Thunder Bay Weather Analysis (2003-2018)

The weather data for Thunder Bay (2003 to 2018) were obtained from Environment Canada website (https://weather.gc.ca) for each growing season from April to September every year and analyzed for some of the weather extremes such as the number of days when the day temperature exceeded 29°C and the night temperature exceeded 16°C. Such extreme temperatures cause flower and pod abscission in canola. The decimal values were rounded to the nearest integer. Data in figures 10, 11, 14 and 15 are from the TBARS/LUARS Annual Reports.

Number of days when the day temperature was below 0 °C:

On an average from 2003 to 2018, 39 days recorded below zero temperature (Figure 1). The highest and the lowest number of days with below zero temperature were 48 and 21 in the years 2013 and 2006, respectively. In most years the number of days with below zero temperature was close to the average (39 days). Subzero temperatures were usually recorded in the months of April, May and September. However, occasionally subzero temperature was recorded in June too. For example it happened one day each in June 2008, 2009 and 2018. Subzero temperature in June could be damaging to crops plants, especially the sensitive ones, such as corn and soybean. Usually, 25 out of 30 days in April had below zero temperature.

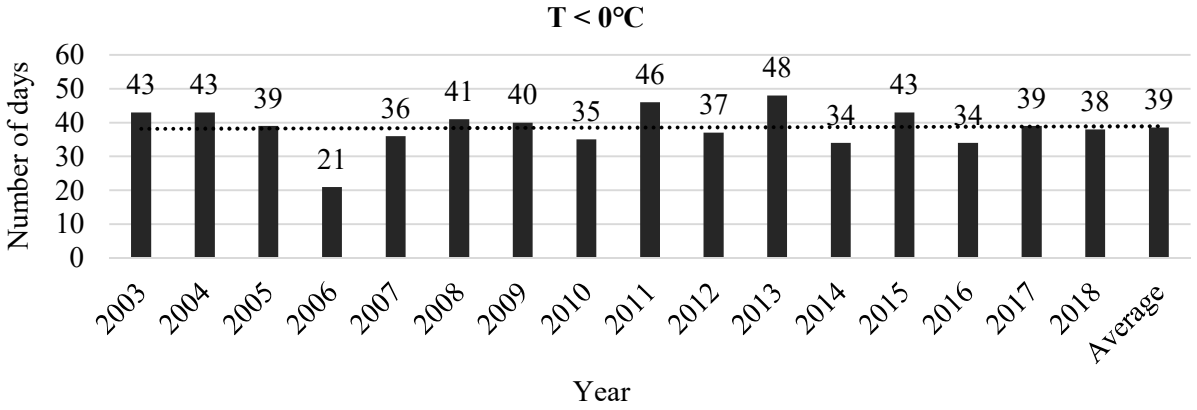

Figure 1: Number of days with day temperature < 0°C.

Number of days when the day temperature exceeded or was equal to 10°C:

Averaged over 2003 to 2018, on 161 days temperature exceeded or equaled 10°C (Figure 2). The highest and lowest number of days with temperature ≥ 10°C were 176 and 148 in the years 2010 and 2014, respectively. The number of days with temperature ≥ 10°C appeared to decline over time (2003-2018) with some exceptions. Is Thunder Bay becoming cooler? Corn and soybean are usually recommended to be seeded when the soil temperature reached 10°C. The number of days with temperature ≥ 10°C in May ranged from 22 (2015) to 31 (2012) with an average value of 26 days. May 2010, 2011 and 2016 had 29 days each with temperature ≥ 10°C. During all the years the day temperature was usually above 10°C during June to September, except in September 2003, 2008 and 2014 when 3 out of 30 days had day temperature below 10°C and in September 2012 on one day temperature fell below 10°C.

