

Effects of Frost Damage on Canola (Rapeseed) in Canada

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INTRODUCTION

A widespread early fall frost on August 27, 1982, caused severe damage in the Western Canadian canola crop. The effects of this frost on the industry were so deleterious that it was decided to document the extent of the damage in relation to agronomic practices and the monetary losses involved. In turn, this could assist in evaluating the impact and provide documented mechanisms for assessing the impact of future frosts.

METHODS

Samples were obtained from 60 bins containing rapeseed harvested from the 1982 crops and located on farms within a 200 mile radius of Winnipeg. Agronomic information on the binned seed was obtained from the producer. Samples of pooled commercial lots were supplied by grain firms and crushing plants as a part of the Grain Research Laboratory's annual new crop survey. These samples were graded by inspectors of the Canadian Grain Commission, and samples were composited by grade and growing area. The data was used to determine the areas of Western Canada most severely affected by frost and to evaluate agronomic practices that could minimize the effect. Data on the amounts and grades of frost damaged seed delivered into primary

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elevators were obtained from a survey conducted by a major grain company. Also, data on the extent of frost damage and on agronomic conditions was gathered as a result of another project which was designed to correlate agronomic conditions with chlorophyll content using samples submitted to crushing plants as part of a continuing survey.

Minimum temperatures recorded during August 1982 at meteorological stations in Manitoba and Saskatchewan were obtained from the Atmospheric Environment Service of Environment Canada in Winnipeg. Minimum temperatures were plotted on a map of the region, and -5°C , -2°C and 0°C isotherms were constructed.

The provincial crop insurance corporations of Manitoba and Saskatchewan provided data on the potential insured acres, actual insured acres, claims by risk area, by crop and by damage and the premiums paid. Cost to the insurance company if all fields were insured was extrapolated from the actual cost and the numbers of insured acres.

Production and yield figures were obtained from Statistics Canada and grade distributions were provided by the Canadian Grain Commission. The Winnipeg Commodity Exchange supplied the price per tonne by grade. The loss to farmers in 1982 was determined using production figures to calculate the price received using grade distribution during 1982 minus the dollar value based on grade distribution for the past 5 to 10 years (1).

RESULTS AND DISCUSSION

Widespread frost can have enormous effects on the canola economy as shown in Table 1. It was necessary, therefore to obtain information on the extent of damage during 1982 in terms of the area and the decrease in yield for such acreage. The area devoted to canola in Western Canada is approximately 49 thousand square miles (1.3

million sq. km.; Fig. 1). Of this area, 90 thousand miles (233 thousand sq. km.) were affected by the frost on August 27, 1982. Based on 50 years' data, the probability of an early fall frost occurring in any one year is less than 10% (2). From plots of minimum temperature (Figure 1), isotherms from -2°C to -5°C coincided with the area where 50 to 100% of the canola graded No. 3 Canada Rapeseed as a result of frost damage.

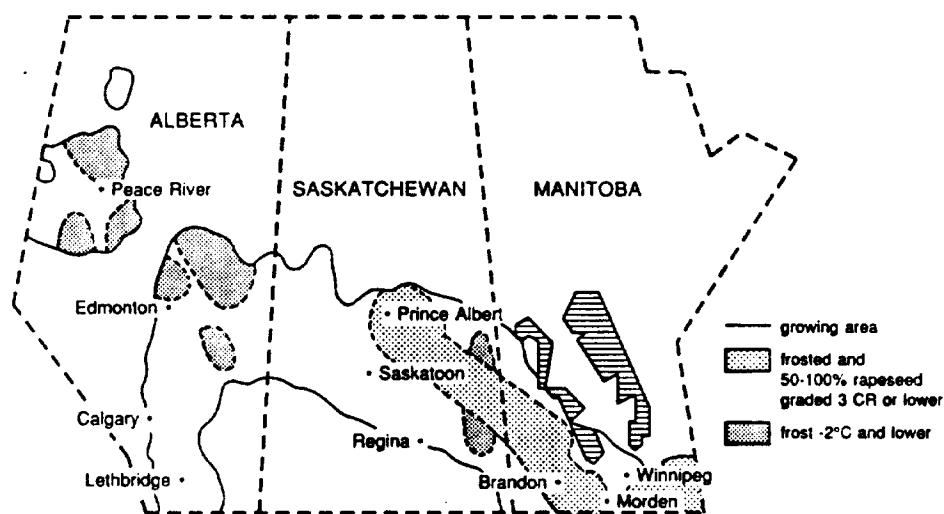


Figure 1. Map of Western Canada (Prairie Provinces) showing canola (rapeseed) growing area and area affected by frost where 50-100% of the canola (rapeseed) graded No. 3 Canada Rapeseed or lower.

