Project No. R8315
Date: February 15, 2017
Humboldt, Saskatchewan

Final Report

Research Report

Determining Best Practices for Summer Storage of Canola

For:
Agriculture Development Fund and
Canola Council of Canada

PAMI
Innovative Solutions
for Agriculture and Beyond

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ADF#20150293

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Determining Best Practices for Summer Storage of Canola

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Acknowledgements

PAMI wants to recognize that this project would not be possible without the support of the Government of Saskatchewan's Ministry of Agriculture, Canola Council of Canada, and the provincial canola grower associations in Alberta, Saskatchewan, and Manitoba. We also want to acknowledge the support of the canola producers at the Dosch Farm, Bergen Farm, Martin Farm, and Altrogge Farm that participated in the study.

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1. Executive Summary

Storing canola, like most crops, is an important process for most farm operations. Producers are interested in adopting practices that would reduce their risk for canola spoilage. Understanding the different storage practices to reduce the risk of spoilage could have a large impact on their total farm revenue.

The summer storage of canola study conducted in 2014 showed that there was significant heat migration within the grain throughout the summer, but no spoilage was observed. It was speculated that, if there were enough moisture in the grain, there would be a potential for moisture migration and spoilage over the summer months. The objective of the current project was to collect additional bin-scale data and determine if higher moisture content canola, greater than 7%, should be managed differently if it is to be stored over the summer months or for longer periods of time. This project focused on evaluating the most common practices of aeration, turning, and taking no action, to determine which practice would minimize the risk of storing higher moisture canola.

Similar to the previous study, leaving the canola alone resulted in the most stable storage condition when compared to turning and aerating, provided the seed was dry (<10% moisture content) when binned and cooled (<-5°C) over the winter. However, it is recommended to continually monitor the temperature profile to ensure the grain mass remains in good condition throughout the storage period. Turning and aerating helped to equalize the temperature distribution but temporarily resulted in unstable conditions that could lead to localized heating and spoilage. Fortunately, all bins reached stable storage conditions over the storage period.

These results were limited to dry canola (<10% moisture content) that had been uniformly frozen (to less than -5°C) over the winter and stored in 3,700 bu bins. Canola in different sized bins or starting seed conditions might behave differently during long-term storage. The intermittently monitored bins allowed for some observations in a wider variety of bin sizes and starting conditions, but the limited number of bins monitored does not necessarily allow expansion of the recommendation to “leave it alone” to all conditions and bin sizes.

2. Introduction

Canola production is a growing industry and the number of canola hectares harvested in Saskatchewan has steadily increased from 1.0 to 4.5 million between 1986 and 2015 (Canola Council of Canada, 2016). The canola crop contributes to roughly $19.3 billion annually to Canada's industry though direct and indirect value chains (Canola Council of Canada, 2013).

Storing canola, like most crops, is an important process for most farm operations, and it is often the last process before delivering to another entity. Bin storage provides a number of benefits including the flexibility of moving crops before a scheduled delivery, the ability to condition the crop if the conditions at harvest were less than ideal, and longer-term storage to take advantage of the fluctuating market prices. However, there is a risk of spoilage that could jeopardize the entire bin if storage conditions are not managed properly.

The Canola Council of Canada and the Prairie Agricultural Machinery Institute (PAMI) recognize the importance of canola storage and gathered information in 2014 to define best management practices for summer storage of dry canola and compared three storage practices: leaving it alone, turning a portion of the grain, and aerating the grain. The primary purpose of both turning and aeration is to break up problem areas and result in a more uniform temperature distribution. The results showed there was significant heat migration within the grain throughout the summer due to ambient heating. If there was enough moisture in the grain, there will be a potential for moisture migration and spoilage over the summer months. Based on the data collected in 2014, the recommended practice was to "leave it alone" to minimize the storage risk throughout the summer. However, the practice was limited to dry canola (6% moisture content) and questions were raised about storage of canola with a higher moisture content.

Therefore, the objective of this project was to collect additional bin-scale data and to determine if higher moisture content canola should be managed differently if it is to be stored over the summer months or for longer periods of time. In addition, other bins of various size and management practices were intermittently monitored to gather additional data. The data was used to define management practices to minimize the risk of spoilage with long-term storage.

3. Methodology

The project equipment, procedure, and methodology are outlined in the following sections. Bin capacities and grain quantities are expressed in bushels in this report to better reflect industry standards; the international system of units is used everywhere else.

3.1 Project Set-up

The in-grain data collection was separated into two parts: a three-bin treatment comparison, and intermittent monitoring of local canola bins to provide data on a wider range of bin sizes and initial grain conditions.

3.1.1 Treatment bins

The monitoring of higher moisture (9%) canola was conducted from June 2 to August 19, 2016, at Dosch Farms near Annaheim, Saskatchewan. The canola was stored in identical 5.8 m diameter, Westeel-Rosco, 3,700 bu hopper bottom bins with a Field King centrifugal fan and a 1.2 m rocket inside the bin (**Figure 1**). Each bin was subjected to a different storage practice and the grain temperature and relative humidity (RH) was monitored until the grain was unloaded. Bin 20 was left alone as a baseline or “control” bin, Bin 21 was “aerated”, and Bin 22 was “turned”. The “aerated” treatment forced ambient air though the bin and approximately 400 bu of canola was removed from the bottom and replaced on the top of the “turned”. Both turning and aeration are common practices to help equalize the temperature distribution in the bin.

