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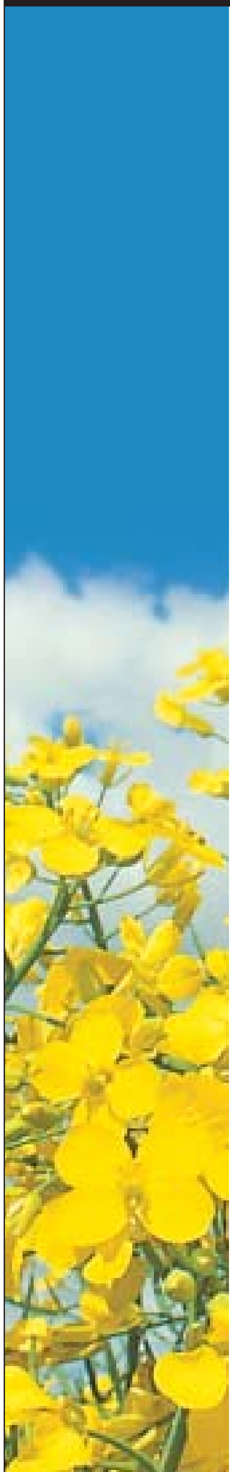
CANOLA ADVANTAGE

May 4, 2005



Tips for assessing spring frost damage in canola

One of the major factors affecting canola production in Western Canada is the short frost-free period - the number of days between the last freezing temperature (0°C) of the spring and the first frost in the fall.

The frost-free period varies considerably from location to location in Canada. The long-term average number of frost-free days is shown in Table 1. Significant variations usually occur on a local scale and extreme variations of the dates of spring and fall frost may occur from year to year.

Table 1. Average Dates of Last Spring and First Fall Frosts and Average Frost-Free Days

Area	Average Date of Last Spring Frost	Average Date of First Fall Frost	Average Frost-Free Days
Guelph, ON	May 17	September 27	132
Kemptville, ON	May 17	September 24	129
New Liskeard,ON	June 2	September 10	99
Kapuskaskin, ON	June 10	September 5	86
Morden, MB	May 14	September 27	129
Winnipeg, MB	May 16	September 25	123
Brandon, MB	May 19	September 19	108
Portage la Prairie, MB	May 11	September 29	131
Regina, SK	May 24	September 11	109
Watrous, SK	May 25	September 10	107
Saskatoon, SK	May 21	September 16	117
Indian Head, SK	May 27	September 15	110
Scott, SK	June 1	September 7	97
Melfort, SK	May 28	September 7	101
Lethbridge, AB	May 23	September 17	116
Olds, AB	May 24	September 11	109
Lacombe, AB	May 31	September 8	99
Ellerslie, AB	May 24	September 11	109
Vermilion, AB	June 1	September 9	100
Beaverlodge, AB	May 26	September 4	101
Fort Vermilion, AB	May 28	August 30	94

Although frosts can occur in any month, it is usually those in late spring and early fall that are critical. A killing frost during seed development or seed maturation is especially damaging. The amount of frost injury will depend on moisture conditions, rate at which thawing occurs, the growth stage of the plant, and the amount of cold temperature hardening the plant has experienced.

The temperature at which frost injury occurs varies with the plant's stage of growth, moisture content and the length of time the temperature remains below freezing. Frost cover (ice crystals) on a plant does not necessarily mean the plant has been damaged. Low temperatures injure plants primarily by inducing ice formation between or within cells. Water that surrounds the plant cells freezes first (at about 0°C), while the water within the cell contains dissolved substances that, depending on their nature and concentration, depress the freezing point of water several degrees.

As the water around the cells becomes ice, more water vapour moves out of the cell and into the spaces around the cell where it becomes ice. The reduced water content of the cells further depresses the freezing point of the cell water. This could continue, up to a point, without damaging the cell, but below a certain point, ice crystals form within the cell, disrupt the cell membrane and injure the cell.

The length of time of freezing temperatures is important. A severe drop in temperature which only lasts a very short time may not damage canola plants, while a light frost of a few degrees that lasts all night may cause severe damage.