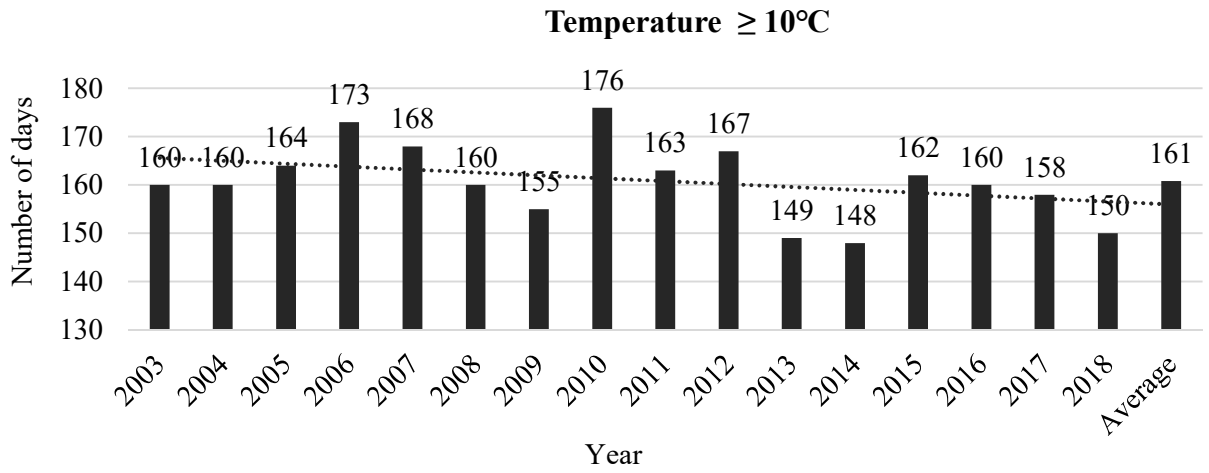

Figure 2: Number of days when the temperature exceeded or was equal to 10°C.

Number of days when the daytime maximum temperature was equal to 25°C:

The number of days with a daily maximum temperature equal to 25°C ranged from 0 (2014 and 2015) to 14 (2006) with an average value of 4 (Figure 3). Most of the time either the day temperature was below or above 25°C; 2003 and 2018 had an equal number of days (3) when day temperature equaled 25°C.

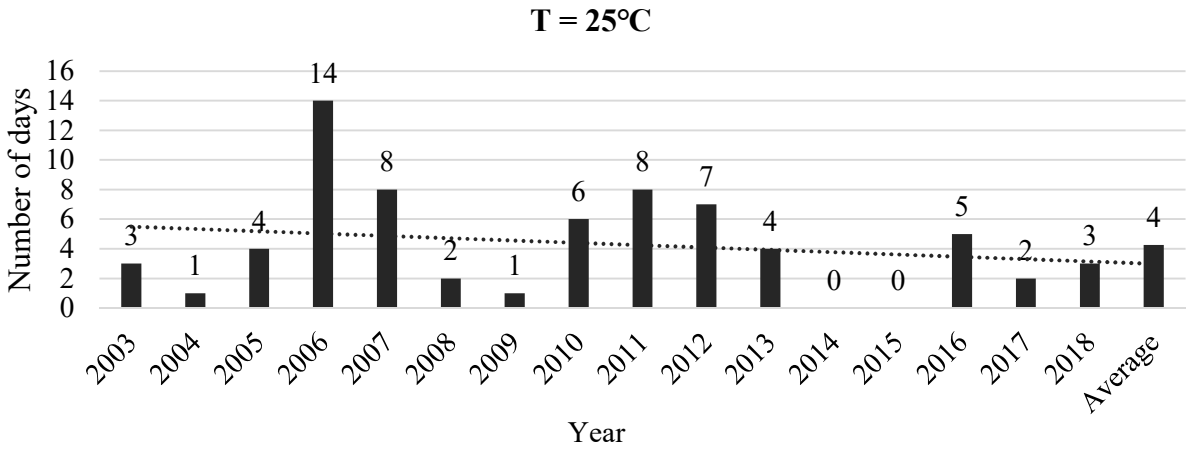

Figure 3: Number of days when the daytime maximum temperature was equal to 25°C.

Number of days when the daytime maximum temperature exceeded 29°C:

During the years 2003 to 2018, on an average seven days recorded daily maximum temperature above 29°C; which were highest (12) in 2005 and lowest (2 each) in 2004, 2014 and 2017 (Figure 4). The data depicted ups and downs in the number of days recording temperature above 29°C. Four out of 16 years equaled average (over 2003-2018). Such an extreme day temperature was recorded only in July during 2004 to 2006, 2014 and 2017, only in August in 2003 and 2009 and

during both July and August during rest of the years (2006, 2008, 2010 and 2011 to 2018). It seems that August has become hotter after 2006! As mentioned elsewhere in this report, this type of temperature would result in flower abscission and drying of young pods in canola.