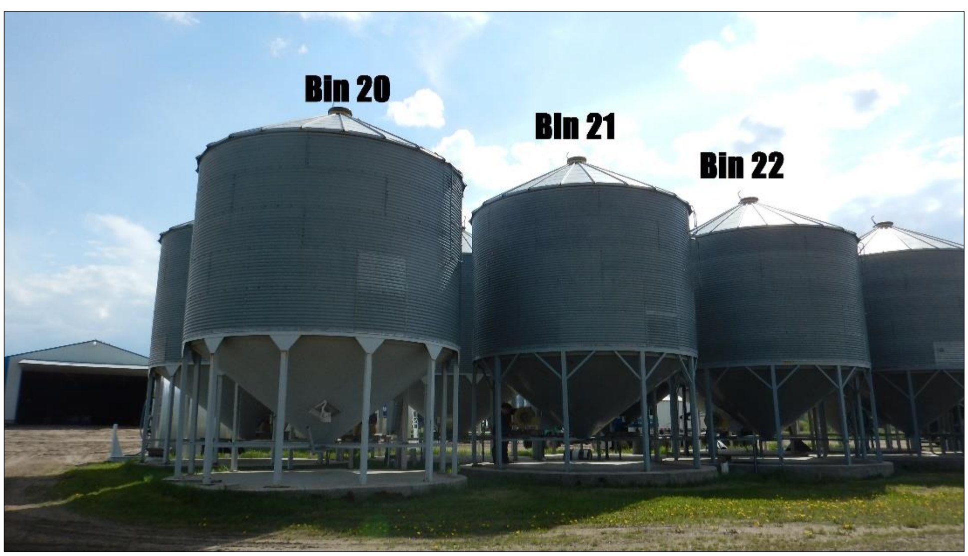

Figure 1. Treatment bin set-up. Bin 20 was the control bin, Bin 21 was aerated in late June, and Bin 22 was partially turned at the beginning of the monitoring period.

A total of ten sensors were installed in each bin and their locations are shown in **Figure 2**. Sensors one to nine are used to monitor the temperature and RH of the canola, while sensor ten was used to monitor the temperature and RH of the headspace within each bin. Sensor 11 was installed near the fan of the control bin to monitor the ambient weather conditions.

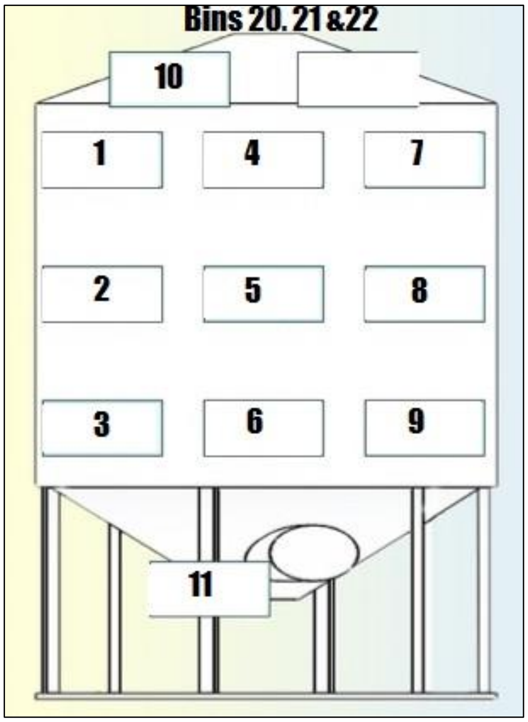

Figure 2. Bin sensor locations.

Since the goal of the study was to monitor the temperature distribution in a bin of cooled grain, the monitoring sensors needed to be installed without disrupting the grain mass, except for the turned bin. Therefore, the sensors were pre-installed inside 3.2 cm diameter hollow tubes with steel flighting at the end of the tube (called probes). The probes were inserted into the canola bins through the bin lid (**Figure 3**). A total of seven probes were used in each bin. The center probe contained sensors 4, 5, and 6, while the six other probes contained only a single sensor at the end (sensors 1, 2, 3, 7, 8, and 9). The probes were positioned so that sensors 1, 4, and 7 were approximately 48 cm below the grain surface, sensors 2, 5, and 8 were 168 cm below the surface (near the middle of the bin), and sensors 3, 6, and 9 were 381 cm below the surface of the grain (near the bottom of the bin but above the hopper). The perimeter sensors (sensors 1, 2, 3, 7, 8, and 9) were positioned approximately 30 cm from the edge of the bin and the center sensors (4, 5, and 6) were positioned near the center of the bin (approximately 275 cm from the edge of the bin).

The sensors were connected to a data acquisition and wireless transmission system to allow remote monitoring of the bin conditions. The bin conditions were regularly monitored through an online platform, http://grain.pamifiles.ca. In addition, an initial representative grain sample was collected and analyzed for moisture content, dockage, and green seed content.

Figure 3. Probe installation process.

3.1.2 Network of Canola Growers

Several additional canola bins were monitored in Saskatchewan from June 16 to August 2, 2016, to provide a larger variety of bin sizes and initial canola storage conditions. PAMI personnel visited participating farms to collect in-grain storage data near the upper edge of the bin and from any existing grain monitoring systems. Three sites within a 200 km radius of Humboldt, Saskatchewan (St. Benedict, Drake, and Elbow, SK) were visited, and a total of five additional bins, ranging from 2,700 bu to 10,000 bu were monitored using a custom mobile probe system.

The mobile in-grain collection system consisted of a towed boom lift with three mobile test probes (**Figure 4**). The probes were fabricated out of 1.9 cm diameter hollow tubes with a welded cone at the end of the probes. The probes were about 3.7 m long and they were manually pushed into the grain from the top of the bin. The sensors were fed down the hollow probe to measure the grain conditions near the cone end. The sensors were allowed to reach steady state for approximately 10 minutes before recording both temperature and relative humidity of the grain mass.

Initially, the plan was to monitor up to 12 producer bins throughout the summer. However, the cost to collect this data was higher than expected due to safety concerns. Instead of using the bin ladders and fall arrest equipment, a boom lift was used to ensure the safety of the staff collecting data. In addition, heavy rainfall in July 2016 prevented access at several of the sites.

Figure 4. Mobile in-grain monitoring system.

3.2 Evaluation Process

Many studies have shown that the moisture content and temperature of the seed are the most important factors to manage during storage. Therefore, the risks of longer-term storage are mitigated by keeping the canola stored in a cool, dry condition.

The Canadian Grain Commission recommends that canola could be stored safely up to five months if the conditions of the binned crop are within the green “no spoilage” zone shown in **Figure 5**. The risk of spoilage will increase if the temperature or moisture is increased beyond the spoilage curve. While drying canola below 10% moisture content will help reduce the risk of spoilage, the associated reduction in weight will also reduce the total revenue from the canola.

