



ORCHARD NETWORK

For Commercial Apple Producers

VOLUME #24, ISSUE #3

August 2020

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Orchard Management

More organic matter means more water, right? Well maybe...

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We all know if we increase our soil organic matter, we will also increase the soil water that is available to the crop, right? According to a recent research paper in the European Journal of Soil Science the relationship between soil organic matter and crop available water is not quite as simple as we thought. They analysed data from 60 published studies and global databases with more than 50,000 measurements and found that an increase in soil carbon (soil organic matter) has only a small effect on soil water retention.

Here's what they found. Adding organic matter to soil enhanced available water capacity only modestly with an average value of 1.5 to 2 mm per meter with a 1 % mass increase in organic carbon. Sandy soil was more responsive to the increase in organic matter while clayey soils really didn't show any change.

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This issue of the **Orchard Network
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Their research also suggests that the gradual loss of organic matter from soil would have a minimal effect on the hydrological cycle or the water cycle. They looked in particular at water content at saturation, field capacity, wilting point and calculated the available water.

The research was well done but perhaps just as simplistic as when we previously said soil organic matter increases crop available water. There are other properties that organic matter influences like soil structure, aggregation and pore size that will certainly have an impact on how well water enters the soil and is held within a soil. The authors of course note that the study does not suggest that farmers shouldn't increase soil organic matter – however they use 1% as a critical level for soil organic carbon as soil aggregates are destabilized and soil nutrient cycling is compromised below that. One per cent soil carbon means the soil organic matter level would be still be less than 2 % - not great in a sandy soil and absolutely terrible in a clay soil at least in Ontario.

We may not see a direct relationship with increasing soil organic matter and increasing water holding capacity, but we do know that higher soil organic matter means a better structured soil, more resistance to erosion, better water infiltration and more resistance to compaction. So, in the end this does mean more crop available water. And in a stress year – those years that are too wet, too dry, too hot, too cold means improving soil organic matter will still help with weather proofing your soil and your crop.

Evaluating the accuracy of temperature forecasts from different weather websites

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Temperature forecast data is used in many aspects of apple production, whether it be predicting the risk of frost overnight or the efficacy of chemical thinning; or in the use of crop load management models. This past spring, we worked with the Pollen Tube Growth Model (PTGM) in a couple of commercial orchards in the Clarksburg and Simcoe areas. The PTGM predicts the rate of growth of the pollen tube from pollination (when the pollen grain lands on the stigma) to fertilization (when the pollen tube reaches the ovary) using recorded hourly temperatures and forecasted hourly temperatures collected throughout the month of June. This predicted rate of growth helps to predict the best timing for blossom thinning application. While working with the PTGM, the question of which weather forecasting website to use came up and we decided to assess the most common ones available in Ontario. Forecasted hourly temperature data was taken from the following weather forecasting websites: Environment Canada, AccuWeather, The Weather Network and Weather Underground during the month of June. The hourly forecasts were separated into time periods: 0-24 hours, 24-48 hours, 48-72 hours and 72-98 hours ahead of time. Temperature forecasts were collected daily in accordance with the corresponding time period. These were then compared to the actual weather data collected from weather stations in two orchards in Simcoe (Simcoe site one and two) and one orchard in Clarksburg to evaluate the accuracy of the forecast.

The difference and absolute difference between each predicted and actual hourly temperature was calculated (actual temperature subtracted from predicted temperature) for each time period and weather forecasting website. The average and standard deviation were then calculated for the difference and absolute difference for each forecasting website and each forecast time period. The average difference (predicted temperature-actual temperature) compared the weather forecasting websites to see if the temperatures tended to predict above or below the actual temperature and by how much. A positive number would indicate an over-prediction a negative number would indicate an under-prediction. The absolute difference is defined as the positive integer of the difference between the predicted and actual temperatures and is the distance between the two numbers.