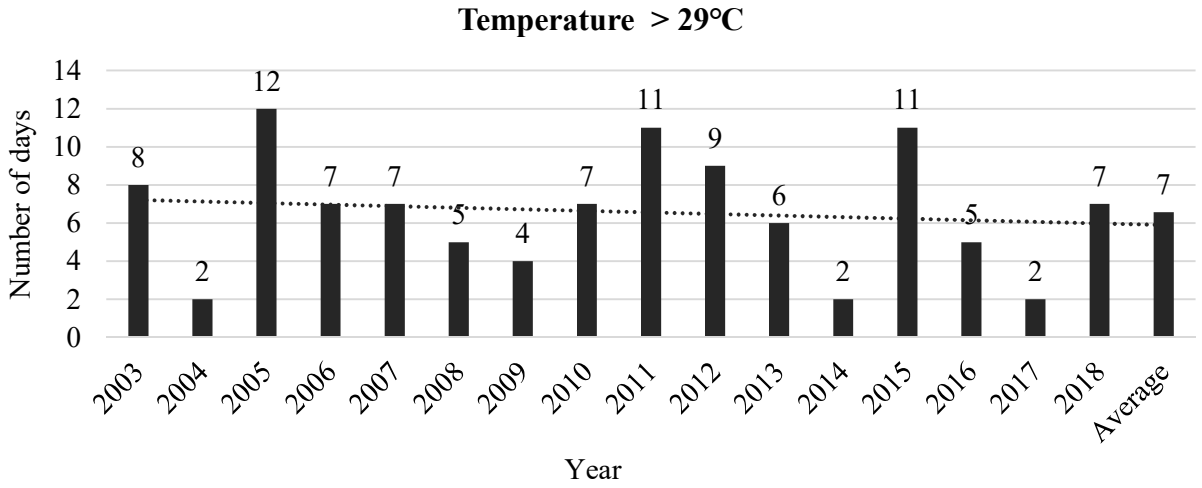

Figure 4: Number of days when the daytime maximum temperature exceeded 29°C.

Number of nights when the lowest temperature was equal to 16°C:

On an average, only two nights from 2003 to 2018 had temperature equal to 16°C (range 0 in 2004, 2006, 2008, 2016 and 2018 to 5 in 2011 and 2012) – Figure 5.

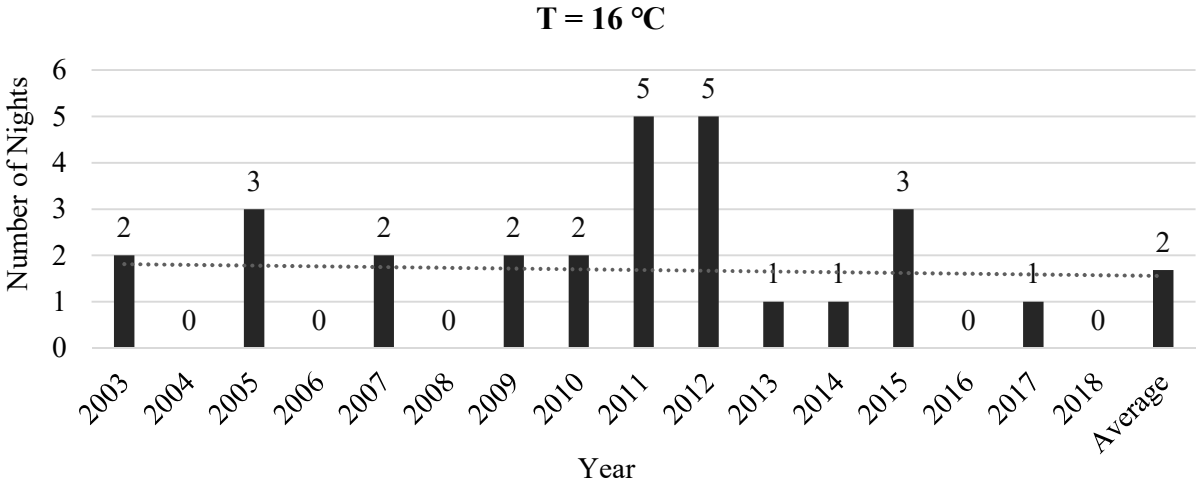

Figure 5: Number of nights when the lowest temperature was equal to 16°C.

Number of nights when the night temperature exceeded 16°C:

Over 2003 to 2018, only three nights recorded temperature higher than 16°C (Figure 6). The highest number of nights (10) exceeding 16°C temperature was recorded during the year 2006,

while the lowest number (zero nights) was recorded in the 2004, 2008, and 2009. The night temperature exceeded 16°C during the months of July and August coinciding with flowering and pod formation in canola. As mentioned elsewhere in this report, night temperatures exceeding 16°C (and day temperatures greater than 29°C) would result in flower abscission and drying of young pods in canola.