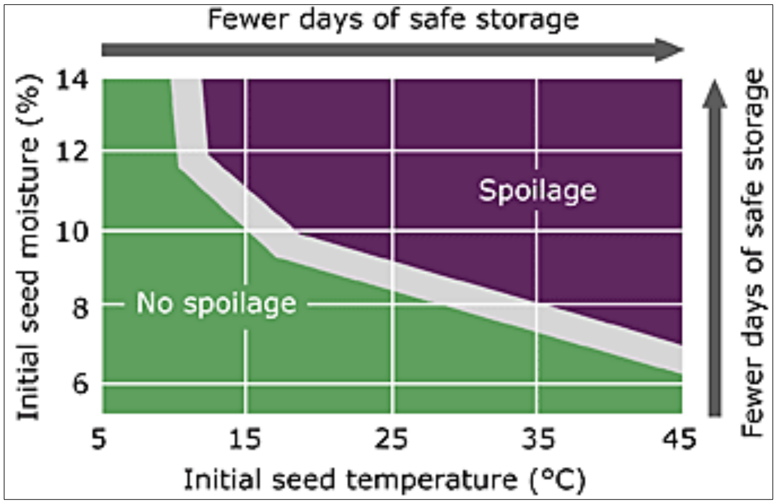

Figure 5. Recommended storage conditions for canola (White, 2013).

The measured temperature and RH within the grain were used to estimate the moisture content of the canola using the Modified Henderson Equation and the concept of Equilibrium Moisture Content (EMC) (ASAE, 2001). The EMC represents the moisture content that the grain would eventually reach if the air conditions remained constant for a period of time. However, the EMC equation is not valid for cooler temperature (less than 5°C). These EMC values appear on the screenshots from the data acquisition system (e.g., **Figure 7**), but the EMC was not used for further analysis due to the uncertainty in the accuracy of the grain moisture content calculated using this method. Grain samples were collected from each bin to allow measurement of the actual moisture content at that start of the monitoring period using a Labtronics moisture meter.

The in-grain temperature profiles for each bin treatment were plotted to determine the effect of each storage practice and the potential risk for heating and spoilage. The average temperature plots are a good indicator for the general bin conditions, while the maximum temperature readings are a good indicator for identifying localized high risk regions.

4. Results

The results from the treatment bins and producer bins are presented in the following sections, along with a comparison of data from the 2014 and 2016 studies.

4.1 Treatment Bin Results

The control, aerated, and turned treatments were monitored for 78 days from June 2 to August 19, 2016, when the grain was unloaded.

The initial canola seed conditions for each treatment are shown in **Table 1**. The average canola temperature was 8.5°C while the average EMC was calculated to be 8.8%. The actual moisture content of the sample collected from each bin was 9% as measured by the Labtronics moisture meter.

Table 1. Initial canola seed condition.

	Control (Bin 20)	Aeration (Bin 21)	Turn (Bin 22)	Average
Avg. initial Temp. (°C)	8.4	8.1	9.0	8.5
Avg. initial EMC (%)	9.3	9.3	7.7	8.8
Dockage (%)	1.9	2.3	2.5	2.2
Green count (%)	0.4	1.0	0.4	0.6

4.1.1 Activity Timeline

The activities that occurred within each treatment bin are illustrated in **Figure 6**. The control bin was left alone during the entire duration, while the turned bin was turned only on the first day. The aeration fans were used twice during the night of day 26 and 27 for a total of approximately 24 hours.

Unfortunately, the in-grain data was lost from day 1 to 12 and from day 33 to 55. The weather may be a factor in the connection failures and the system was rewired to continue the monitoring.

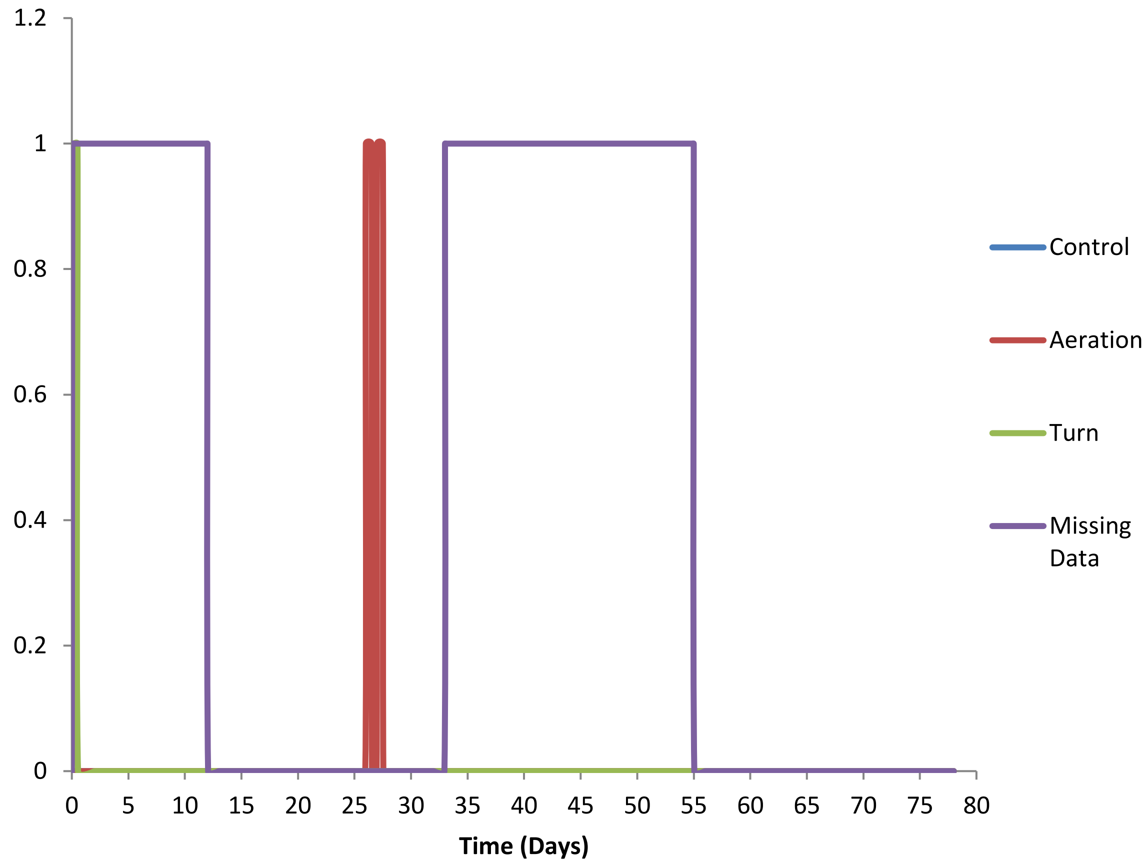

Figure 6. Activity chart (Note: 1 = activity, 0 = no activity).

