205,031 acres in 2002 with an average of 104,632 acres of confection and 34,573 acres of oil type sunflowers (NSAC 2014) to a low of 35,072 in the flood year of 2011. According to the Saskatchewan Crop Insurance Corporation (SCIC), the reported sunflower acreage in Saskatchewan peaked at about 61,774 acres in 1999 and has since declined to 7,035 acres in 2014. This decline in acres can be attributed to a number of factors: the loss of adapted cultivars, the lack of a reliable seed supply and other new emerging specialty crops. The market demand also shifted from a high linoleic-oil profile to a mid-oleic known as Nusun.

Agronomics



Crop Rotation Considerations

Sunflower is a deep rooted crop with an ability to scavenge water and nutrients from lower depths. Its longer growing season can assist with spreading out harvest. The tall stubble aids in trapping snow. It provides a good fit seeded prior to spring wheat in a broadleaf/cereal crop rotation. As sunflower is susceptible to sclerotinia caution is advised in growing it immediately after susceptible crops if disease pressure is present. If soil salinity is an issue, sunflower provides an alternative to planting a forage crop.

Sunflower is susceptible to a number of herbicide residues. Consult a current issue of the Saskatchewan Ministry of Agriculture’s “Guide to Crop Protection” for re-cropping restrictions and read the product labels.

Seeding Date

Sunflower is a warm season crop. Like canola, the growing point of a sunflower is above the soil surface, as such, it is more susceptible to spring frost damage than a cereal crop. Its greatest frost tolerance is at emergence and in the cotyledon stage.

During these early growth stages, sunflower can withstand temperatures of -3.3° to -3.8° Centigrade (C) (26.1 to 25.2°Fahrenheit (F)) for short periods. By the V-2 stage, frost susceptibility is -2.7° to -3.3° C (27.1 to 26.1° F) but for the V-4 to V-6 stages, -1.6 to -2.2°C (29.1 – 28.0° F) is the lower limit. Seeding in mid-May into warm, moist soil is optimum. Avoid seeding into cold, wet soils as this delays emergence and gives weeds a head start. Current sunflower varieties require 105 to 125 days to mature.



Field Selection and Seeding Depth

Sunflower prefers a well-drained soil with near neutral pH (6.5 -7.5). Fields with sloughs and shelterbelts encourage crop attack from blackbirds at maturity. Seed size is determined by the environmental conditions during seed filling, therefore confectionery sunflowers tend to be grown where there is more reliable late-season rainfall or under irrigation.

A sunflower crop has the ability to exploit a large volume of soil for water with its rooting depth of 1.5 metres (5 feet). Over the growing season, it uses an inch more soil water than durum and two inches more than canola. Their maximum water use time is during the middle of the growing season when the temperatures are high and the crop canopy is well developed. Plants can survive longer and wait on moisture under dry conditions but they can also dry out a field more than other crops for the following year. Sunflower seeds should be seeded 1½ to 2 inches deep but can be seeded to moisture 3 to 4 inches deep if necessary. Their hard shells require soil moisture for germination. AC Sierra should not be seeded deeper than 3 inches.

Table 1 – Growing Degree Days: Sunflower Growth and Development

		Average days & GDD** units accumulated from planting	
Sunflower Stage	Plant	GDD units	Days
VE	Emergence	167	10
V4	4 True Leaves	349	20
V8	8 True Leaves	545	28
V12	12 True Leaves	690	34
V16	16 True Leaves	772	38
V20	20 True Leaves	871	44
R1	Miniature Terminal Bud	919	46
R2	Bud < 1" from Leaf	1252	61
R3	Bud > 1" from Leaf	1394	67
R4	Bud open Ray Flowers Visible	1492	71
R5.1	Early Flower	1546	73
R5.5	50% Flowered	1623	77
R6	Flowering Complete	1780	84
R7	Back of Head – pale yellow	2052	86
R8	Bracts Green – head back yellow	2211	1047
R9	Bracts Yellow – head back brown	2470	119

Source: NDSU Carrington Research Extension Centre

** Sunflower growth and development responds to heat units similar to corn and several other crops. In sunflower, the base temperature of 6.7° C (44 ° F) is used to determine Growing Degree Days (GDD). The daily GDD = {(daily maximum temperature + daily minimum temperature) ÷ 2} - 6.7° C.

Vegetative Stages



True leaf – 4 cm



V-12



V-E



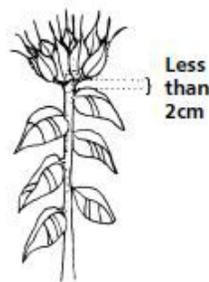
V-2



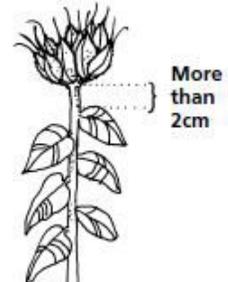
V-4

Stages of Sunflower Development

(A. A. Schneiter and J.F. Miller.)



R-2



R-3

Reproductive Stages



R-1



R-2



R-3



R-3 Top View



R-4 Top View



R-5.1



R-5.5



R-5.9



R-6



R-7



R-8



R-9

Courtesy of NDSU

Seeding Equipment

While sunflower is normally considered a row crop, solid-seeded no-till sunflower production has become popular with producers using air drills in Saskatchewan. Advantages include using existing equipment, as well as the ease of changing between crops at seeding time.