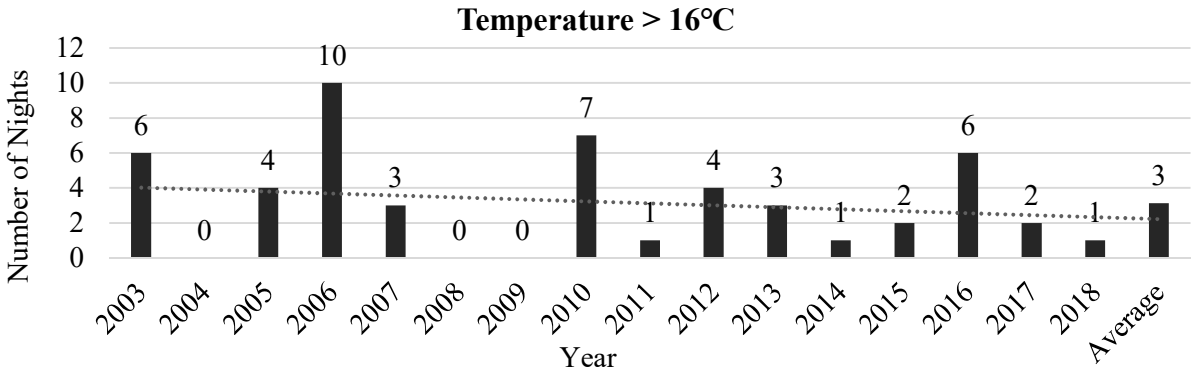

Figure 6: Number of nights when the night temperature exceeded 16°C.

Number of rainy days:

The number of rainy days during 2003 to 2018 varied widely from 35 days in 2016 to 104 days in 2017 with an average value of 63 (Figure 7). In 6 out of 16 years, the number of rainy days was more than the average. The period 2011 to 2016 had consistently lower than the average number of rainy days and exhibited a declining number of rainy days than most of the previous years. It is desirable to have well spread rain throughout the growing season! Of late wet fall, challenging harvesting, has been a concern. Total number of rainy days in September 2017 and 2108 were 16 (10 in September 2019) compared to only 6 in 2016.

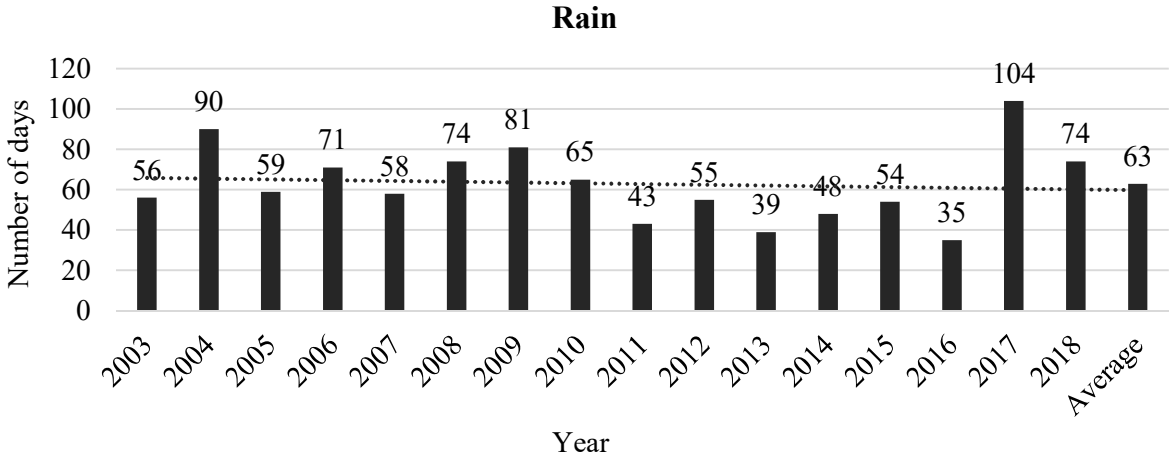

Figure 7: Number of rainy days.

Number of days with rainfall equal to 25mm per day:

Only two days in 2010 and one day in 2012 recorded rainfall equal to 25 mm (Figure 8).

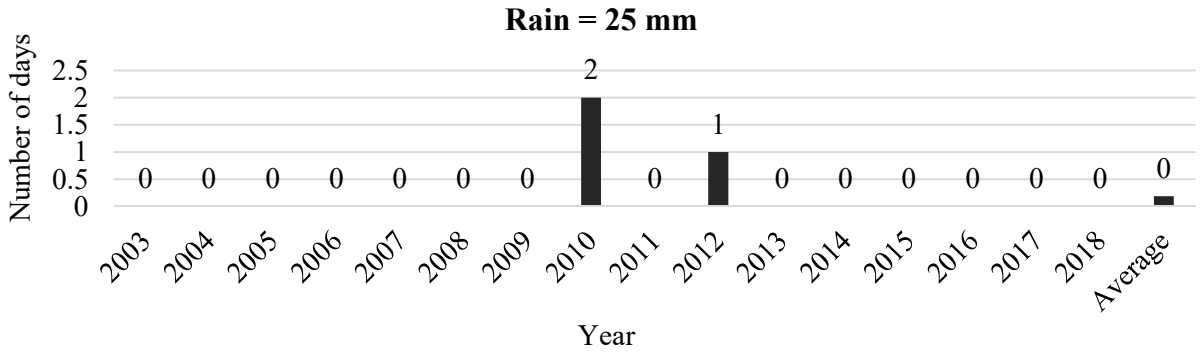

Figure 8: Number of days with rainfall equal to 25 mm.