4.1.2 Effects of the Spring and Summer Ambient Conditions on Grain Temperature

The ambient temperature ranged from 6°C to 27°C, while the ambient RH ranged from 25% to 95% during the testing period (June to August 2016). The average ambient temperature of 18°C was warmer than the average initial canola temperature of 8.5°C. This would suggest that the overall bin would slowly warm up over the summer months if no action was taken. When monitoring began on June 2, 2016, the temperature of the grain near the edge of the bin was considerably higher than the temperature of the core of the bin (**Figure 7**).

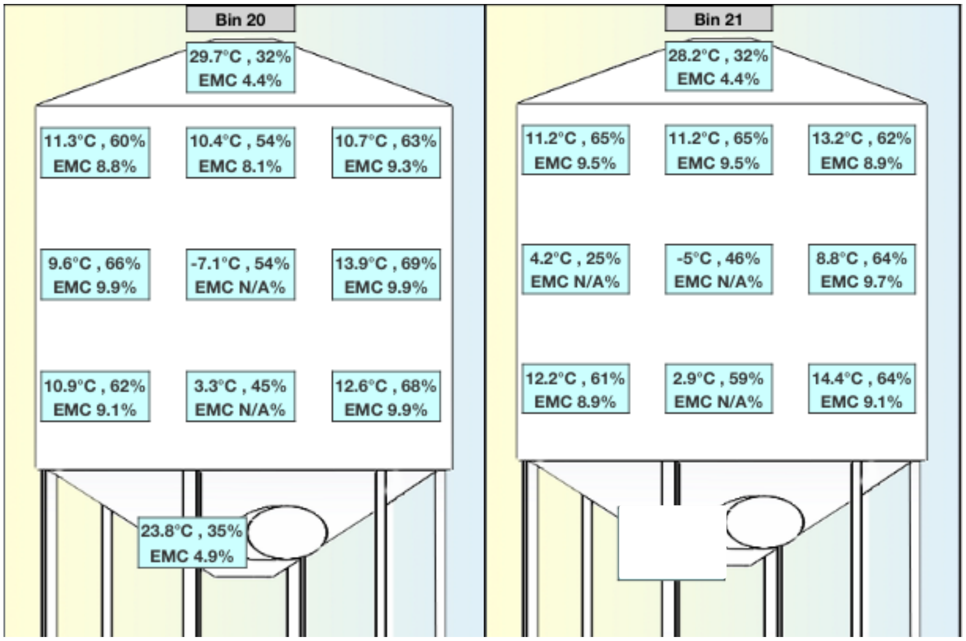

Figure 7. Initial temperature and EMC profiles on day 1 (left: control bin, right: aerated bin before aeration).

The expected air current and moisture migration model is shown in **Figure 8** to illustrate the potential risk for spring and summer storage. The figure shows that the warm outside air will warm the outside grain and pick up any free moisture because the water capacity of the air will increase at higher temperatures. The warm, moist air, when passing through cool grain, will deposit any excess moisture when the air is cooled, which may result in a high moisture zone. High temperatures or moisture zones are undesired in the storage bins because they pose a high risk of spoilage.

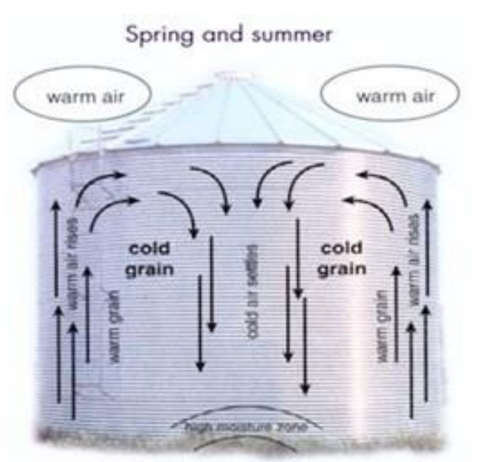

Figure 8. Air movement in bin, spring, and summer (Canola Council of Canada, 2014).

4.1.3 Effect of Turning

A snapshot of the control and turned treatment bins' data acquisition screens are shown in **Figure 9** to illustrate the effect of turning.

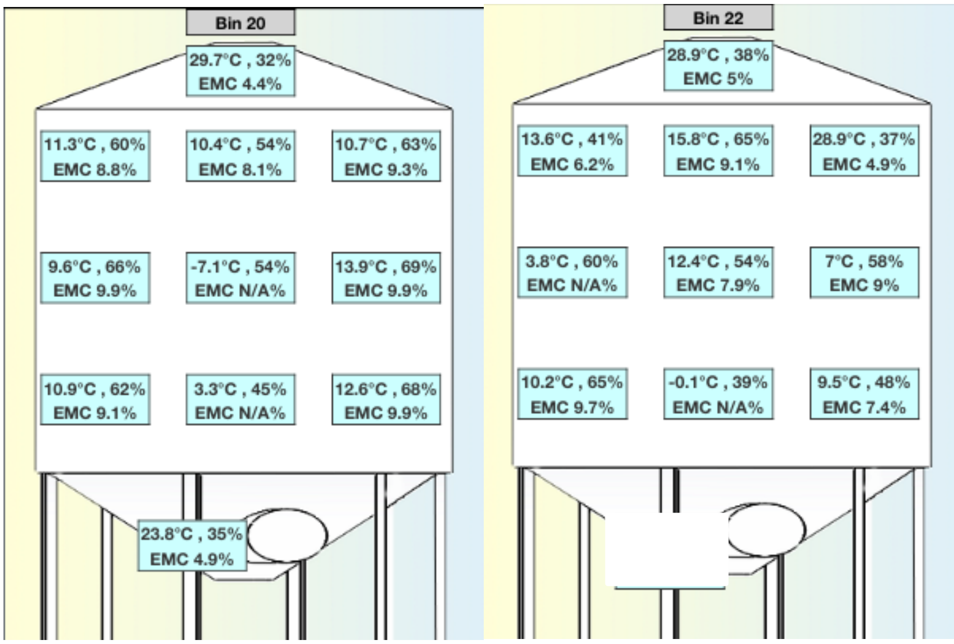

Figure 9. Initial temperature and EMC profiles on day 1 after turning Bin 22 (left: control, right: turned).