For example, if the predicted temperature was 22°C and the actual temperature was 25°C the difference would be -3°C but the absolute difference (the distance between the predicted and actual temperature) would be 3°C. The average absolute difference gives us an indication of how accurate the weather forecasting websites are, overall. The standard deviation shows the variation in data points, a smaller number indicates the values tend to be closer to the average, a larger number indicates more variability in the differences. This information will be helpful with choosing the most suitable weather forecasting source for Ontario growers in the future for use in crop load management models which use temperature forecast data

Table 1. Average absolute difference of the 0-24-hour forecast compared to the actual hourly temperatures

	Environment Canada		AccuWeather		Weather Network		Weather Underground	
	Avg. Abs. Diff. (°C)	Std. Dev. (°C)	Avg Abs. Diff. (°C)	Std. Dev. (°C)	Avg. Abs. Diff. (°C)	Std. Dev. (°C)	Avg. Abs. Diff. (°C)	Std. Dev. (°C)
Simcoe Site 1	3.20	2.33	3.03	2.01	3.01	1.95	2.98	1.92
Simcoe Site 2	3.24	2.49	3.06	2.19	3.14	2.62	2.93	2.13
Clarksburg	3.65	3.78	3.72	2.97	2.36	2.26	2.02	2.70

Table 2. Average absolute difference of the 24-48-hour forecast compared to the actual hourly temperatures

	Environment Canada		AccuWeather		Weather Network		Weather Underground	
	Avg. Abs. Diff. (°C)	Std. Dev. (°C)	Avg. Abs. Diff. (°C)	Std. Dev. (°C)	Avg. Abs. Diff. (°C)	Std. Dev. (°C)	Avg. Abs. Diff. (°C)	Std. Dev. (°C)
Simcoe Site 1	N.F*	N.F	3.40	2.41	3.32	2.05	3.03	1.88
Simcoe Site 2	N.F	N.F	2.98	1.90	3.30	2.26	3.02	2.30
Clarksburg	N.F.	N.F	4.33	3.21	1.73	1.36	1.95	1.58

*N.F. stands for no hourly forecast available for this time period

Table 3. Average absolute difference of the 48-72-hour forecast compared to the actual hourly temperatures

	Environment Canada		AccuWeather		Weather Network		Weather Underground	
	Avg. Abs. Diff. (°C)	Std. Dev. (°C)	Avg. Abs. Diff. (°C)	Std. Dev. (°C)	Avg. Abs. Diff. (°C)	Std. Dev. (°C)	Avg. Abs. Diff. (°C)	Std. Dev. (°C)
Simcoe Site 1	N.F*	N.F	3.43	2.02	3.59	2.38	3.18	1.93
Simcoe Site 2	N.F	N.F	3.30	1.96	3.60	2.59	3.19	2.35
Clarksburg	N.F	N.F	3.96	2.37	3.61	2.03	2.10	1.31

*N.F. stands for no hourly forecast available for this time period

Table 4. Average absolute difference of the 72-98-hour forecast compared to the actual hourly temperatures

	Environment Canada		AccuWeather		Weather Network		Weather Underground	
	Avg. Abs. Diff. (°C)	Std. Dev. (°C)	Avg. Abs. Diff. (°C)	Std. Dev. (°C)	Avg. Abs. Diff. (°C)	Std. Dev. (°C)	Avg. Abs. Diff. (°C)	Std. Dev. (°C)
Simcoe Site 1	N.F*	N.F	N.F	N.F	N.F	N.F	3.07	2.32
Simcoe Site 2	N.F	N.F	N.F	N.F	N.F	N.F	3.14	1.89
Clarksburg	N.F	N.F	N.F	N.F	N.F	N.F	2.04	1.56

*N.F. stands for no hourly forecast available for this time period

Table 5. Average difference of the 0-24-hour forecast compared to the actual hourly temperatures

	Environment Canada		AccuWeather		Weather Network		Weather Underground	
	Avg. Diff. (°C)	Std. Dev. (°C)	Avg. Abs. Diff. (°C)	Std. Dev. (°C)	Avg. Abs. Diff. (°C)	Std. Dev. (°C)	Avg. Abs. Diff. (°C)	Std. Dev. (°C)
Simcoe Site 1	-0.78	3.88	-1.17	3.44	-1.14	3.84	-0.85	3.45
Simcoe Site 2	-0.97	3.97	-1.36	3.51	-1.31	3.88	-1.13	3.45
Clarksburg	-0.07	5.26	-1.91	4.36	-0.33	3.25	0.30	2.09