A disadvantage of this is that the row width is defined by the air drill used, varying between 10 and 12 inches. These seeders and drills are not specifically designed to evenly space sunflower seeds which are seeded at 0.5 to 1 plants/square foot which is a much lower seeding density than that used for cereal, oilseed or pulse crops. This can result in crop rows where a portion of the row will have gaps while there will be narrow plant spacing in another portion.



A study “Response of Sunflower to Uniformity of Plant Spacing” (1980) conducted in Minnesota showed that a lack of uniformity in plant stands can reduce yields an average of 10%. While most air seeders and drills can do an adequate job, growers need to be aware of this potential problem and evaluate the plant population distribution in their sunflower field.

Some adjustments to air drills when planting sunflower could include: using the proper metering roller, slowing the metering roller speed, calibrating the drill and then recalibrating the drill when the variety or seed lot is changed, and/or reducing airflow.

Seeding tip: Once the drill is calibrated, a good seeding technique is to only put a couple of bags of seed in the bin and operate until the low seed light displays, then repeat the process. Once completed, calculate the acres seeded: if it appears that your seeding rate is right, then fill the seed bin and plant the remainder of the field.

Seeding Rate and Variety Selection

Yield and lodging are highly dependent on seeding rate and the plant density derived from that seeding rate. To ensure that grain yield is not limited, research conducted by Bill May at Indian Head in 2015 recommends that when seeding with an air drill you should target a plant density above 30,000 plants/acre.

This compares to Saskatchewan’s current recommendation for oilseed types at 0.57 – 0.59 plants/sq. ft. (25,000 – 26,000 plants/acre) when using a row crop planter. In Manitoba, the current row crop seeding rate recommendations for oil types are between 0.4 and 0.5 plants/sq. ft. (20,000 to 22,000 plants/acre) and for confection-types 0.4 plants/sq. ft. (18,000 plants/acre). Seeding at the lower end of the seeding rate spectrum may reduce seed costs and lodging. Lower seeding rates can create gaps within rows thereby causing heads to face upward increasing the potential for bird damage. High seeding rates increase lodging with an increased risk for sclerotinia.

Oil-type semi-dwarf and open pollinated dwarf sunflowers are the best adapted types in a large part of Saskatchewan. The recommended seeding rates for these dwarf sunflowers are higher due to their higher seedling mortality. The Saskatchewan Sunflower Committee currently recommends a seeding rate of 0.93 - 1.02 plants/sq. ft. (40,500 to 45,000 plants/acre) for the open-pollinated dwarf variety AC Sierra which is adapted for organic production.

Information regarding specific varieties adapted to Saskatchewan growing conditions is published annually in the Saskatchewan Ministry of Agriculture’s “Varieties of Grain Crops” publication. The data is provided by the Saskatchewan Sunflower Committee (SSC) which has been conducting trials since 1983. Sunflowers no longer require 3 years of yield testing to be sold in Saskatchewan; however the SSC publishes their trial results each year.

Plant density trials at Indian Head, SK

AC Sierra 19,897 plants/acre



AC Sierra 27,980 plants/acre



AC Sierra 29535 plants/acre



AC Sierra 35442 plants/acre



Table 2 - Seed Density of Sunflowers as a Function of Row Spacing, assuming 90% germination rate and 10% stand loss

Row spacing: (inches)	10	12	16	18	22	30	36
Plants/acre	Average seed spacing within row - inches*						
16,000	31.8	26.5	19.9	17.6	14.4	10.6	8.8
18,000	28.2	23.5	17.6	15.7	12.8	9.4	7.8
25,000	20.3	16.9	12.7	11.3	9.2	6.8	5.7
30,000	16.9	14.1	10.6	9.4	7.7	5.7	4.7
40,000	12.7	10.6	7.9	7.1	5.8	4.2	3.5
45,000	11.3	9.4	7.1	6.3	5.1	3.8	3.1

* Calculated based on the following formula from the National Sunflower Association Sunflower Manual, assuming 90% germination and plant survival

$SS = (6,272,640/RS)/PP/(GR \times SR)$ where:

SS = in row seed spacing in inches

RS = between row spacing in inches

PP = desired plant population at harvest

GR = germination rate as a decimal. For example, if germination is 95%, then germination rate is = .95

SR = stand reduction as a decimal. This reduction is a result of other factors between germination and final harvest population.

Table 3. - Sunflower Seed Size and Associated Seed Weight

Oil-Type Sunflowers		Confection Sunflowers	
Seed Size	Seeds/lb.	Seed Size	Seeds/lb.
No. 2	5,000 - 6,000	Medium	4,000 - 5,000
No. 3	6,000 - 7,000	Large	3,000 - 4,000
No. 4	7,000 - 9,000	Extra Large	2,000 - 3,000

courtesy National Sunflower Association of Canada

Most sunflower varieties are hybrids and as such new seed must be purchased each year. Sunflower is sold by weight and number.

Sunflower seed is purchased by the bag. If a bag contains 200,000 seeds, depending on the seed size, it can weigh anywhere from 18 to 29 pounds. This demonstrates the variability of seed size. It is also advantageous to know the germination rate of the seed lot being purchased in order to determine your seeding rate.

When using an air seeder, the seed distribution system works better with smaller sized seed than with larger. Larger seeds can cause plugging problems. Other factors that influence seeding rate include how shiny the seed coat is, air pressure and travel speed.

Fertility

Sunflower growers should follow soil test recommendations for the amount of fertilizer required when growing sunflowers. No more than 10 pounds of nitrogen and potash should be placed with the seed as germinating sunflower seeds are very sensitive to seed-placed fertilizer. Additional fertilizer must be side-banded as low plant populations exaggerate seed sensitivity to fertilizer.