To turn the grain in Bin 22, approximately 400 bu of grain was removed from the bottom and placed back at the top of the bin. This transfer process removed the cooler grain from the center and bottom of the bin and allowed the warmer grain to move toward the center while the frozen core was mixed with the grain near the bottom of the bin. This resulted in a warmer core and a cooler bottom compared to the control bin (**Figure 10**). The temperature of the grain pulled out of the bin was as low as -3.8°C, but the temperature of the grain equalized to approximately 14°C before it was loaded back into the bin (due to exposure to ambient air during the time it was out of the bin). Turning the bin is viewed as a quick method to even out the temperature profile. However, partial turning (as was done here) results in cold grain coming in contact with warm grain, which can lead to condensation.

4.1.4 Effect of Aeration

The change in the temperature profile in the aeration treatment bin (Bin 21) is shown in **Figure 10**.

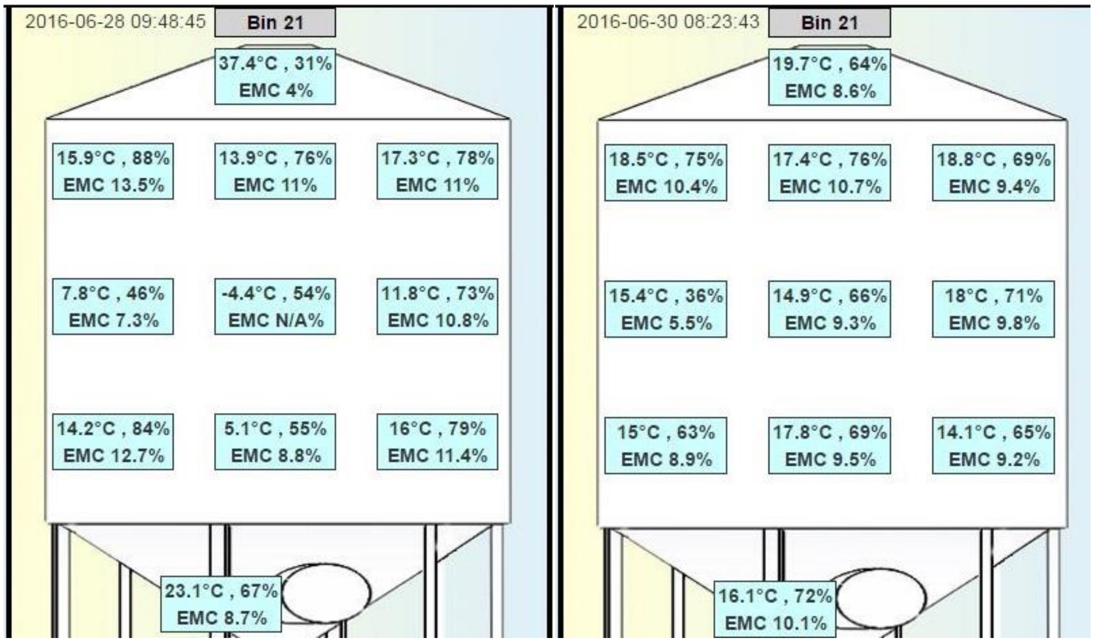

Figure 10. Temperature and EMC profile of the aerated bin (left: immediately prior to aeration, right: after aeration).

The bin snapshot on the left (**Figure 10**) shows the temperature profile before the fans were turned on during day 26 (June 28). The temperature in the bin after two periods of aeration (12 hours each on the nights of June 28 and June 29) is shown on the left of **Figure 10**. After aeration, the bin had a uniform temperature profile. However, pushing warm ambient air through cold grain could theoretically result in condensation near the warming front.

4.1.5 Average Grain Temperature

The average grain temperature plot was used to assess the overall condition of the canola bin (**Figure 11**).

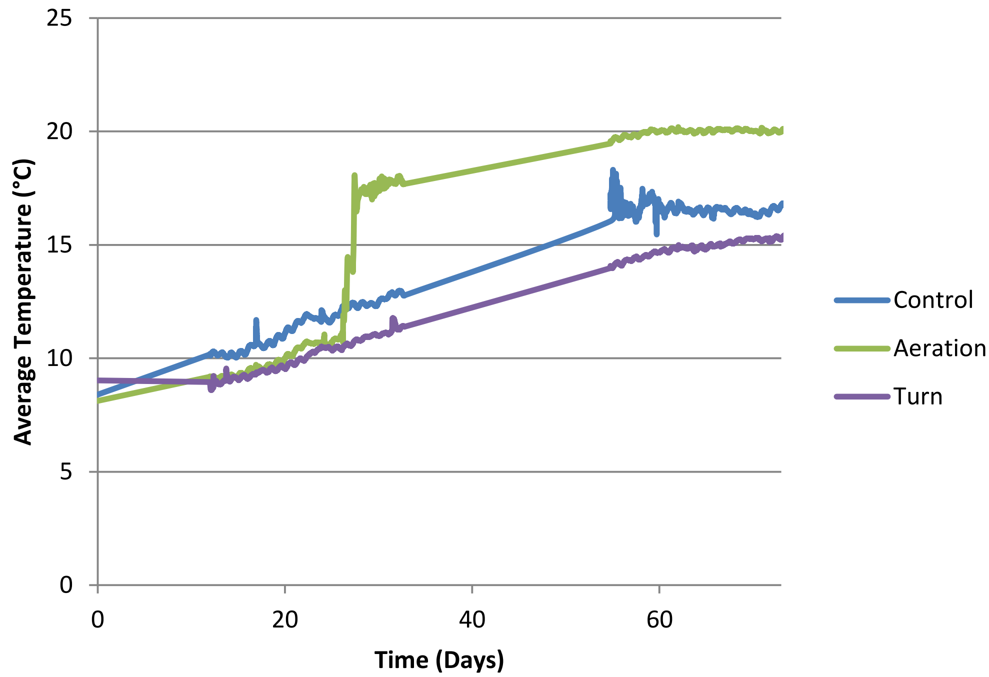

Figure 11. Average canola temperatures for the three treatment bins over the measurement period.