*N.F. stands for no hourly forecast available for this time period

Table 6. Average difference of 24-48-hour forecast compared to actual hourly temperatures

	Environment Canada		AccuWeather		Weather Network		Weather Underground	
	Avg. Diff. (°C)	Std. Dev. (°C)	Avg. Diff. (°C)	Std. Dev. (°C)	Avg. Diff. (°C)	Std. Dev. (°C)	Avg. Diff. (°C)	Std. Dev. (°C)
Simcoe Site 1	N.F*	N.F	-1.92	3.70	-1.09	3.75	-1.31	3.32
Simcoe Site 2	N.F	N.F	-1.86	3.02	-1.11	3.85	-1.30	3.58
Clarksburg	N.F	N.F	-2.05	4.99	0.19	2.20	-0.13	2.32

*N.F. stands for no hourly forecast available for this time period

Table 7. Average difference of 48-72-hour forecast compared to actual hourly temperatures

	Environment Canada		AccuWeather		Weather Network		Weather Underground	
	Avg. Diff. (°C)	Std. Dev. (°C)	Avg. Diff. (°C)	Std. Dev. (°C)	Avg. Diff. (°C)	Std. Dev. (°C)	Avg. Diff. (°C)	Std. Dev. (°C)
Simcoe Site 1	N.F*	N.F	-2.66	2.98	-1.25	4.14	-1.36	3.48
Simcoe Site 2	N.F	N.F	-2.59	2.87	-1.39	4.23	-1.50	3.68
Clarksburg	N.F	N.F	-3.21	3.12	-0.08	4.16	-0.63	2.43

*N.F. stands for no hourly forecast available for this time period

Table 8. Average difference of 72-98-hour forecast compared to actual temperatures

	Environment Canada		AccuWeather		Weather Network		Weather Underground	
	Avg. Diff. (°C)	Std. Dev. (°C)	Avg. Diff. (°C)	Std. Dev. (°C)	Avg. Diff. (°C)	Std. Dev. (°C)	Avg. Diff. (°C)	Std. Dev. (°C)
Simcoe Site 1	N.F*	N.F	N.F	N.F	N.F	N.F	0.36	3.84
Simcoe Site 2	N.F	N.F	N.F	N.F	N.F	N.F	0.17	3.67
Clarksburg	N.F	N.F	N.F	N.F	N.F	N.F	-0.03	2.53

*N.F. stands for no hourly forecast available for this time period

For the average absolute difference, Weather Underground seemed to be the most accurate weather station overall. It also had the smallest standard deviation which means it had the least variation. [Environment Canada was less suitable](#) as it only had hourly forecasting data for the first 24 hours. Weather Underground was the most accurate for both orchards in Simcoe and the orchard in Clarksburg for the 0-24-hour forecast time period (Table 1). Environment Canada was the least accurate for all three orchards for the 0-24-hour time period (Table 1). For the 24-48-hour time period, The Weather Underground was the most accurate for Simcoe site one, AccuWeather was the most accurate for Simcoe site two and the Weather Network was the most accurate forecast for Clarksburg (Table 2). Weather Underground was the most accurate for all three orchards for the 48-72-hour time period (Table 3). The Weather Network was the most inaccurate for both Simcoe orchards and AccuWeather was the most inaccurate for Clarksburg for the 48-72-hour time period (Table 3). Weather Underground was the only station that forecasted 72-98-hours in advance (Table 4).

The average difference indicates whether the forecasting data over-predicts or under-predicts. Most weather forecasting websites tended to under-predict. The Weather Network seemed to be the weather forecasting website that underpredicted the least overall. AccuWeather underpredicted the most as AccuWeather's forecasted hourly temperatures had the largest average difference below the actual forecast for all three orchards in all of the time periods it had hourly forecasts for (Table 5, 6 and 7). Environment Canada's forecasted hourly temperatures had the smallest difference below the actual forecast for all three orchards in the 0-24-hour time period (Table 5) but only had an hourly forecast for this time period. For the 24-48-hour and 48-72-hour time periods, the Weather Network's forecasted hourly temperatures had the smallest difference below the actual hourly temperatures for all three orchards (Table 6 and 7).