Bill Mays' 2010 report "Demonstrating the nitrogen response of hybrid sunflowers across Saskatchewan" shows that sunflower yield responded to nitrogen (N) as nitrogen rate increased from 0 to 45 lb. /acre of actual nitrogen but when the nitrogen rate was increased above 45 lb. /acre of actual nitrogen the response to nitrogen differed among fields. In Saskatchewan and western Manitoba a moderate rate of fertilizer, 45 to 62 lb. /acre of actual N is recommended until a producer has a better understanding of the response of sunflower to N rate on their own fields. The same study also concluded that as N increased kernel weight also increased.



Weed Control

Broadleaf weed control options are limited in sunflower compared to other crops. Growers are encouraged to consult a current edition of Saskatchewan Ministry of Agriculture's "Guide to Crop Protection" as well as the product labels for current herbicide recommendations. Producers should be aware of and follow the maximum residue limits (MRL's).

Sunflower hybrids that carry herbicide resistance are being developed. Consult the current Saskatchewan Ministry of Agriculture's "Varieties of Grain Crops Guide" for varieties adapted to your growing area.



Common Diseases and Pests



Blackbirds

Blackbirds seem to have a particular attraction to sunflowers. Soon after petal drop, birds can be found perching on the heads to feed. There are a number of precautions that can be taken to help reduce bird invasion. First, try to avoid planting sunflower fields adjacent to nesting habitat such as sloughs, marshes or tree bluffs. When possible, cut cattails with a mower. Planting a lure crop of sunflowers near a slough or trees is also recommended. Control weeds in the crop that may serve as attractants. Avoid ploughing down adjacent stubbles that may serve as an alternative food source. Desiccation of a mature crop can speed dry down and

reduce the exposure time. Begin scare tactics as soon as birds are noticed in the area with cannons, flashers or gunshots. Scare cannons with variable shot patterns are more effective than those with regular patterns. Scare cannons are available from your local conservation offices. Scare cannons and sound systems can be purchased from companies such as Margo Supplies, High River, Alberta or Bird Guard, (<http://www.birdgard.com/choosing-the-right-bird-gard>). The sound systems are very effective but unfortunately only for four to twenty-five acres depending on the model. At this time there are no deterrent products registered for spray application.

Within Saskatchewan, blackbird damage will qualify for blackbird damage compensation. Growers should contact the Saskatchewan Crop Insurance Corporation for more information.





Sunflower Insect Problems



Adult Banded Sunflower Moth

Cochylis hospes

This straw colored moth averages 7mm in length, with a distinct brown triangular area in the middle portion of its forewings. Overwintering as mature larvae in the soil, female adult moths move from previously infested fields into new crops to lay eggs during the evening on the bracts of sunflower heads. Scouting should be done when plants are in the late bud (R-4) to early bloom stage (R-5) in the early morning or early evening. Examine 20 plants

from five different locations throughout the field remaining at least 20-30 metres from the field margin. The economic threshold, if scouting is done in the early morning or early evening, is one moth/two plants.



Young Banded Sunflower Moth Larvae

Young larvae start out either light pink or yellow.

Larvae bore or tunnel in the seed and head.



Mid-stage Banded Sunflower Moth Larvae

As larvae mature, they transition in color to reddish purple



Mature Banded Sunflower Moth Larvae

The final stage of maturity in banded sunflower moth larvae finds them green in colour.



Sunflower Moth

Homoeosoma electellum

Adult moths 10-15mm long with whitish forewings that fold over their bodies when at rest are blown in from the southern United States. With one larval generation per year, adults lay their pearl white eggs in pollinating blooms with female moths being particularly attracted to flowering sunflowers. New adults die off in the fall. Larvae initially feed on pollen and flower parts while adults feed on nectar. Larvae will tunnel deep into the heads and live within silken cocoons. Scouting involves placing

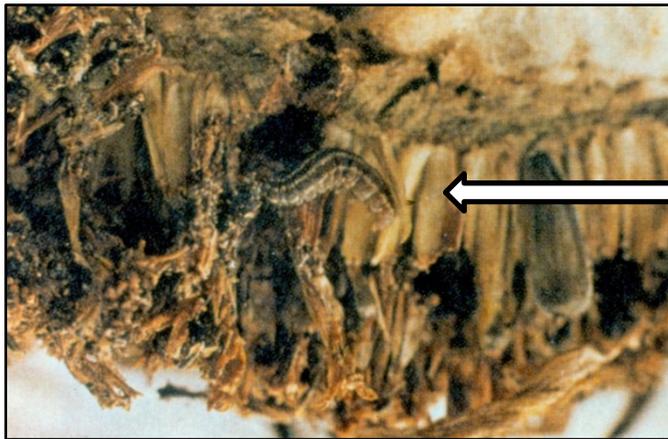
pheromone traps just prior to flowering to detect the arrival of adults. Once traps reveal the arrival of adults, scouting should be done starting at the onset of blooming and until blooming ceases. Inspect 10 heads at ten different sites around the crop perimeter within 20 metres of the field edge. Economic threshold is reached when 2-4 moths/10 heads at the onset of bloom or within seven days of the adult moths first appearance at dusk.



Overwintering cocoon Sunflower Moth

Homoeosoma electellum

Cocoons are found in sunflower heads that are woven with silk by the larvae and retain black pellets of frass.



Sunflower Seed Maggot feeding



Seed damaged by the Sunflower Seed Maggot

Sunflower Seed Maggot Fly

Neotephritis finalis

Both sexes are 6mm long, have a yellowish body and a 13mm wing span. On the wings, broad dark bands that form a distinct F-shaped mark near the tips can be found. They feed on the nectar of flowering plants and overwinter as larvae in plant debris in the soil. There is one generation per year. No scouting protocol or economic thresholds have been established.