The effects of aerating and turning are noticeable when comparing the average temperature in the aerated and turned bins to the control bin. Turning the bin on day 1 resulted in a higher average temperature in the turned bin compared to the other bins, but the turned bin's overall warming rate was slightly lower than the control and aeration bin for the remainder of the testing period. This change in warming rate meant the average temperature in the turned bin was the lowest of the three bins for the majority of the summer.

The average temperature in the aerated bin followed the temperature trend of the control bin before aeration, but its average temperature was raised quickly on day 26 when the bin was aerated. The average temperature in the aerated bin continued to rise for the remainder of the testing period, but at a slower rate than the control or turned bin. This is likely because, after aeration, the temperature differential between the ambient air and the grain in the aerated bin was lower than the other bins. In fact, the average temperature in the aerated bin appeared to stabilize around 20°C since the average ambient temperature was approximately 18°C for the last few weeks of the monitoring period.

4.1.6 Maximum Grain Temperature

The maximum temperature was plotted to help assess the risk of localized heating and spoilage. The maximum values measured from the nine in-grain sensors are shown in **Figure 12**. Signals of potential localized heating would be a rapid temperature rise that could not be explained by any actions, such as providing supplemental heat or airflow into the bins.

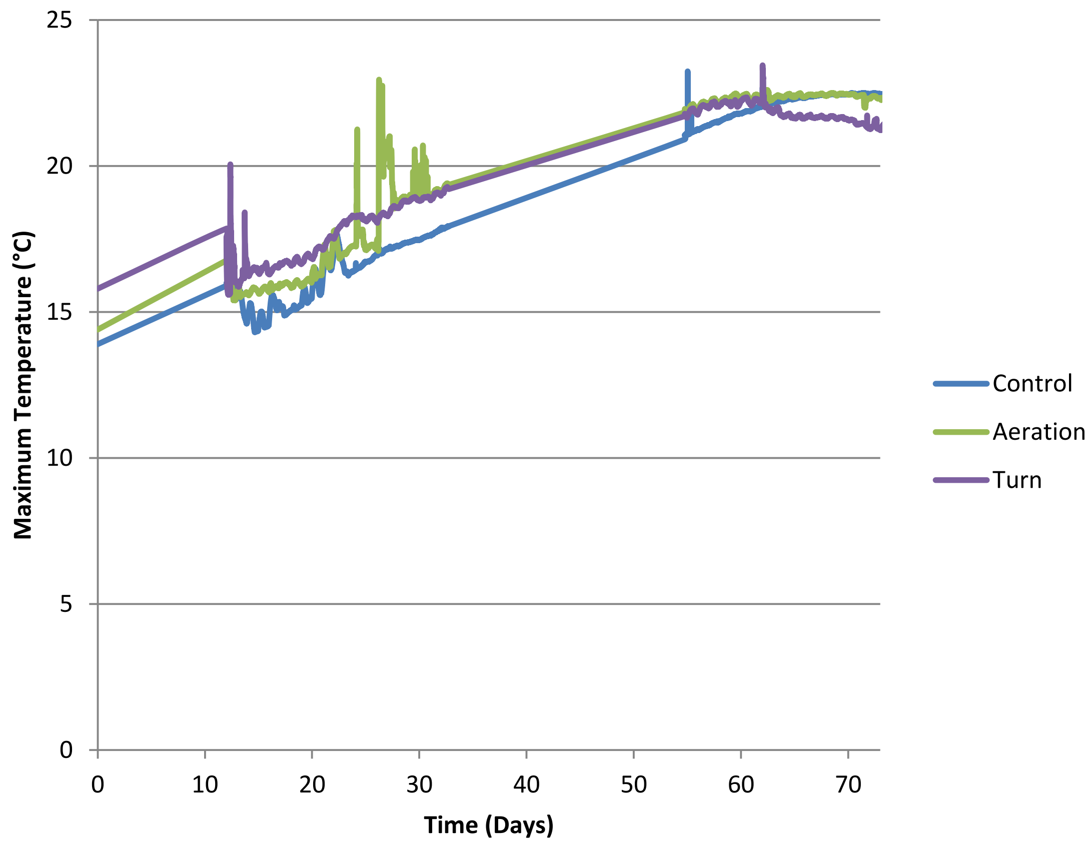

Figure 12. Maximum canola temperature for the three treatment bins throughout the monitoring period.

The maximum grain temperature throughout the test ranged between 14°C to 23°C, with several small temperature rises (**Figure 12**). The temperature of the grain in all three treatments reached up to 23°C but quickly equalized to a lower temperature. Overall, small temperature increases with a short duration are typically expected during the summer months. The grain at the periphery of the bin is often influenced by the daily fluctuating ambient temperatures. However, if these temperatures continue to increase, they are a warning sign for localized heating. The three bins did not show signs of localized heating in any of the treatments.

The maximum temperature in the turned bin was about 1°C to 3°C warmer than the control bin while the maximum temperature in the aerated treatment was about 1°C to 6°C warmer than the control bin until the temperatures equalized after approximately 60 days of storage. This suggests that the control treatment resulted in the most stable conditions throughout the summer.

4.1.7 Effect of Sunny Side and Shady Side of the Bin on Grain Temperature

The average sunny- and shady-side temperatures from the three treatment bins are shown in **Figure 13**. These averages are from all treatment bins regardless of the depth.