The Weather Underground was the only station that forecasted 72 to 98 hours in advance and tended to over-predict in Simcoe and slightly under-predict in Clarksburg (Table 8). In the case of working with the PTGM, which predicts when to apply a blossom thinner based on the growth rate of the pollen tube which is modelled using

actual and forecasted hourly temperature, it is most favourable to have a forecast that's average difference is closest to zero. It may be more desirable to have a forecast that over-predicts in the long-range forecast (24-72 hours ahead) which will predict the spray window to be sooner, so that you don't miss your spray window when planning a day or two ahead. In the shorter range (0-24 hours ahead), a forecast that under-predicts may be more desirable as you don't want to plan to spray too early and knock off more blossoms than desired, especially in the first application when you are waiting for the target number of flowers have their pollen tube growth reach fertilization.

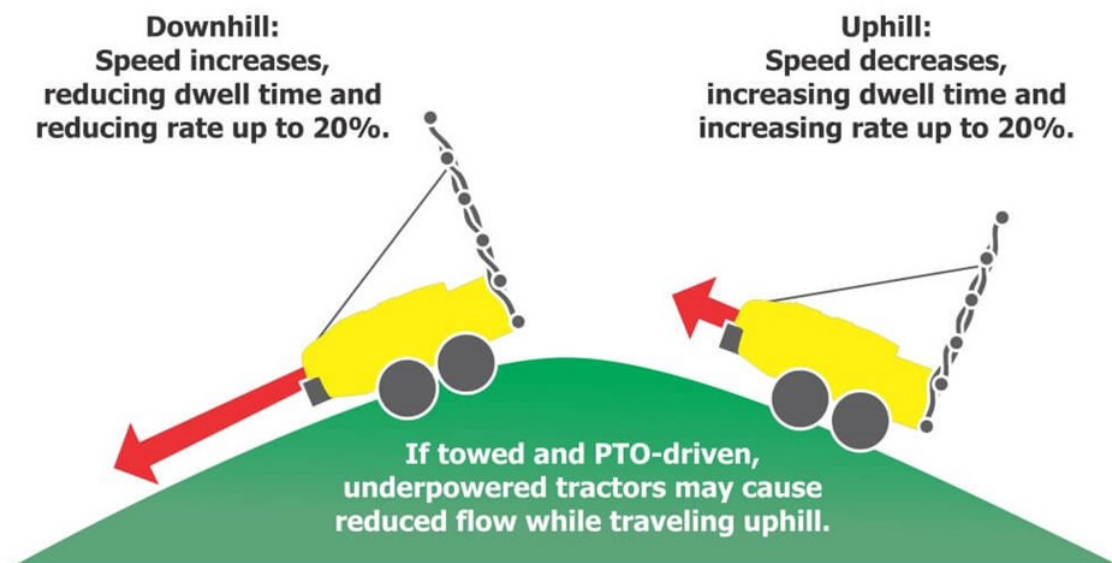
In conclusion, the Weather Underground had the most accurate overall predictions as it mostly had the smallest average absolute difference across all time periods and locations (Tables 1-4). However, the Weather Network tended to under-predict the least in most time periods, particularly in the 24-48- and 48-72-hour time periods with the average difference being closest to zero (Tables 6 and 7). In some time periods, certain forecasts were more suitable for certain orchards depending on the location. The data collected for this study was site specific and it is recommended that growers keep a record of how weather predictions compare to their actual temperatures in their own orchards to understand which weather forecast website is most suitable for them.

Rate controllers on air-assist sprayers

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Dr. Jason Deveau, Application Technology Specialist, OMAFRA*

There are many advantages to using rate controllers, but their primary role is to maintain a constant application rate. All sprayers change speed on hills, at row-ends, or in response to surface conditions. Since flow from an uncontrolled sprayer is constant, the application rate varies significantly (up to 40% in hilly conditions). Rate controllers compensate for changing speed by adjusting flow.