Female



Male



Sunflower Beetle Larvae

Zygogramma exclamationis

They are hump-backed, measure 8-10 mm in length, and are yellowish-green in color with a brown head. Immature larvae are slow moving and feed on sunflower leaves at night. They hide under the flower bud bracts and in leaf axils during the day. Mature larvae drop to the ground and form bare yellow pupae. Scouting should generally be done July to mid-August. Ten plants at five different locations within the field should be examined by peeling back bracts around the

flowers. Economic thresholds are 10-15 larvae per plant during the summer.



Adult Sunflower Beetle

Closely resembling the adult Colorado potato beetle, these beetles are 6-8mm in length with four dark stripes on each forewing. The last stripe will end in the middle of the abdomen and have a small dot off the end of it. They overwinter in the soil and emerge as sunflower seedlings emerge in the spring. Females are capable of laying up to 1000 eggs on the leaves and stems of sunflower plants. There is one generation per year in Saskatchewan. They feed on emerging sunflower seedlings and the uppermost leaves in the late summer. Scouting should begin in May and June with the examination of 10 seedlings at two

locations on each side of a field and two sampling sites near the centre. Economic thresholds are 1-2 adult beetles at the 2-6 leaf stage.



Sunflower Stem Weevil (Spotted Weevil)

Cylindrocopturus adspersus

There are two stem weevils. This weevil is 1/8 to 3/16 inch long and is grayish-brown with white spots on the wing covers and the thorax. There is only one generation per year with adults overwintering in sunflower stalks and root crowns. Emergence generally occurs in April with feeding occurring on stem and leaf tissue. Eggs are laid at the base of stalks under the epidermis and hatch in mid-July. Alternate hosts include: ragweed, pigweed, Russian knapweed, lambsquarters, golden ragwort, perennial sowthistle,

red clover, cocklebur and kochia.



Sunflower stem damage caused by Stem Weevil larvae

The sunflower stem weevil is often responsible for weakened stems and lodging. Upon hatching, larvae initially feed in the vascular tissue of the stem leaving tunnels in the stalk tissue. As the larvae mature, they tunnel down through the stem pith towards the crown of the plant. Once there, they tunnel out an overwintering chamber.

Sunflower Bud Moth

Suleima helianthana

These small moths have a 16-18 mm wing span and gray-brown forewings that have two dark transverse bands. The first band will extend across the middle of the wing and the second band is located near the wing tip. They overwinter as pupae in the stem of sunflower plants so residue management becomes an important way of reducing their numbers. In Saskatchewan, there are two generations per year. Eggs are laid on the terminals of immature sunflowers or on the receptacle of mature sunflowers. Adults feed on nectar of flowers. No scouting or economic thresholds have been established.



Sunflower Budworm point of entry



Head damage from Sunflower Budworm



Thistle caterpillar

(Painted Lady butterfly larvae) and its accompanying frass

Larvae feed selectively on foliage leaving the stem and midrib. Economic threshold levels are 25% defoliation provided the majority of the larvae are less than 1.25 inches long. Once the majority of the larvae are fully grown, most of the feeding damage will already been done. Spraying is not generally warranted.

Painted Lady butterfly

Vanessa cardui





Lygus bug adult and juveniles

Distinguishable by the triangular or “V” – shaped marking in the upper centre of their backs and membranous wingtips, the 6mm long adult can be pale green to reddish brown to black in appearance. Overwintering as adults in plant debris, adults migrate into crops in the spring and summer to lay eggs on stems. Adults are strong fliers and feed on new growth by using their piercing sucking mouthparts to extract plant juices. One generation per year in colder climates is the norm. Economic thresholds are one lygus bug/ per nine heads.



Grasshopper species

Grasshoppers are capable of feeding on both the leaves and the developing seeds of sunflower. Economic thresholds are 8 adults per square yard.

Diseases



Sclerotinia

Sclerotinia wilt, basal stem rot and head rot of sunflower are all caused by the fungus *Sclerotinia sclerotiorum*. All three diseases are caused by the same fungus but are differentiated by the fungal stage causing infection as well as the plant part infected.

S. sclerotiorum over winters as hard, black and irregularly-shaped fungal structures known as sclerotia which can survive in or on the soil surface for up to 4 years. In the spring the sclerotia germinate in one of two ways to produce either mycelia or mushroom-like structures known as apothecia. The mycelia are capable of directly infecting sunflower roots to cause wilt or basal stem rot. The earlier the plant is affected the more severe the yield losses will be. Wilt may occur at any stage of growth but will be most obvious during flowering and seed development. A characteristic symptom of this disease is the wilting of all leaves within a few days of infection. As the disease progresses root rotting and wet lesions that are covered with white mycelium may be present at the stem base.

Head rot occurs when the sclerotia germinate to produce apothecia. The apothecia release windborne spores known as ascospores which initiate infection of the head and stem tissue. Head rot is favoured under wet conditions which are required for apothecial formation and disease development. Head and stem rot will often first appear as a water-soaked spots or bleached areas on the back of the head. Disease is favoured under cool conditions and can result in complete destruction of the affected tissues. When disease is severe, the affected tissue, seeds and sclerotia formed within the infected tissue will fall to the ground. The remaining tissue will appear shredded and may be covered with white mycelia.