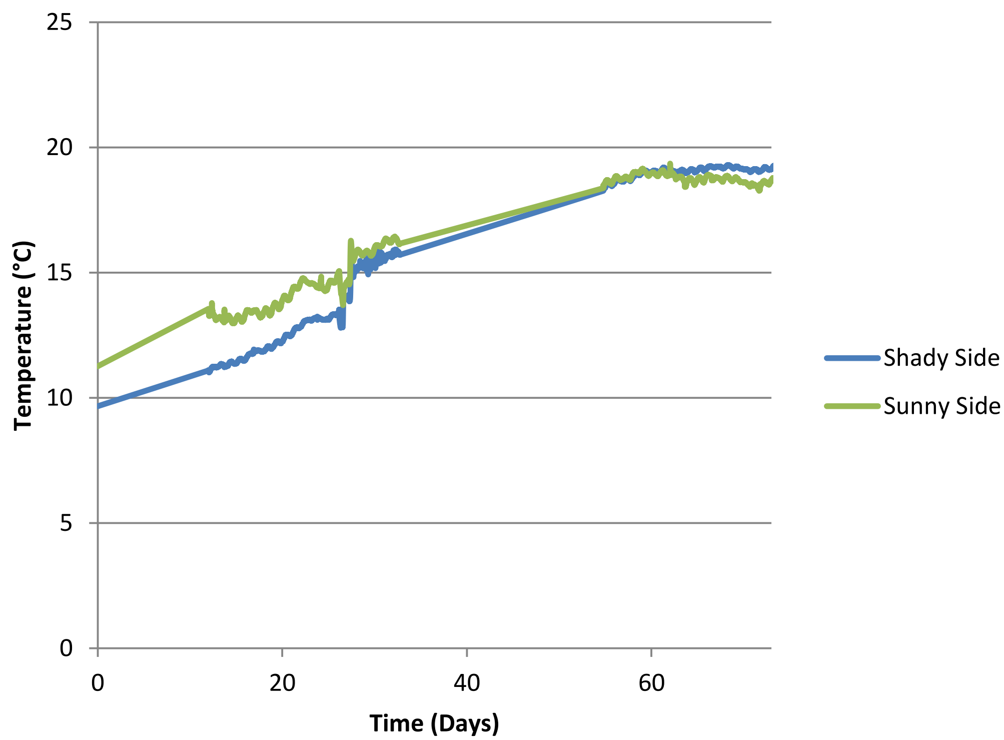

Figure 13. Average temperature of the treatment bins with respect to the direction of the sun.

The temperature trends show that the sunny side was slightly warmer than the shady side for the first 30 days of monitoring, but the difference is less than 3°C. The difference in temperature between the two sides became negligible after 30 days of storage.

4.1.8 Summary of Temperature Data

Table 2 summarizes the temperature profile for the three storage treatments.

Table 2. Comparison between the initial to final canola temperature.

	Control (Bin 20)		Aerated (Bin 21)		Turned (Bin 22)	
	Initial	**Final**	**Initial**	**Final**	**Initial**	**Final**
Average temperature (°C)	8.4	17.0	8.1	20.2	9.0	15.6
Max temperature gradient (°C)	21.0	18.5	19.4	4.7	15.9	12.0
Maximum temperature (°C)	13.9	22.5	14.4	22.3	15.8	21.5

These results suggest the following:

- Canola storage should be monitored on a regular basis due to the inevitable heating during the spring and summer months.
- Turning the bin assisted in unifying the temperature distribution and resulted in the lowest average temperature throughout the summer. However, partially turning the bin resulted in unstable conditions immediately after turning.
- Aerating the bins minimized the temperature variation within the bin but resulted in the highest average bin temperature with signs of warm localized grain for a short duration. However, the temperature was quickly equalized after the aeration period and the aeration process did not add a significant amount of moisture to the grain.
- Doing nothing resulted in generally stable conditions throughout the summer months and similar average and maximum temperatures to the treatment bins.

4.2 Comparison of 2014 and 2016 Data

The procedures and data collected from the three treatment bins in 2016 were meant to validate the data collected in 2014. The main difference between the 2016 and 2014 studies was the moisture content of the grain (9% in 2016 and 6% in 2014). The average grain conditions at the start and end of testing for both trials are summarized in **Table 3** and **Table 4**.

Table 3. Key temperature indicators at the beginning of testing for both trials (°C).

	Average Grain Temperature		Core Temperature		Max Grain Temperature		Highest Temperature Gradient	
	June 2014	**June 2016**	**June 2014**	**June 2016**	**June 2014**	**June 2016**	**June 2014**	**June 2016**
Control	7.6	8.4	-12.0	-7.1	15.0	13.9	27.0	21.0
Aerated [(1)]	3.8	8.1	-17.0	-5.0	13.0	14.4	30.0	19.4
Turned [(2)]	9.0	9.0	6.0	12.4	11.0	15.8	5.0	15.9

[(1)] before aeration

[(2)] after turning

The average grain temperatures at the start of testing in 2016 were slightly higher than in 2014, but otherwise, the general trends were the same.

Table 4. Key temperature indicators at the end of testing for both trials (°C).

	Average Grain Temperature		**Core Temperature**		**Max Grain Temperature**		**Highest Temperature Gradient**	
	July 2014	**August 2016**	**July 2014**	**August 2016**	**July 2014**	**August 2016**	**July 2014**	**August 2016**
Control	15.2	17.0	-1.9	4.0	23.1	22.5	25.0	18.5
Aerated	21.5	20.2	21.1	17.6	22.6	22.3	3.1	4.7
Turned	14.1	15.6	-3.0	9.5	18.9	21.5	21.9	12.0

In both years of testing, the turned bin had the lowest average grain temperature and the aerated bin had the highest average grain temperature at the end of the monitoring period. The average grain temperature was slightly higher in 2016 than 2014 (except for the aerated bin) and the core temperature in the control and turned bins was considerably lower in 2014 than in 2016. This discrepancy is likely due to the differences in starting core temperature and duration of monitoring between the two years.

Even though the turned bin had the lowest average temperature at the end of testing in both years, the average temperature in the control bin was not considerably different than the turned bin. Since the turning action results in unstable conditions for a short period after turning, it is recommended to leave the cool grain alone and monitor the grain temperature throughout the summer.