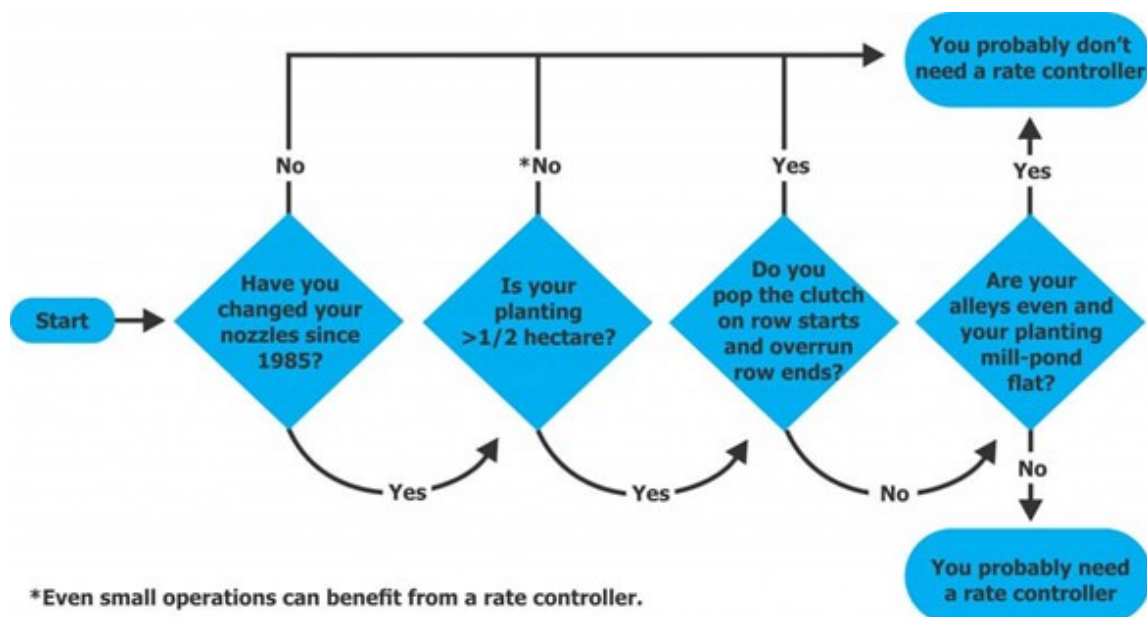
Hilly operations create highly variable application rates. Changes in travel speed can translate to 40% variability in rate applied. Rate controllers adjust flow to compensate.



Pesticide is not saved directly (since increased uphill rates already cancel out reduced downhill rates) but consider the pesticide label. Labels that list a range of rates are contingent on pest pressure and crop size, but also compensate for poor coverage from low-performing equipment. When coverage uniformity is improved, experience has shown that operators can safely spray at minimal rates.

Experience has also demonstrated that when coverage uniformity is improved, pack-out benefits follow. Even a modest improvement represents a quick return on investment. Equally important, a more consistent application reduces the risk of higher residue levels on the uphill and improves crop protection on the downhill.

Now, if you are wondering if a rate controller is right for your operation, or if you should just stop reading now, consult this handy decision support matrix:



This decision support matrix will help you decide if a rate controller is right for your operation. Spoiler alert: It probably is.

Description	Pros	Cons
Good: Monitors and adjusts pressure. Uses math to assume flow.	-Fewest moving parts. -Simple interface. -Lowest cost.	System monitors pressure, but does not register flow. For example, if nozzle flow is restricted, back pressure increases. The controller will compensate to correct pressure, implicitly reducing flow, but the operator is not alerted to the actual problem.
Better: Monitors and adjusts flow, not pressure.	Alerts operator to changes in flow. Operator usually sets the percent error threshold a little high to ignore transient changes.	System will not register pressure deviations. At threshold speed, pressure may drop too low. This can cause inconsistent check valve operation and spray pattern collapse. With tall booms, the top nozzles may close completely.
Best: Monitors flow and pressure and adjusts flow.	-Best likelihood of a consistent application. -Alarms or automatic compensation of flow and pressure (user sets hard stops). -Provides a low tank level warning. -Stores preset calibrations to quickly switch between blocks.	-Highest cost. -Steepest learning curve. -More “wire-wiggling”. -Operators often choose to over-apply at low speeds as a tradeoff for uniform output and consistent atomizer performance.

Rate controller adoption and components

As we write this, less than 10% of air-assist sprayers have rate controllers. In the dark old days of the 1980’s, air-assist operators were ill-advised to install high flow, low pressure field sprayer controllers. That history of mismatched components and subsequent bad experiences continues to hinder widespread adoption.