The best method for control is crop rotation. Crop rotation away from susceptible hosts can be used to prevent the buildup of inoculum. Susceptible hosts to infection by *S. sclerotiorum* include most broadleaved crops such as canola, lentils, and soybean. When possible follow a 5 year rotation away from susceptible crops. To reduce the risk of head rot wide row spacing can be used to maximize air circulation.

Harvesting

Fall frosts help to dry down the crop therefore sunflowers are usually the last crop harvested. When the backs of the heads have turned yellow and the bracts around the head have turned brown they have reached physiological maturity, even though portions of the stem and leaves may still be green. At this point the seed moisture will be about 40%. The yield and oil content will have reached their maximum and will not be affected by frost. The crop will not be ready to harvest until the moisture content of the seed has dropped to 12 to 15%. Harvesting at 20% moisture helps reduce risk of losses due to birds, disease and fire but the crop will require drying.



Harvest tip: Depending on sunflower variety and environmental conditions, harvesting at higher moisture levels leads to gumming in the combine creating harvest difficulties. This can be overcome by waiting for additional dry-down of the plant.



Harvesting before full maturity can reduce seed size and oil content

Harvest tip: A fairly accurate way to estimate the moisture is to use a 75-gram sample instead of 150 gram sample. Using a moisture meter sunflower chart, you multiply the moisture reading by two (2). A five head representation sample will be fairly precise. Confection varieties are so tall a drone may assist in establishing where to select the 15-20 head sample.

Sunflowers are usually straight combined. Conventional straight-cut headers with minor modifications to prevent seed loss can be used instead of row crop headers. Pans bolted onto the front of the header are inexpensive and greatly reduce losses from dropped heads. Some producers have used crop lifters instead. Sunflower reels can be purchased which stop the heads from being caught or being thrown over. Another option is to use bat reels and operate them as high as possible. When combining, a forward speed of 3-5 miles per hour is suitable for most harvest conditions. A low cylinder speed should be used for a dry crop. Excessive cylinder speed may result in cracking, de-hulling and breakage of seed.



Caution: fire potential can be minimized by blowing the fine hairs and dust off the engine, the exhaust manifold, exhaust areas, engine compartments, and lights. Extra caution should be used to keep the radiator from plugging.

Storage

Sunflower is safe to store at 9.5% moisture or less. Seed should be aerated at 10 to 12% moisture or if combined warm. Sunflower seeds aerate very well, due to their large seed size and low bushel weight.

Straight aeration can be an efficient way to reduce moisture levels. Night time aeration is more ideal than during day time.

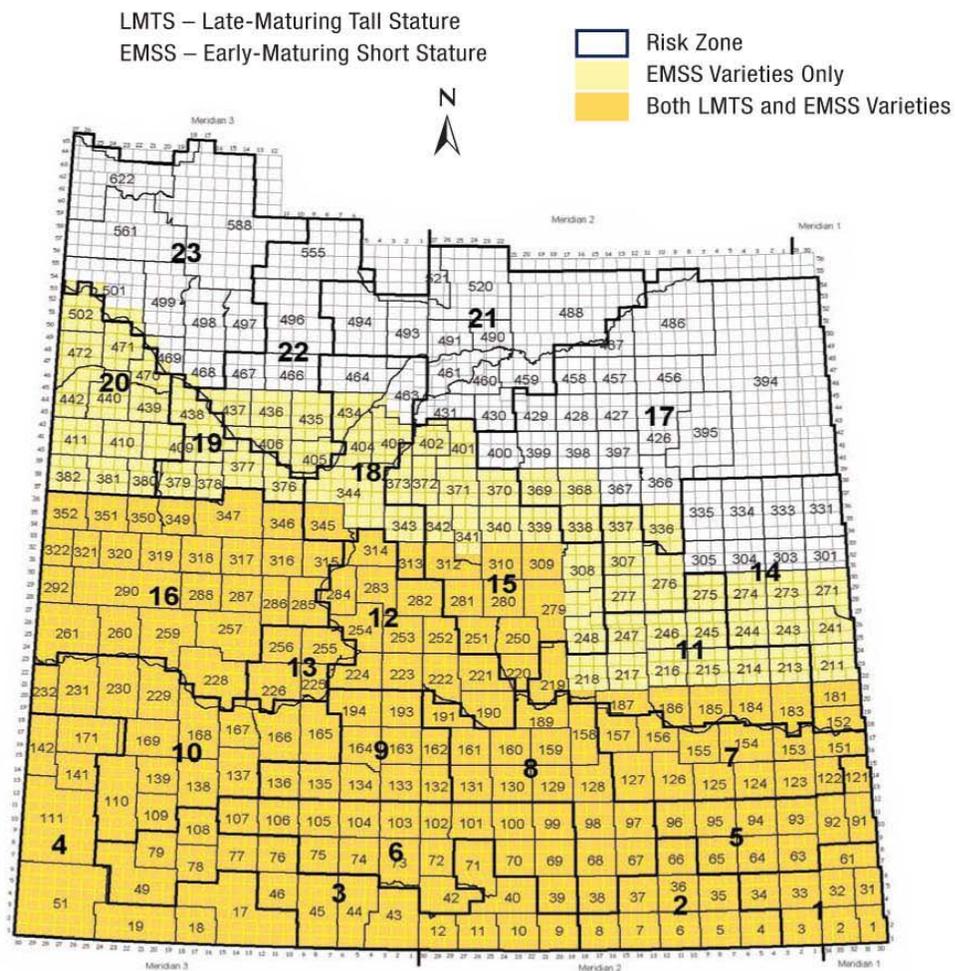
Seeds with moisture content over 12% require drying. Caution should be exercised when using a grain dryer as the fine hairs on the seed ignite easily. Bin dryers should be operated at 33° C (91.4° F) and batch dryers at 50-60° C (122-140°F). Experienced growers usually delay harvest until the sunflowers no longer require drying.