4.3 Intermittent Bin Monitoring

A total of three sites and five different bin sizes were intermittently monitored throughout the summer in 2016 to gather data on a wider range of bin sizes and management practices. The safety concerns related to climbing bins and the unfavourable weather in July limited the number of bins that were monitored.

Table 5 shows the canola storage data collected at the various sites compared with the temperature collected in the control treatment on the same day and in a similar location within the bin.

Table 5. Canola temperature comparison from various sites with the control treatment (all temperatures are reported in °C).

		Temperature in intermittently monitored bin [Temperature in control bin for comparison]		
Bin details	**Date**	**North**	**Center**	**South**
10,000 bu Viterra bin	June 16, 2016	14.1 [14.1]	2.35 [12.0]	7.5 [13.6]
5,000 bu Westeel-Rosco	June 24, 2016	19.1 [15.8]	14.9 [13.8]	17.9 [14.9]
	August 2, 2016	22.6 [21.9]	21.3 [19.3]	22.2 [20.1]
2,700 bu Wooden bin	July 26, 2016	11.6 [21.7]	10.5 [13.0]	11.8 [21.3]
3,300 bu Westeel-Rosco	July 26, 2016	14.9 [21.7]	11.5 [13.0]	15.1 [21.3]
3,300 bu Westeel-Rosco	July 26, 2016	13.5 [21.7]	12.5 [13.0]	16.6 [21.3]

The first bin, with a 10,000 bu capacity, was cooled in the previous fall with aeration and left untouched until the in-grain monitoring in June. The temperature in both the 10,000 bu bin and the control bin showed that the grain in the center was cooler than at the periphery due to the ambient warming effect (**Table 5**). However, the grain near the top center of the 10,000 bu bin was much cooler than comparable grain in the control bin on the same day. This may be due to the minimum temperature the grain in each bin was cooled to over the winter (which is unknown) or the fact that the 10,000 bu bin had a larger diameter than the control bin, resulting in a greater insulation effect.

The other bins were similar in size and diameter to the control bin. The 5,000 bu Westeel-Rosco bin was filled on May 1, 2016, by combining small amounts of canola remaining in other bins. Therefore, the grain in this bin would not have been cooled over the previous winter and likely went into the summer storage season with a higher average temperature than the control bin. However, the temperature of the canola near the top of the Westeel-Rosco bin was very similar to comparable grain in the control bin by August 2, 2016. Since the temporary probe used to monitor the temperature in these intermittent bins could not reach the core of these bins, the temperature of the core of this bin is unknown.

The temperature of the grain near the top of the other intermittently monitored bins was similar to each other and slightly cooler than the control bin. Interestingly, the canola stored in the wooden bin was the coolest of all the bins monitored that day.

The canola temperature, with respect to grain depth, was also measured with a StorMax temperature cable on the 10,000 bu bin on June 16, 2016. The grain temperatures in the center of the bin as recorded by the StorMax cables were 5.5, 0.9, -1.1, -0.1, and 12.1°C from the top to bottom of the bin. For comparison, the temperatures in the 3,500 bu control bin on the same day were 12 °C at the top center and -6°C at the core. Both bins showed that the canola is a very good insulator when no action is taken, which resulted in a core that is cooler than the top and bottom of the bin. The fact that the core of the larger diameter bin was actually warmer may have been due to the fact that the grain in the smaller bin was cooled to a lower temperature over the winter.

5. Conclusions

The grain temperature in control, aerated, and turned bins were compared to determine the best practice for storing a higher moisture content canola over the spring and summer months. The overall findings from 2014 were validated with a similar treatment comparison in 2016 using canola bins with an average of 9% moisture content.

If the grain is dry and frozen over the winter, it can be safely stored through the summer months without any management. Turning the bin resulted in the lowest average bin temperature, while aerating resulted in the most uniform temperature distribution. In both cases, turning and aerating helped to equalize the temperature distribution, but resulted in potentially unstable conditions that could increase the risk of spoilage. Both turning and aerating created regions where cold grain was directly adjacent to warm grain for short durations. This condition may have resulted in condensation due to the temperature differential. Fortunately, this did not seem to happen in either 2014 or 2016 as there was no indication of wet spots or spoilage when the grain was unloaded.

Leaving the grain alone resulted in the most stable and favorable storage conditions. Monitoring the temperature of canola during storage is recommended due to the potential for spoilage during the spring and summer storage. It should also be noted that the recommendation of leaving it alone is limited to dry canola (<10% moisture content) that had been uniformly frozen (to <-5°C) over the winter. Although one of the intermittently monitored bins had a much higher starting temperature in May and maintained stable conditions until August, this single instance is not enough to expand the recommendation to all starting conditions. Canola with different starting conditions might behave differently than observed in this study.

6. Dissemination Activities

The results from this project have been and will be made available to producers and other stakeholders through a variety of activities:

- Blog updates on the Canola Council of Canada's CanolaWatch newsletter.
- Articles resulting from interviews with media (e.g., Western Producer, Country Guide, Farming for Tomorrow, etc.).
- Presentations and seminars at various events (e.g., CropConnect, North East Ag Update, CanoLAB, Farm Progress Show, etc.).

These activities will continue beyond the project end date due to PAMI's on-going grain storage research and commitment to continually provide relevant research updates to producers.

7. Project Expenses

The project costs and funding breakdown for the entire project is presented in **Table 6**.

Table 6. Project budget, costs, and funding.

Description	ADF Budget	ADF Actual	PAMI	Canola Council	Total Actual Project Costs
Salaries	34,851.00	34,849.00	16,993.60	20,337.40	72,180.00
Equipment rental	2,913.00	3,204.30		8,930.83	12,135.13
Materials/supplies	1,750.00	1,465.70			1,465.70
Field travel	2,000.00	1,995.00		65.10	2,060.10
Other	1,000.00	1,000.00			1,000.00
Total	**$42,514.00**	**$42,514.00**	**$16,993.60**	**$29,333.33**	**$88,840.93**

PAMI committed to a minimum contribution to cover 15% of labour costs. PAMI's total contribution of $16,993.60 represents approximately 24% of labour costs. The contribution from the Canola Council was $30,800.00 including GST, so their contribution to project expenses totaled $29,333.33.

6. References

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