Today’s components, however, are specific to air-assist sprayers and have made installations easier and more successful. Do your homework and speak with the manufacturer (not necessarily the local dealer) to ensure the controller, and all its components, meet your needs.

Let’s describe the components so you’re prepared to have the conversation:

- Console
- Flow meter(s)
- Flow control valve (including electric boom shut-offs)
- Speed sensor
- Wire harness

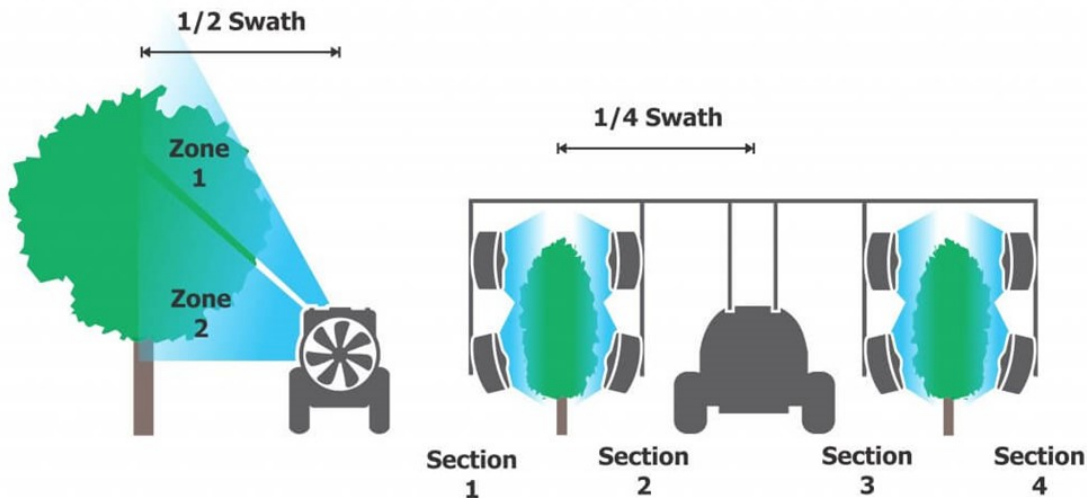


Examples of rate controller components.

Console

The console is the interface. The user enters criteria about the sprayer, the planting, and calibration data and receives information about sprayer performance. Select a console designed for air-assist sprayers and not field

sprayers. Controllers intended for horizontal booms perceive swath in two dimensions, but air-assist controllers account for multiple vertical booms or boom sections in the swath (see the following figure).



Field sprayer rate controllers used in vertical crops must be “tricked” when programming swath. Leading air-assist rate controllers can assign flow to zones on a single vertical section (left) and adjust swath (sometimes called width) for multiple booms (right).

Flow meter

With rate controllers, flow is detected by one or more flow meters positioned pre-manifold. The relief valve becomes more of a safety device, defining the high-pressure limit and bypassing flow if required. Most rate controllers use a flowmeter with no ability to monitor pressure. While still effective, adding a pressure sensor ensures nozzles are operating in the desired pressure range. Turbine or paddle meters are inexpensive and acceptably accurate. They require periodic cleaning because some chemistry can accumulate and interfere with their moving parts. Filtration helps to minimize this issue. Magnetic or ultrasonic meters have no moving parts, higher resolution, wider metering ranges and aren’t affected by the viscosity of the spraying solution or entrained foam. However, they are considerably more expensive than mechanical meters.

Flow control valve

Unlike boom control valves that are open or closed, flow control valves are capable of a range of adjustments. Valve actuation is controlled by 12-volt servomotors. The level of precision depends on the style of valve.

- **Butterfly valves:** Simple, inexpensive, and typically for pressures <10bar (150psi). Some have minor leak-by when closed. Control is less precise as the valve opens because the orifice gets geometrically larger. This gives a narrow metering range.
- **Calibrated ball valves:** Versions available for all pressures. May be simple flow through balls with similar metering limits to a butterfly. A better ball design is also available that offers a linear flow rate through the entire adjustment range, offering more stable rate control over the entire flow range. Several manufacturers offer these. All ball valves offer zero flow when closed.