After several days of near freezing temperatures, fall-sown and early spring-seeded canola will undergo a gradual hardening process that will allow the plants to withstand freezing temperatures without serious damage. It is likely that cold weather sets off a chain of plant gene activities that produce or degrade proteins that protect cells. Plants growing under these conditions are slower growing, producing smaller cells that have a higher concentration of soluble substances more resistant to frost damage.

Studies at the Universities of Manitoba and Saskatchewan and at Agriculture and Agri-Food Canada Beaverlodge Research Centre have shown that fall-sown and early-seeded canola seedlings that had undergone hardening could withstand -8 to -12°C temperatures. This would also explain why volunteer canola and other weeds such as winter annuals (e.g. stinkweed) have a high tolerance to cold temperatures in the spring.

Rapidly growing canola seedlings are more susceptible to frost damage than plants that are growing slowly under cold conditions, especially when there is ample moisture. Exposure to warm weather can cause cold hardened plants to lose frost tolerance and, similar to unhardened later-sown canola, be killed by temperatures of only -3 to -4°C. Canola at the cotyledon stage is more susceptible to frost damage than canola at the three- to four-leaf stage which can usually withstand a couple of degrees more frost.

Figure 1.

Figure 2.

Figure 3.

Canola seedlings will usually recover from a light spring frost that does not damage the growing point of the plant. A light frost that wilts the leaves but does not cause any browning, will not injure the plants. There may be some discoloration of the leaves, usually a yellowing or whitening especially under drought conditions. See Figure 1.

When a frost does blacken the cotyledons and/or leaves, no action should be taken for at least four to 10 days. See Figure 2.

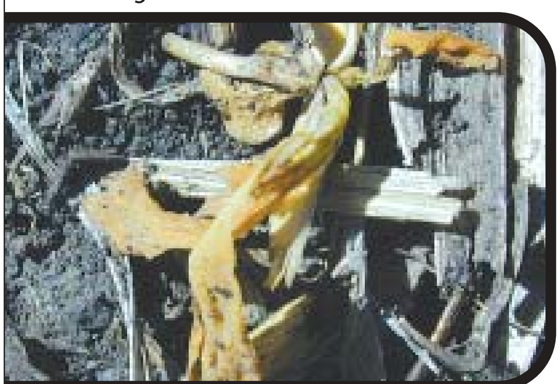
The extent of killing can be determined only by waiting several days following the frost. Time is required to determine the extent of the damage and whether or not the growing point has been killed. If there is any green colour at the growing point in the centre of the frozen leaf rosette, the plant will recover and yields will be higher than if the field is worked and reseeded. In a 2004, a Canola Council study of reseeding canola showed a 7.4 bushel loss compared to leaving the frosted crop. Economically, $72/acre would be lost in this reseeding situation.

Under good growing conditions, green re-growth from the growing point should occur in four to five days. Under poor growing conditions — cold and/or dry — this may take up to 10 days. See Figure 3.

Consider the percentage of plants killed, the percentage recovered, the weed population and the time of year when evaluating frost damaged seedling fields. See Figures 4 and 5.

Figure 4.

Figure 5.



To evaluate a frost damaged field, walk a diagonal path across the field and evaluate all plants in a 1/4 m^2 (3 ft^2) every 20 paces and note each sample. This should result in 50 to 100 samples. Calculate the percentage of the field that has adequate plant recovery. For example, 80% of the field has a minimum of 20 to 40 recovering healthy plants per m^2 (2 to 4 per ft^2) and a light and/or easily controlled weed population, and the remainder of the field has fewer plants. This field probably still has a higher yield potential than one that is reseeded, because it is likely that only the 20% with less than 2 to 4 plants per square foot will benefit significantly from reseeding.

With a moderate weed population that cannot be controlled, the reseeding threshold would increase because the competition limits the ability of the crop to compensate. The surviving plants will take advantage of the reduced competition for light, moisture and nutrients, and grow larger, producing more branches, pods and seeds per pod, compensating for the lost plants. The surviving plants will require longer to mature but a re-seeded crop will require an even longer frost-free period and have a greater risk of fall frost damage.

Frost damage to seedlings in the spring has never been more than a minor problem across Western Canada.

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