TABLE 1. Economic Effects of Frost Damage on Canola

Area of Impact	Effects
National/Industry	<ul style="list-style-type: none"> - availability of high quality seed for crushing - availability of high quality seed for export - effect on future crop planning
Regional/Local	<ul style="list-style-type: none"> - effect of grade and price received - effect on storage of low quality seed - insurance coverage increased or no insurance coverage - effect on future crop planning

The effects of frost damage on canola depends upon the stage of maturity of the crop, the degree and duration of freezing temperatures, seed moisture content, the rate at which thawing occurs and the temperature of cold hardening (3). In 1982, temperatures of -2°C and lower occur when most of the Western Canadian canola crop was in a late stage of flowering or early stage of seed maturation and lasted

for approximately 5 hours. Seeds at a later stage of maturity may have escaped frost damage at these temperatures (3). The moisture content of individual crops at the time of freezing was unknown.

Despite the early fall frost, the overall average yield for Western Canada in 1982 was 1,245 kg/ha, higher than both the five and ten year averages (1). Conditions prior to the frost, however, had indicated the potential for an extremely high yielding crop, but the yield for Manitoba in 1982 was lower than the five year average. A survey conducted by the Grain Research Laboratory with a major crushing plant indicated that yields decreased from 1100 kg/ha to 600 kg/ha.

Quality was greatly affected by the frost damage that produced a higher proportion of lower grades, a major economic effect from a farm standpoint. According to a survey conducted by a country elevator company, frost damage was most severe in Manitoba with 73% of elevators purchasing or rejecting No. 3 Canada Rapeseed or lower compared with 61% in Saskatchewan. In 1982, only 32% of the canola crop graded No. 1 Canada at the country elevators, while 30% graded No. 2 Canada and 38% graded No. 3 Canada and lower. This represents a large change from the five year average (1977-1981) grade distributions of 70% No. 1 Canada Rapeseed, 21% No. 2 Canada and 9% No. 3 Canada and lower (4). Normally primary elevator operators are able to blend the small percentage of lower grade seed into high quality No. 1 Canada seed. However, in 1982 the large percentage of lower grade seed made blending impossible. As a result, export shipments of No. 1 Canada Rapeseed decreased from 98.3% (five year average) to 86% (1982) (5). Except for a relatively large carry-over of high quality seed from previous crop years, export shipments of No. 1 Canada canola would have been lower. Japan, the major buyer of Canadian canola, imported No. 2 Canada Rapeseed for the first time (2% of total shipments) while most of the other lower grade seed was shipped to Europe (5). Concern was expressed by importing countries about the

availability of No. 1 Canada Rapeseed seed and how the lower grades would affect crushing operations. These concerns were shared by Canadian crushing plants. All of the B. napus samples collected in another survey were affected to some degree by frost with only 54.6% of the samples falling into either No. 1 Canada or No. 2 Canada Rapeseed category. Samples grading No. 1 Canada and No. 2 Canada were from fields swathed before the frost on August 27, indicating that at this stage of development damage was less severe. In these cases, fields of canola had adequate time to complete pod development. Canola fields swathed three days earlier produced much higher proportion of seed that graded No. 1 Canada. The samples from fields swathed after the frost received lower grades and had higher chlorophyll levels (measure of immaturity).

The country elevator survey also revealed that later maturing B. napus cultivars, Altex and Regent, were more severely affected by frost than B. campestris cultivar, Candle. However, it was not clear whether these differences were due to the stage of development or a real difference in susceptibility to frost damage in the two species of canola. In Alberta, where 27.6% of canola acreage was seeded to Altex and 52.2% was seeded to Candle, the severity of frost damage for these two varieties was in the ratio of 17:2 (6). Of the 169 frost damaged canola samples from Manitoba and Saskatchewan, only six were B. campestris varieties. These results suggested a low probability of frost damage to the earlier maturing B. campestris varieties although the proportion of B. campestris planted in Manitoba and Saskatchewan was relatively low.