Number of days when rainfall exceeded 25 mm in a single day:

On an average, there were only two days during 2003 to 2018 when rainfall exceeded 25 mm (range one day in 2010, 2011 and 2017 to 4 days in 2004, 2005 and 2012; Figure 9). Overall, there seems to be a declining trend in the number of days with rainfall exceeding 25 mm on a single day from 2004-2005 to 2017-2018.

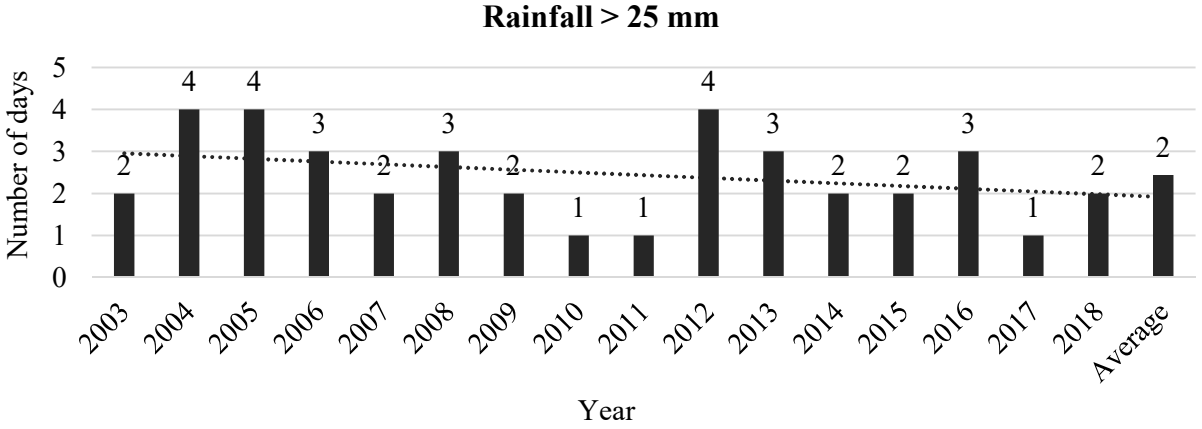

Figure 9: Number of days when rainfall exceeded 25mm/day.

Total Rainfall (May to September):

The highest total rainfall (498 mm) was recorded during 2013, and the lowest rainfall (285 mm) was recorded during 2009 (Figure 10). The sixteen-year average total rainfall during growing season was 389 mm, which matches with long term average rainfall of 392 mm. In 8 out of 16 years, rainfall was below 16 years average. In 7 out of 16 years, the total seasonal rainfall exceeded 400 mm. (Figure 10).

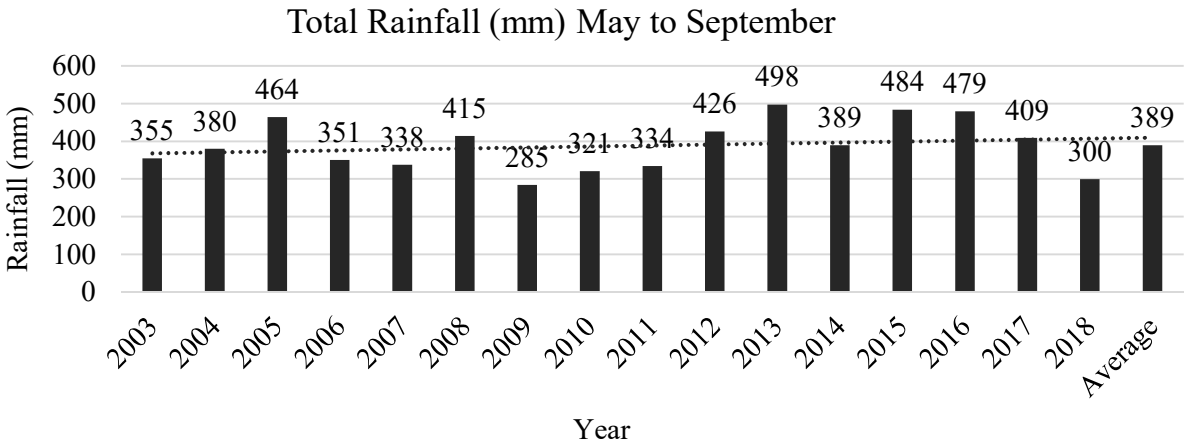

Figure 10: Total rainfall during the growing season (May to September; 2003-2018).

Rainfall and Sable wheat grain yield:

It seems that for the crop (wheat variety Sable) yield, 350 mm to 400 mm rainfall was ideal; the grain yields below or above this range of rainfall were relatively lower (Figure 11).

