

Hail – Nature's Costly Projectile

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Hail is one of the most shocking natural perils for farmers. In the space of minutes, a hailstorm can move across a field at 50 km/hr and transform the most robust field to one of complete devastation. It's estimated that in the worst Prairie hail zones, the average farmer will experience total crop losses due to hail an average of three times in their working life. Fortunately many areas of agro-Manitoba are below this risk level.

Hailstorms reportedly destroy approximately three per cent of Prairie crops each year. In Manitoba, insurance companies pay out roughly \$21 million dollars annually for hail losses.

Hailstones begin life as small frozen raindrops or snow crystals. They grow mainly by accreting supercooled (substantially lower than 0 C) liquid and air from the surrounding cloud as they are held aloft by strong updrafts. Only cumulonimbus clouds can produce hail. Cumulonimbus clouds have strong updrafts which can suspend developing hailstones inside. As accumulations grow on the originating snow crystal forms a small light snow pellet called graupel. Occasionally these snow pellets fall to the ground, but their low densities and soft wet texture keeps them from doing much damage. If this graupel continues to be kept aloft in the cloud and continues to grow by accreting supercooled liquid, it eventually becomes too heavy to be kept aloft by updrafts and falls to earth as the solid particles of ice we call hail.

Storms and Stones

On the Canadian Prairies, hail-damaged areas, called hail streaks, are typically between three and 20 km wide and 50 to 150 km long. The worst storms are usually those of long duration with long, narrow tracks. There is often a distinctive gradation to a hail streak with the largest hailstones usually occurring towards the centre. The worst of these storms can drop close to 300,000,000 cubic metres of ice. A hailstorm which hit Selden, Kansas in June, 1959 left an area 10 by 15 km wide covered in hailstones to a depth of 46 cm. Closer to home, an August 1956 hailstorm in the Wawanesa area left a pile 15.2 cm high.

Hailstones often vary from five to 10 cm or more in diameter. The most frequent size is pea size (about 1 cm diameter). The largest hailstone ever recorded fell in Bangladesh on April 14, 1986. It weighed

in at one kilogram. The largest hailstone ever recorded in the U.S. fell at Coffeyville, Kansas, on Sept 3rd 1970. It weighed 755 grams and had a diameter of 14.0 cm. The largest hailstone on record for Canada was 290 grams, falling on Cedoux, Saskatchewan, in August, 1973. Hailstones as large as 8.6 cm in diameter have been reported in Manitoba newspapers.

Although there are numerous hail factors influencing crop damage (kinetic energy, number of hailstones of relatively large diameter, momentum, mass, mean diameter, stones/sqM), damage appears to best correlated with maximum hailstone size. This can perhaps best be understood by considering the calculated terminal velocity of various size hailstones. For example it has been estimated that a one cm diameter hailstone would fall at 9 metres per second (m/s), but an 8 cm diameter hailstone would fall at 48 m/s (171 km/hr). The fastest a baseball can be thrown is 162 km/hr.

Hail Days of Summer

A regional hail risk measure termed "hail days" is often used by agrometeorologists. It is simply the number of days in a year that hailstorms can be expected. Kericho in Kenya, which is at 80 km south of the equator and at 2,200 metres elevation, holds the world record with 132 hail days a year. In the U.S. the "hail alley" along the Nebraska, Colorado and Wyoming borders typically has nine to 10 hail days a year. Central Alberta's "hailstorm alley", to the lee of the Rockies, and southernmost Saskatchewan east of the Cypress Hills, get hit by hailstorms on average four to six days each year. Most of southern Manitoba can expect three hail days per year. Because the susceptible stages of crops are only part of the hail season, most farmers in southern Manitoba only experience one to two hail damage days annually. As a whole Manitoba averages over 52 days of crop hail damage a year within an average hail damage season of 107 days. An average of 75 per cent of the total crop hail losses in Manitoba come from the five most damaging hailstorm days (roughly 10 per cent of storms).

Hail At Supper, Farmers Suffer

From an crop insurer's perspective Manitoba's worst hail year was 1994, when over \$49 million was paid out for hail losses in Manitoba. The next two worst years were 2000 (\$30 million) and 1989 (\$29 million). During the 32 years that

MCIC has offered hail insurance the three years with the least hail losses were 1998, 1972 and 1971. In recent years the average annual insurance payout in Manitoba due to hail damage on crops has been \$21 million.

In Manitoba, July is the peak month for hail, followed by June and then May or August. This is later than Alberta and Saskatchewan, where May and June are peak months. Although the peak period for hailstorms is in July, the peak crop damage period for hail in Manitoba is in August. This would indicate that storms are more vigorous in August, or more likely, crops are more susceptible to damage then.

About half of all hailstorms last six minutes or less and only about a quarter last more than 12 minutes. Most hailstorms occur during the daytime, primarily in the late afternoon. For Manitoba the peak time for hail is mid-afternoon, with nearly half of all hailstorms between noon and 6 pm. Another third of the storms occur in the next six hours, while early morning has the least occurrences. Crop hail claims show a late afternoon and early evening maximum, between 3 and 7 pm.

Manitoba's Hail Alley

In Manitoba, major hailstorms generally track from west to east, with the prevailing direction being from the northwest perpendicular to an advancing cold front. It is rare for a hailstorm to come from the south or east.

It wasn't too long ago that it was felt that Manitoba's southwest corner had the highest hail risk. This impression was in line with U.S. research that found that hail damage increased with elevation.