Crop Insurance

Saskatchewan Crop Insurance Corporation (SCIC) insures sunflower production in certain areas of the province. If you want crop insurance coverage check with your local Customer Service SCIC office to make sure your farmland is in the insurable area and that the variety you grow is eligible for insurance in that area.

Sunflower Insurable Area



Marketing

There are three main markets for sunflowers: human food (confectionery), oil for human-consumption (oil-type) and feed for wild birds (oil-type). When sunflowers are grown for the human food market seed size is an important quality and economic factor. The Canadian Grain Commission has established standards for both oil and confectionary types. The distance to a crushing plant for oil-type sunflower growers is important due to the low bulk density of sunflowers which increases the cost of transportation. The nearest processing plants that crush sunflower seed are near Fargo and Enderlin, North Dakota. The establishment of small crushers using physical methods to extract oil may present opportunities for producers that can find a niche market for fresh sunflower oil. The current trend of consumers looking for locally grown food may increase the potential of this value-added approach.

Sunflower prices for birdseed can be 1 to 2 cents per pound higher than the price paid by the oil crushing facility. The price at the crushing plant is determined by the international price of oil for human consumption. There are a number of facilities that process sunflowers for bird feed across southern Manitoba, Saskatchewan and Alberta. These markets can be dealt with directly or through various grain brokers. There is a potential market for feeding, both dairy and beef cattle for production of specialty dairy and meat products.

Useful Resources

Production Web Links:

- [NDSU www.ag.ndsu.edu/pubs/plantsci/rowcrops/eb25w-2.htm](http://www.ag.ndsu.edu/pubs/plantsci/rowcrops/eb25w-2.htm)
- [NSAC www.canadasunflower.com/pdf/ProductionGuide.pdf](http://www.canadasunflower.com/pdf/ProductionGuide.pdf)

Manuals

- Sunflower Production Manual: NDSU Extension Service, N.D. Agricultural Experimental Station, North Dakota State University, revised September 2007
- The Sunflower Production Guide: Manitoba Agriculture, Winnipeg 1996
- Sunflower Technology and Production: Schneiter, A. A. ed. 1997: Sunflower Technology and Production. Madison, WI, ASA, CSSA, and SSSA.
- Sunflower Seed Crops: Agriculture and Agri-Food Canada, 1981.
<http://www.archive.org/details/sunflowerseedcro00otta>
- Practical Guide to Sunflower Production: Saskatchewan Wheat Pool 1985.

Research Reports:

- Saskatchewan Sunflower Co-op Trial Report: Testing of New Hybrid Sunflowers across Saskatchewan. Saskatchewan Sunflower Committee.
- ADOPT Report: Demonstration of Seeding Rates for Sunflowers in Saskatchewan. Saskatchewan Sunflower Committee. 2015
- ADOPT Report: Demonstrability of the Nitrogen Response of Hybrid Sunflowers Across Saskatchewan. Saskatchewan Sunflower Committee. 2010
- Guide To Crop Protection: Saskatchewan Ministry of Agriculture, annual publication
- Varieties of Grain Crops: Saskatchewan Ministry of Agriculture, annual publication
- Specialty Crop Report: Saskatchewan Ministry of Agriculture, annual publication
- Crop Planning Guide: Saskatchewan Ministry of Agriculture, annual publication

Additional Reading:

- Angadi, S. V. and M. H. Entz, 2002: Agronomic performance of different stature sunflower cultivars under different levels of interplant competition. Canadian Journal of Plant Science 82, 43-52.
- Beckie, H. J. 2009. Herbicide-resistant weeds on the march in Alberta. Proc. Agron. Update Conference, Lethbridge, AB. In press
- Beckie, H. J. and S. A. Brandt, 1996: Sunola Response to Nitrogen fertilization. Canadian Journal of Plant Science 76, 783-789.
- Corp, W. G. S., 1994: Sunola production guide. Western Grower Seed Corp.
- Gubbels, G. H. and W. Dedio, 1986: Effect of plant density and soil fertility on oilseed sunflower genotypes. Canadian Journal of Plant Science 66, 521-527.
- Gubbels, G. H. and W. Dedio, 1990: Response of early-maturing sunflower hybrids to row spacing and plant density. Canadian journal of plant science = Revue Canadienne de phytotechnie 70, 1169-1171.
- Halvorson, A. D., A. L. Black, J. M. Krupinsky, S. D. Merrill and D. L. Tanaka, 1999: Sunflower Response to Tillage and Nitrogen Fertilization under Intensive Cropping in a Wheat Rotation. Agron J 91, 637-642.