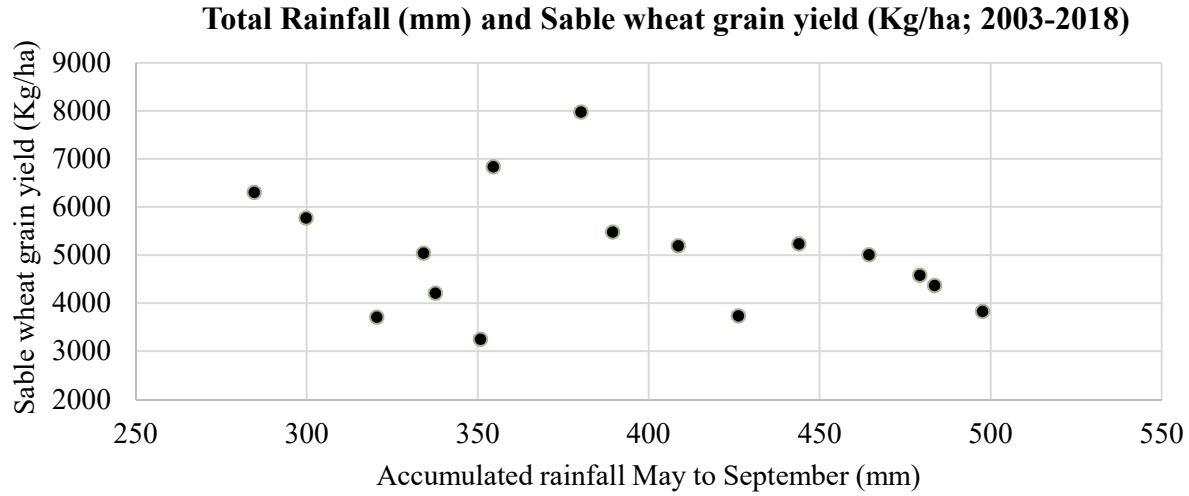

Figure 11: Sable wheat grain yield variation with total seasonal (May-September) rainfall.

Number of days when snowfall was recorded:

The number of days with snowfall from April to September during 2003-2018 ranged from zero in 2018 to 8 in 2013 with an average value of 3 (Figure 12). Snowfall occurred mostly in April and at times in May as well (2006 and 2013).

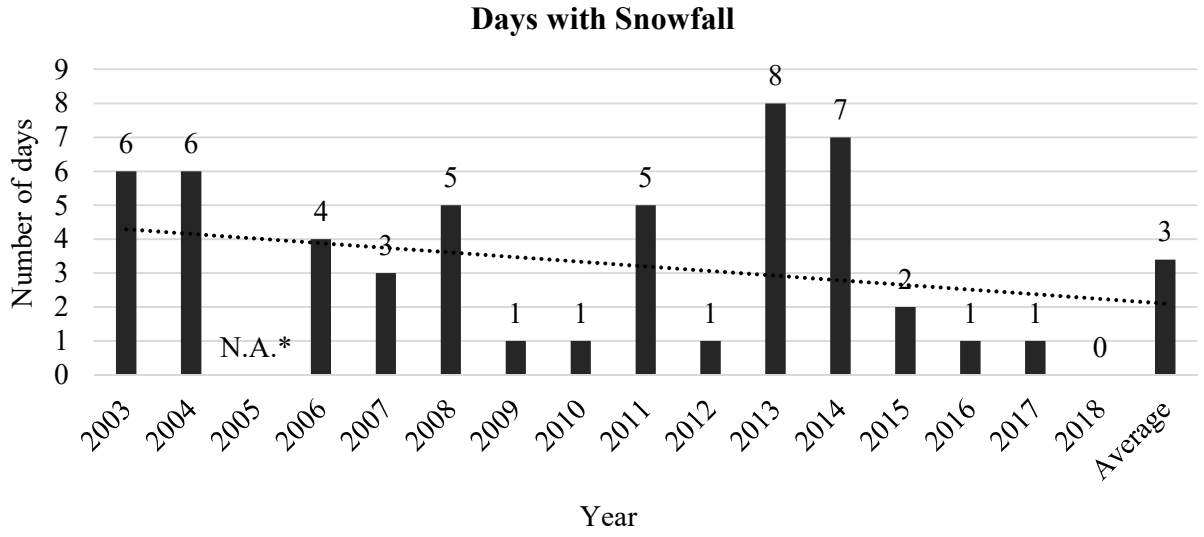

Figure 12: The number of days when snowfall was recorded. * N.A.: Data not available.

First killing frost date:

The earliest first killing frost date was recorded on September 6 in 2011 and latest on October 8 in 2017 (Figure 12). In 12 out of 16 years, killing frost was recorded on or after September 15.

