

CALCULATING RISK OF WINTER INJURY TO TREE FRUIT

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CRITICAL WINTER TEMPERATURES FOR FRUIT TREES

When you select a site for a new orchard planting, one of your first considerations should be the likeliness of mid-winter injury to your trees. Winter injury weakens a tree, leading to a decline in tree health and a shortened productive life. The critical mid-winter temperatures that damage fruit trees are as follows: -31°C to -35°C for apple, -25 for peach, -32 for apricot, and -26 for sweet cherry (Bill Shane, Michigan State). Continue reading to learn how to calculate the risk of winter injury in your region.

CONSIDER CANADIAN CLIMATE NORMALS

Climate normals are used to describe the expected climate of a region. This data is tracked by Environment Canada and averaged over time, and extreme weather events are reported. Visit the Environment Canada website to find Canadian climate normals for your nearest weather station: http://climate.weather.gc.ca/climate_normals/

Let's consider an example for Greenwood, NS (1981-2010):

1. Choose the tab **Normals Data** and look for the table **temperature**. In Greenwood, the extreme minimum temperature was -35.5°C on February 7, 1993 (Figure 1). This temperature would be expected to cause winter injury to apple trees.

▼ Temperature

1981 to 2010 Canadian Climate Normals station data

	Temperature												Year	Code
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
Daily Average (°C)	-5.5	-4.9	-0.7	5.3	11.2	16.2	19.7	18.9	14.5	8.7	4.0	-1.9	7.1	A
Standard Deviation	2.2	2.2	1.5	1.3	1.4	1.1	1.1	1.1	1.3	1.3	1.4	2.2	0.8	A
Daily Maximum (°C)	-0.6	0.3	4.3	10.6	17.4	22.4	25.8	25.1	20.6	14.2	8.3	2.6	12.6	A
Daily Minimum (°C)	-10.4	-10.0	-5.7	0.0	5.0	9.9	13.5	12.6	8.3	3.2	-0.5	-6.3	1.6	A
Extreme Maximum (°C)	18.8	17.8	24.3	30.3	33.8	35.0	35.6	37.2	34.1	27.8	23.0	19.5		
Date (yyyy/dd)	1999/ 24	2000/ 28	1998/ 31	2009/ 28	1992/ 22	1944/ 29	1949/ 30	1944/ 12	2010/ 01	1949/ 12	1982/ 05	2008/ 12		
Extreme Minimum (°C)	-28.9	-35.5	-27.2	-13.4	-7.2	-1.7	2.8	0.2	-4.4	-8.9	-16.2	-26.1		
Date (yyyy/dd)	1957/ 16	1993/ 07	1948/ 13	1995/ 05	1945/ 03	1945/ 03	1975/ 02	1978/ 25	1947/ 29	1948/ 23	1978/ 23	1947/ 26		

Figure 1. 1981 to 2010 Canadian Climate Normals station data for the temperature in Greenwood, NS.

2. What is the probability of such extreme temperatures? Look for the table **days with minimum temperature**. In Greenwood, the minimum temperature of less than -30°C occurred for an average of 0.07 days over 30 years (Figure 2).

▼ Days with Minimum Temperature

1981 to 2010 Canadian Climate Normals station data

Days with Minimum Temperature

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
> 0 °C	1.4	1.8	3.6	13.9	28	30	31	31	29.4	22.7	12.9	4.2	209.8	A
<= 2 °C	30.5	27.7	29.5	22.7	7.5	0.40	0	0.03	2.7	12.9	21.3	29.2	184.5	A
<= 0 °C	29.6	26.5	27.4	16.1	3	0	0	0	0.60	8.3	17.1	26.8	155.4	A
< -2 °C	27.6	24.3	22.6	8.4	0.47	0	0	0	0.07	4	11.6	23.2	122.3	A
< -10 °C	16.1	14.2	6.2	0.10	0	0	0	0	0	0	0.63	8.4	45.7	A
< -20 °C	2.3	1.6	0.47	0	0	0	0	0	0	0	0	0.30	4.7	A
< -30 °C	0	0.07	0	0	0	0	0	0	0	0	0	0	0.07	A

Figure 2. 1981 to 2010 Canadian Climate Normals station data for the average number of days with minimum temperature in Greenwood, NS.

CALCULATING THE PROBABILITY OF WINTER INJURY

You can determine the probability of winter injury in your region with a calculation. Begin by filling in the blanks and then follow the equation.

Critical mid-winter temperature of your crop = _____ (i.e. apples are damaged at approximately -30°C)

Average number of days with minimum temperature less than -30°C = _____ (i.e. Greenwood data shows an average of 0.07 days)

EQUATION

$$\text{Probability of winter injury in a given year} = \frac{\text{Number of days with temperature less than your critical temperature}}{30 \text{ (because days are given as a 30-year average)}} \times 100 \text{ (probability)}$$

For the Greenwood example, the probability of exceeding the critical mid-winter temperature of apple trees (approximately -30°C) in a given year is:

$$\text{Probability of winter injury to apple trees} = \frac{0.07}{30} \times 100 \quad \text{Probability of winter injury to apple trees} = \mathbf{0.23\%}$$

For the Greenwood example, the probability of exceeding the critical mid-winter temperature of peach trees (approximately -20°C) in a given year is:

$$\text{Probability of winter injury to peach trees} = \frac{4.7}{30} \times 100 \quad \text{Probability of winter injury to peach trees} = \mathbf{15.7\%}$$



OTHER CONSIDERATIONS

Remember that mid-winter injury is not the only consideration when you choose an orchard site. Injury from cold temperature is also a risk when trees blossom in early spring, when the flower buds can be damaged by temperatures below zero. Prior to establishing a new planting, you should consider features of your site like slope direction, air drainage, soil drainage, depth and fertility, and cropping history. For more information, review the ***Best Management Practices for Nova Scotia Apple Production*** available from Perennia: <http://www.perennia.ca/fieldservices/fruit-crops/tree-fruits/>.

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