- Harter, A. V., K. A. Gardner, D. Falush, D. L. Lentz, R. A. Bye and L. H. Rieseberg, 2004: Origin of extant domesticated sunflowers in eastern North America. *Nature* 430, 201-205.
- Holt, N. W. and R. P. Zentner, 1985: Effect of plant density and row spacing on agronomic performance and economic returns of non-oilseed sunflower in Southeastern Saskatchewan. *Canadian Journal of Plant Science* 65, 501-509.
- May, W. E., Y. Gan, S. Brandt, H. R. Kutcher and G. P. Lafond, 2008: Adaptation of oilseed crops in Saskatchewan 2009 Soils and Crops *pp.* 1-9. University of Saskatchewan, Saskatoon, SK.
- Manitoba Agriculture Services Corporation, 2008. Database (not online)
- National Sunflower Association, 2008 www.sunflowerlsa.com/stats
- Robinson, R. G., J. H. Ford, W. E. Lueschen, D. L. Rabas, D. D. Warnes and J. V. Wiersma, 1982: Response of sunflower to uniformity of plant spacing. *Agronomy Journal* 74, 363-365.
- Seiler, G. J. and L. H. Rieseberg, 1997: Systematics, origin, and germplasm resources of the wild and domesticated sunflower. In: A. A. Schneiter ed. *Sunflower Technology and Production*. *pp.* 21-65. ASA, CSSA, and SSSA. Madison, WI.
- Sposaro, M. M., C. A. Chimenti and A. J. Hall, 2008: Root lodging in sunflower. Variations in anchorage strength across genotypes, soil types, crop population densities and crop developmental stages. *Field crops research* 106, 179-186.
- Walley, F.L. and R.J. Soper, 1985. Fertilizer Technology in Special Crop Production: Project 208. Canada/ Manitoba Subsidiary Agreement on Value-Added Crops Production. Zubriski, J. C. and D. C. Zimmerman, 1974: Effects of nitrogen, phosphorus, and plant density on sunflower. *Agronomy Journal* 66, 798-801.