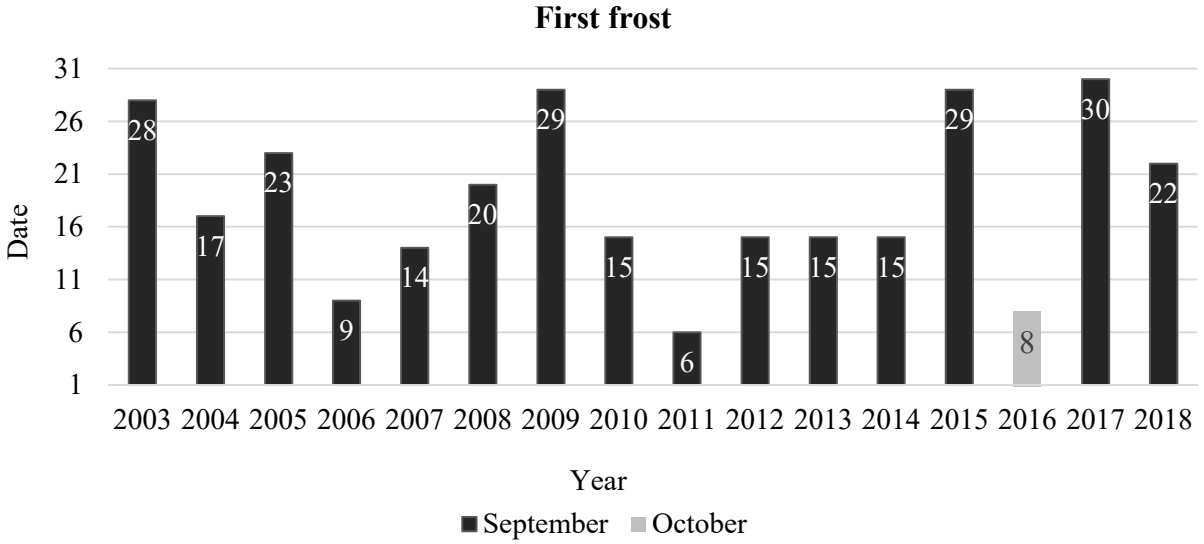

Figure 13: First killing frost date (2003 to 2018).

First Seeding Date:

The earliest spring seeding date varied from May 1 to May 23 (Figure 14). Up to 2012, in 5 out of 10 years we were able to start seeding before May 10. After 2012, there was only one year (2015)

when we were able to start seeding before mid May. In most of these later years, we weren't able to seed before May 17 (due to cold and wet springs). This delay in seeding is a matter of concern!

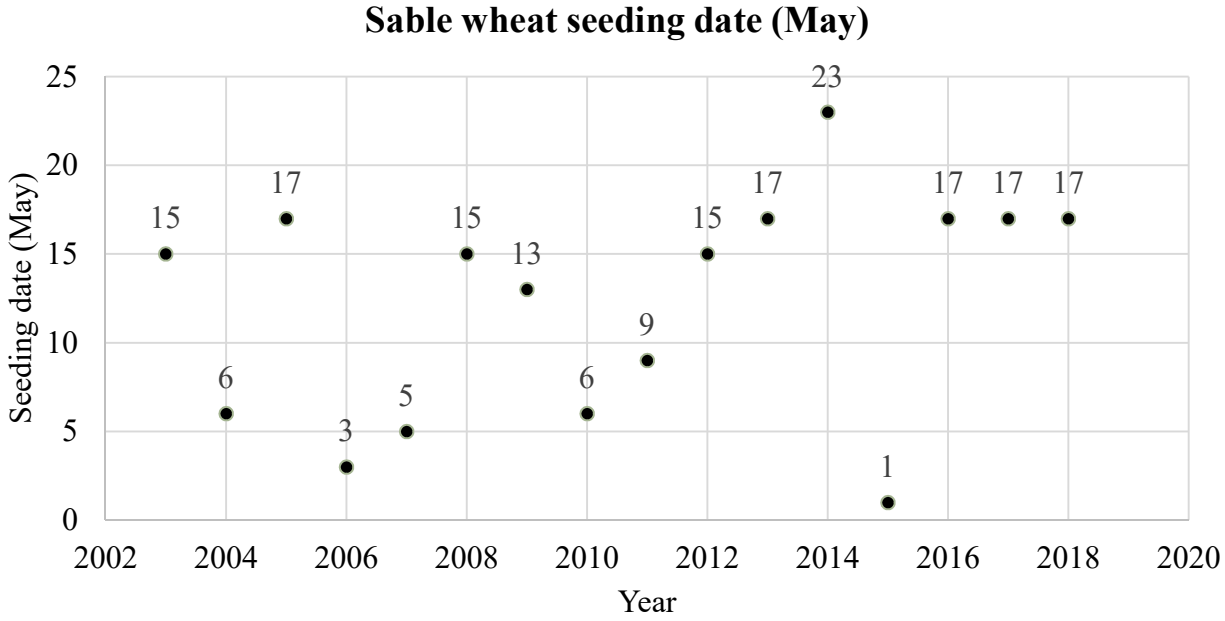

Figure 14: First seeding date (2003-2018)

CHU and GDD:

The CHU ranged from 1,204 in 2004 to 2,239 in 2016 (average over 2013-2018: 1900; Figure 15).