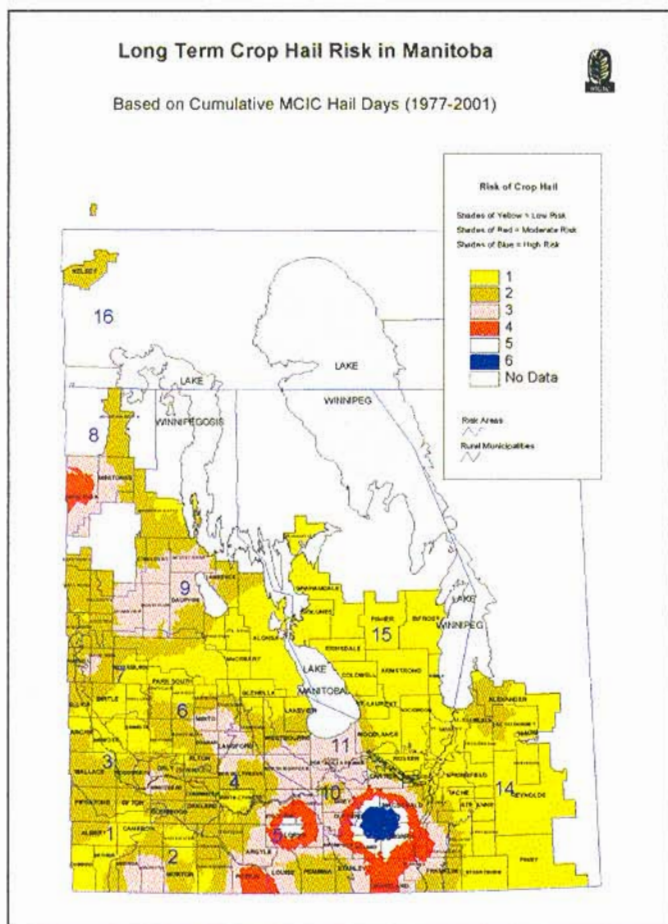
This has been found not to be true for Manitoba. Data over 23 years have been plotted from crop insurance claims on the "Long Term Crop Hail Risk in Manitoba" map on page 24. It shows some areas are particularly prone to hail damage. The worst region is in the Red River Valley, centred on the Homewood-Brunkild-Sperling area. The next worst area is centered on the Treherne-Holland-Swan Lake area. The Swan River region and Cartwright-Pilot Mound region are also hot spots.

The likely explanation for some of the high hail frequency areas in Manitoba is that they result from the uplift of easterly flows over the terrain. Since advancing air from the west is often warmer than the air it is moving towards, it can often be

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Long Term Crop Hail Risk in Manitoba

Based on Cumulative MCIC Hail Days (1977-2001)



...Hail – Nature's Costly Projectile *continued*

undercut by cooler "lowland" air pockets, and result in the warmer air mass being lifted. This forced ascent of warm air favors the buildup of thunderstorms, which frequently contain hail, to move east with the advancing fronts. This process creates a preferred area for hail, particularly when the process is further aided by the provision of further lift, say flow over a hill.

Crop hail damage is least in regions near and southeast of lakes Manitoba and Winnipeg, likely because of their buffering affect on daytime heating which reduces the atmospheric instability required for hail formation.

Although Manitoba has hot spots for hail, its random nature means that these hot spots do not occur every year. For example the "MCIC Recorded Hail Days" map shows the hail pattern for 2000. Not every long-term hot spot shows up and even when the hot spots do show up there are township portions with limited losses. In fact hail has been observed to occur on only one field, or even one portion of a field, in a region. This independence is the main reason why insurance coverage can be provided for this single peril, whereas it is not offered for other perils. Other reasons for single-peril hail insurance availability are that hail occurs at a relatively low frequency, it's loss impact can clearly be separated from bad management, and reinsurance support is available.

Had Hail – Now What

Predicting yield loss from hail is always difficult. Although early season defoliation appears quite devastating, research has shown that many plants can successfully recover under favorable conditions. Crops vary in susceptibility to hail damage. Hay and cereals are some of the crops most resistant to hail, whereas crops such as buckwheat, fababeans, peas and canola are quite susceptible.

No matter what the crop, if it is insured for adequate amounts of coverage, a minor to moderate hailstorm may not hurt the farmer's bottom line if the crop continues to be managed properly. One of the biggest mistakes a farmer can do following a hailstorm is to give up on a crop and not manage it properly – if anything, management becomes more critical.

If possible hail loss assessments should be delayed for a week to ten days because it is difficult to distinguish living and dead tissue immediately after a storm. Another reason is that some plants initially surviving after a storm may soon die because of disease infection at the sites of plant damage.

In fields with questionable stands there are often several things to consider before making a destroy or replant decision; (1) Date, (2) Population of plants that will survive, (3) Health and damage level of those plants, especially their roots and stems, (4) Size or frequency of skips? (5) Productive capability of the soil, (6) Do you have insurance to recover your costs to date? (7) What is the risk/benefit of a later planted or destroyed crop?

A crop hail adjustor can only assist you with estimates of some of this information — therefore the final decision is ultimately the farmer's. Additionally when taking hail adjustor appraisals into consideration it is important to recognize that adjusting appraisal formulas account for losses only at the time of the hail claim. Subsequent losses, such as those caused by delayed maturity or increased disease are not accounted for.

The speed of damage of hail makes it one of the hardest perils for producers to deal with emotionally. Hail occurs overnight whereas other perils like drought give farmers time to agonize and cope. Farmers facing hail damage must maintain perspective and apply their best judgement. Being proactive and purchasing hail insurance is one of the best ways a farmers can reduce their potential stress from hail losses — hail insurance can turn the "white plague" into the "white combine".

MCIC Recorded Hail Days in Manitoba 2000