Reduced grades had a large effect on the cash value of the canola crop. Canola that graded No. 2 Canada Rapeseed sold for \$281/tonne (£130/T) while canola that graded Sample Canada Account Grade sold for \$150/tonne (£70.8/T). Using the grade distributions and production figures for 1982 for No. 1 Canada Rapeseed to Sample Canada Account

Grade, the estimated loss to the cash value of canola was calculated to be \$36.92 million (£17.09 million; Table 2).

TABLE 2. Price Received by Farmers for all Grades of Canola for 1982 Production as Compared to 1977-83 Production Figures

Grade	\$ per Tonne	1977-83		1982		* Difference \$
		Dist. % in grade	\$ * Mill.	Dist. % in grade	\$ * Mill.	
No. 1 Can.	281	70	426.49	32	194.97	231.52
No. 2 Can.	268	21	121.46	30	174.32	-52.86
No. 3 Can.	253	06	32.91	27	148.11	-115.20
Sample Can.	153	03	9.95	11	36.49	-26.54
Total			590.81		553.89	36.92

Loss = 36.92 million lost as a result of the 1982 grade distribution

\$ per tonne figures were for 1982 crop year (average)
* as per thousand tonnes

Canadian crushing plants were also affected by lower grades. One Canadian crushing plant estimated a \$9.2 million (£4.26 million) net loss on their oilseed operations for the fiscal year-end of March 31, 1983 (7).

Provincial crop insurance corporations were established to minimize losses to the farmers in poor years. However, in 1982 only about half of the farms in Manitoba and Saskatchewan were insured. In 1982, insurance payments for canola in Manitoba amounted to \$5.0 million (£2.3 million) or 29% of the total for all crops. Of this amount, 23% were for losses due to frost damage. The combined dollar loss due to frost damage for Manitoba and Saskatchewan in 1982 totalled \$8.75 million (£4.1 million), representing 66.3% of the total indemnities paid out to canola. This figure only represents those fields that were insured. The amount that would have been paid out if all crops were insured in Manitoba would be \$7.71 million (£3.6 million), and in Saskatchewan the value would be \$9.70 million (£4 million), totalling \$17.41 million (£8.1 million; Table 3).

TABLE 3. Insurance Coverage and Payout for Manitoba and Saskatchewan
1982

	Manitoba			Saskatchewan		
	All Crops /000	Canola /000	%	All Crops /000	Canola /000	%
Coverage	\$307,668 £142,439	\$28,475 £13,183	9.26	\$1,232,448 £570,578	\$54,202 £25,094	4.4
Paid out						
Total	\$ 17,003 £ 7,872	\$ 4,978 £ 2,305	29.30	\$ 72,912 £ 33,756	\$ 8,216 £ 3,804	11.3
Paid out						
Frost	\$ 11,900 £ 5,509	\$ 3,947 £ 1,827	79.30	\$ 19,894 £ 9,210	\$ 4,806 £ 2,225	27.3
= 66.3% of monies paid out was for frost damage						
1.95 x 3,946,552 = \$ 7,711,850 for Man. if all fields were insured						
2.01 x 4,805,594 = \$ 9,701,038 for Sask. if all fields were insured						
Paid out \$17,412,888 (£8.1 million) total if all fields were insured						

The total loss absorbed as a result of down-grading due to frost damage as opposed to a normal year for Manitoba and Saskatchewan was \$69.9 million (£32.4 million; Table 4).

TABLE 4. Total Dollar Loss for Manitoba and Saskatchewan as Per Crop Insurance Data and Production Data

	Manitoba	Saskatchewan
Total Value in 1982 =	\$ 109,531,801	\$ 164,097,666
Normal Value =	116,858,738	226,630,927
Loss =	7,326,937	62,533,261
Total Loss in Manitoba and Saskatchewan = \$69,860,196 (£32.4 million)		

CONCLUSION

Freezing temperatures in Western Canada during 1982 caused widespread damage over 90,000 square miles (23,300 sq. km.). The prolonged sub-freezing temperatures resulted in 832,916 tonnes of canola being graded No. 3 Canada or lower. The monetary losses associated with the frost have been estimated at \$70 million Canadian

or (£32.4 million) of which \$37 million (£17.13 million) were associated with the losses due to down-grading. However, this did not have a negative impact on the future crop plantings of canola as the area seeded to canola in 1983 increased by 23%.

The cardinal criteria required to assess the impact of future frost damage are:

- area affected
- temperature (-2°C or lower)
- duration
- stage of plant development from early flowering to swathing
(greatest impact in early flowering stage)
- field conditions (more impact with uneven stands)

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