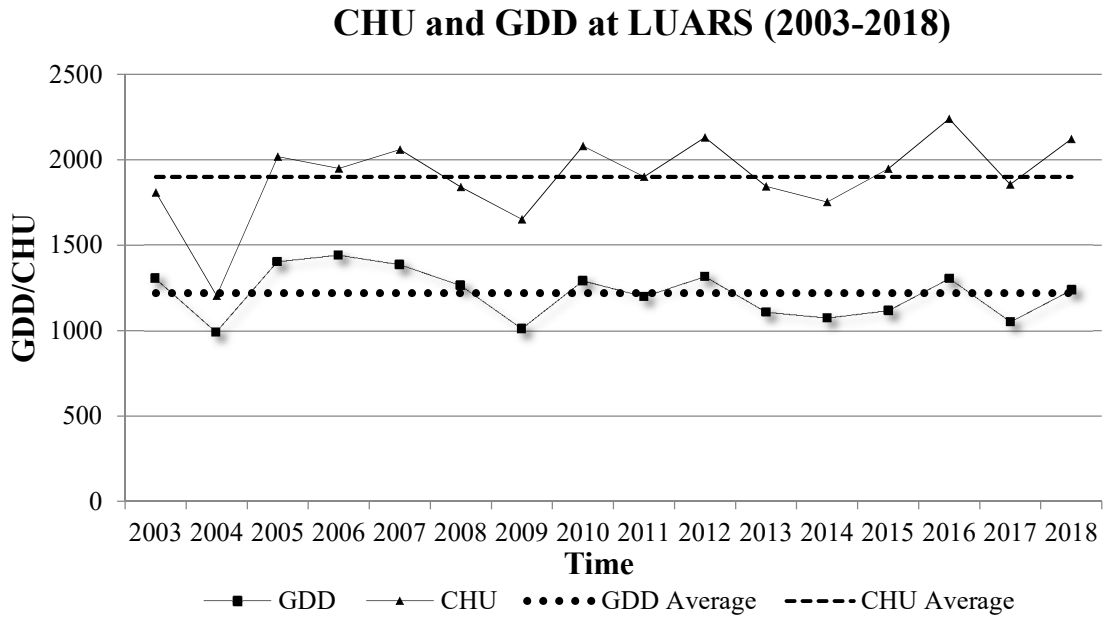

Figure 15: CHU and GDD at LUARS (2003-2018)

The GDD ranged from 994 in 2004 to 1441 in 2006; with an average value of 1,220 (Figure 15). Surprisingly, wheat (Sable) grain yield was highest (7.976 kg/ha) in 2004 when the CHU and GDD were the lowest (grain yield data for all years not shown for sake of brevity). You may recall that silage corn, which made re-entry on Thunder Bay farms in 2004 had matured and was harvested during that year. It seems that CHU and GDD didn't matter for crop production in Thunder Bay.

Conclusions:

Despite our short growing season at Thunder Bay, we have been able to successfully raise crops without any crop failures in any of the years. However, weather has not been consistent; for example, the number of rainy days varied widely from 35 to 104 days, the total seasonal rainfall varied considerably from 285 mm to 498 mm, and there have been risks of frost in June, day temperature rising above 29℃ and night temperature exceeding 16℃. Such temperatures result in flower abscission and drying of young pods in canola. It seems that August has been becoming hotter after 2006, which is suitable for corn and soybean provided there is enough rainfall/or soil moisture to support crop growth. Rainfall of 350-400 mm seemed to be optimum for wheat (variety Sable) grain yield. Of late, there have been two main concerns; (i) cold and wet springs delaying seeding in spring and (ii) wet falls, challenging harvesting. The number of days with temperature $\geq$ 10℃ appeared to decline over time (2003-2018) with some exceptions. Risk of killing frost in the first ten days of September cannot be ruled out. The CHU ranged from 1,204 in 2004 to 2,239 in 2016 (average over 2013-2018: 1900). The GDD ranged from 994 in 2004 to 1441 in 2006; with an average value of 1,220. It seems that CHU and GDD didn't matter much for crop production in Thunder Bay.

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