Sunflower Moisture Chart – Courtesy of Canada Grain Commission



Canadian Grain Commission
Commission canadienne
des grains



CONVERSION TABLE
MODEL 919/3.5 MOISTURE METER
SUNFLOWER

SAMPLE / ÉCHANTILLON
150 g
Calibrate at 73 \ Calibrer à 73

TABLEAU DE CONVERSION
HUMIDIMÈTRE DE MODÈLE 919/3.5
TOURNESOL

Meter Reading	TEMPERATURE °C TEMPÉRATURE																														Relevé d'humidité
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30											
	MOISTURE %															TENEUR EN EAU															
61.0	16.8	16.7	16.6	16.5	16.4	16.2	16.1	16.0	15.9	15.8	15.7	15.5	15.4	15.3	15.2	15.1	14.9	14.8	14.7	14.6	61.0										
62.0	17.0	16.9	16.7	16.6	16.5	16.4	16.3	16.1	16.0	15.9	15.8	15.7	15.6	15.4	15.3	15.2	15.1	15.0	14.8	14.7	62.0										
63.0	17.1	17.0	16.9	16.8	16.7	16.5	16.4	16.3	16.2	16.0	15.9	15.8	15.7	15.6	15.4	15.3	15.2	15.1	15.0	14.8	63.0										
64.0	17.3	17.2	17.0	16.9	16.8	16.7	16.6	16.4	16.3	16.2	16.1	15.9	15.8	15.7	15.6	15.5	15.3	15.2	15.1	15.0	64.0										
65.0	17.4	17.3	17.2	17.1	16.9	16.8	16.7	16.6	16.5	16.3	16.2	16.1	16.0	15.8	15.7	15.6	15.5	15.3	15.2	15.1	65.0										
66.0	17.6	17.5	17.3	17.2	17.1	17.0	16.8	16.7	16.6	16.5	16.3	16.2	16.1	16.0	15.8	15.7	15.6	15.5	15.3	15.2	66.0										
67.0	17.7	17.6	17.5	17.4	17.2	17.1	17.0	16.9	16.7	16.6	16.5	16.4	16.2	16.1	16.0	15.8	15.7	15.6	15.5	15.3	67.0										
68.0	17.9	17.8	17.6	17.5	17.4	17.3	17.1	17.0	16.9	16.7	16.6	16.5	16.4	16.2	16.1	16.0	15.8	15.7	15.6	15.5	68.0										
69.0	18.1	17.9	17.8	17.7	17.5	17.4	17.3	17.1	17.0	16.9	16.8	16.6	16.5	16.4	16.2	16.1	16.0	15.8	15.7	15.6	69.0										
70.0	18.2	18.1	17.9	17.8	17.7	17.6	17.4	17.3	17.2	17.0	16.9	16.8	16.6	16.5	16.4	16.2	16.1	16.0	15.8	15.7	70.0										
71.0	18.4	18.2	18.1	18.0	17.8	17.7	17.6	17.4	17.3	17.2	17.0	16.9	16.8	16.6	16.5	16.4	16.2	16.1	16.0	15.8	71.0										
72.0	18.5	18.4	18.2	18.1	18.0	17.8	17.7	17.6	17.4	17.3	17.2	17.0	16.9	16.8	16.6	16.5	16.4	16.2	16.1	16.0	72.0										
73.0	18.7	18.5	18.4	18.3	18.1	18.0	17.9	17.7	17.6	17.4	17.3	17.2	17.0	16.9	16.8	16.6	16.5	16.3	16.2	16.1	73.0										
74.0	18.8	18.7	18.5	18.4	18.3	18.1	18.0	17.9	17.7	17.6	17.4	17.3	17.2	17.0	16.9	16.8	16.6	16.5	16.3	16.2	74.0										
75.0	19.0	18.8	18.7	18.6	18.4	18.3	18.1	18.0	17.9	17.7	17.6	17.4	17.3	17.2	17.0	16.9	16.7	16.6	16.5	16.3	75.0										
76.0	19.1	19.0	18.8	18.7	18.6	18.4	18.3	18.1	18.0	17.9	17.7	17.6	17.4	17.3	17.2	17.0	16.9	16.7	16.6	16.4	76.0										
77.0	19.3	19.1	19.0	18.9	18.7	18.6	18.4	18.3	18.1	18.0	17.9	17.7	17.6	17.4	17.3	17.1	17.0	16.9	16.7	16.6	77.0										
78.0	19.4	19.3	19.1	19.0	18.9	18.7	18.6	18.4	18.3	18.1	18.0	17.8	17.7	17.6	17.4	17.3	17.1	17.0	16.8	16.7	78.0										
79.0	19.6	19.4	19.3	19.2	19.0	18.9	18.7	18.6	18.4	18.3	18.1	18.0	17.8	17.7	17.5	17.4	17.3	17.1	17.0	16.8	79.0										
80.0	19.7	19.6	19.4	19.3	19.2	19.0	18.9	18.7	18.6	18.4	18.3	18.1	18.0	17.8	17.7	17.5	17.4	17.2	17.1	16.9	80.0										
81.0	19.9	19.7	19.6	19.5	19.3	19.2	19.0	18.9	18.7	18.6	18.4	18.3	18.1	18.0	17.8	17.7	17.5	17.4	17.2	17.1	81.0										
82.0	20.1	19.9	19.8	19.6	19.4	19.3	19.1	19.0	18.8	18.7	18.5	18.4	18.2	18.1	17.9	17.8	17.6	17.5	17.3	17.2	82.0										
83.0	20.2	20.1	19.9	19.7	19.6	19.4	19.3	19.1	19.0	18.8	18.7	18.5	18.4	18.2	18.1	17.9	17.8	17.6	17.5	17.3	83.0										
84.0	20.4	20.2	20.1	19.9	19.7	19.6	19.4	19.3	19.1	19.0	18.8	18.7	18.5	18.4	18.2	18.0	17.9	17.7	17.6	17.4	84.0										
85.0	20.5	20.4	20.2	20.0	19.9	19.7	19.6	19.4	19.3	19.1	19.0	18.8	18.6	18.5	18.3	18.2	18.0	17.9	17.7	17.6	85.0										
86.0	20.7	20.5	20.4	20.2	20.0	19.9	19.7	19.6	19.4	19.3	19.1	18.9	18.8	18.6	18.5	18.3	18.1	18.0	17.8	17.7	86.0										
87.0	20.8	20.7	20.5	20.3	20.2	20.0	19.9	19.7	19.5	19.4	19.2	19.1	18.9	18.8	18.6	18.4	18.3	18.1	18.0	17.8	87.0										
88.0	21.0	20.8	20.7	20.5	20.3	20.2	20.0	19.8	19.7	19.5	19.4	19.2	19.0	18.9	18.7	18.6	18.4	18.2	18.1	17.9	88.0										
89.0	21.1	21.0	20.8	20.6	20.5	20.3	20.2	20.0	19.8	19.7	19.5	19.3	19.2	19.0	18.9	18.7	18.5	18.4	18.2	18.0	89.0										
90.0	21.3	21.1	21.0	20.8	20.6	20.5	20.3	20.1	20.0	19.8	19.6	19.5	19.3	19.2	19.0	18.8	18.7	18.5	18.3	18.2	90.0										
91.0	21.4	21.3	21.1	20.9	20.8	20.6	20.4	20.3	20.1	19.9	19.8	19.6	19.5	19.3	19.1	19.0	18.8	18.6	18.5	18.3	91.0										
92.0	21.6	21.4	21.3	21.1	20.9	20.8	20.6	20.4	20.3	20.1	19.9	19.8	19.6	19.4	19.3	19.1	18.9	18.8	18.6	18.4	92.0										
93.0	21.7	21.6	21.4	21.2	21.1	20.9	20.7	20.6	20.4	20.2	20.1	19.9	19.7	19.6	19.4	19.2	19.0	18.9	18.7	18.5	93.0										
94.0	21.9	21.7	21.6	21.4	21.2	21.0	20.9	20.7	20.5	20.4	20.2	20.0	19.9	19.7	19.5	19.3	19.2	19.0	18.8	18.7	94.0										
95.0	22.0	21.9	21.7	21.5	21.4	21.2	21.0	20.8	20.7	20.5	20.3	20.2	20.0	19.8	19.6	19.5	19.3	19.1	19.0	18.8	95.0										
96.0	22.2	22.0	21.9	21.7	21.5	21.3	21.2	21.0	20.8	20.6	20.5	20.3	20.1	19.9	19.8	19.6	19.4	19.3	19.1	18.9	96.0										
97.0	22.4	22.2	22.0	21.8	21.7	21.5	21.3	21.1	21.0	20.8	20.6	20.4	20.3	20.1	19.9	19.7	19.6	19.4	19.2	19.0	97.0										
98.0	22.5	22.3	22.2	22.0	21.8	21.6	21.4	21.3	21.1	20.9	20.7	20.6	20.4	20.2	20.0	19.9	19.7	19.5	19.3	19.2	98.0										
99.0	22.7	22.5	22.3	22.1	21.9	21.8	21.6	21.4	21.2	21.1	20.9	20.7	20.5	20.3	20.2	20.0	19.8	19.6	19.5	19.3	99.0										
100.0	22.8	22.6	22.5	22.3	22.1	21.9	21.7	21.6	21.4	21.2	21.0	20.8	20.7	20.5	20.3	20.1	19.9	19.8	19.6	19.4	100.0										

TABLE NO. 3 • OCTOBER 1978
TABLEAU N° 3 • OCTOBRE 1978

CALIBRATION : Two stage, 103 °C, 3 h, Vacuum Oven
ÉTALONNAGE : Deux étapes, 103 °C, 3 h, Four à vide

Sunflower Moisture Chart continued – Courtesy of Canada Grain Commission