Left- A butterfly valve. Right- A ball valve. Notice how a small change in the opening angle translates into a large change in the orifice size; this is difficult to control manually. Servomotors not pictured.

Compared to field sprayers, air-assist sprayers travel slower and use lower flow rates. It is a mistake to employ valves intended for high-flow, high-speed sprayers.

- **Speed:** Valves are rated by connection size ($\frac{1}{2}$ ", $\frac{3}{4}$ ", etc.) and opening time (e.g. 1-14 seconds are common). Many rate controllers can be programmed to optimize adjustments for the speed and size of the valve.
- **Precision:** As control valves open over their 90° range, the ability to control flow is less precise. Slower valves give less precision, but greater stability.
- **Size:** Valve size should accommodate maximum flow and no more. If the valve is too large, it can only meter flow over the first few degrees of opening. For example, let's say a valve capable of 200 L/min (50 gpm) and rated 1 second is used. Your sprayer meters 0-20 L/min (0-5 gpm). This means the whole metering range happens in the first tenth of a second. Even lightning-fast consoles will give unstable readings (aka hunting) as the computer overshoots the target in an effort to comply.

Control valves are "service parts". Seals, moving parts and abrasive liquids mean they will require regular care and eventual replacement. It's a wise precaution to make them accessible and easily removable. We suggest installing them with quick-connects (see top-right of the previous collage of rate controller components above) to make field-maintenance fast and easy.

Speed sensor

Speed can be based on GPS, engine tachometer readings, radar, or wheel rotations. Newer rate controllers may even take the speed directly from the tractor's data feed. Price, reliability and crop conditions are all factors you should consider in the choice.

- **GPS:** Easiest to deploy, very accurate (especially RTK-GPS) and reasonably priced. However, overhead canopy can block satellite signals. Some controllers compensate for the GPS losses with sophisticated internal kinematic devices that measure the inertia of the sprayer and calculate speed when the GPS is not reliable.
- **Wheel rotation speed sensors:** An entry-level sensor, it's typically a reed switch or Hall effect sensor that detects either the lug nuts or magnets installed on the rotating wheel. More magnets improve accuracy. Its exposure makes it prone to physical damage, and readings change with tire radius (which changes as the tank empties, on soft ground and with temperature). This is why wheel sensors are calibrated in the alley, with the tank half full and both tires at the same pressure.

- **Radar speed sensors:** Employing the Doppler effect to measure speed, radar is the most accurate sensor. They are unaffected by terrain, slope or tank volume. They can be mounted anywhere in sight of the ground. They are, however, the most expensive and are typically not repairable if they fail.
- **Tachometer speed sensors:** Largely obsolete, they measure the tractor's tachometer speed and convert it to travel speed. Difficult to install and prone to the same inaccuracy as wheel sensors.
- **Interface sensors:** Relatively new, some rate controllers interface with tractor electronics to receive speed data. ISOBUS, the standard interface language that agricultural electronics are increasingly adopting, makes this data exchange more common.

Wire harness

It may seem we're drilling deep to mention wires, but standards are changing. Many controllers employ traditional analog wiring, but they are being made obsolete by the newer ISOBUS option.

- **Traditional Analog:** Simple wires with automotive or custom plugs designed to match components. Relatively inexpensive and sometimes field repairable, analog wiring carries signal voltage (and power) to and from the controller to drive valves and receive analog sensor data. Communication is one-way: Sensor to controller, controller to valves.
- **Modern ISOBUS:** Bus systems are more like a computer network, where digital signals travel back and forth between the controller and each component. Components that require power are wired directly to a battery. This results in a greatly simplified harness. The controller's single ISOBUS wire "daisy chains" all components to relay commands and receive status, which makes system monitoring and diagnosis easier and more effective.

Conclusions

Rate controllers are a worthy consideration for your existing or future air-assist sprayer. Assess your needs and work with a knowledgeable dealer or manufacturer that can assemble and install a system appropriate for your operation.

Making the Most of Your Crew at Harvest

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2020 has presented some difficult challenges throughout the production season, especially around seasonal agricultural worker arrival. As workers are still trickling in, there are many growers facing the harvest season with a reduced crew. There were results found from timing and observing labour crews in 2016 and 2018 in Ontario orchards that could help you in your operation this year (and future years) to increase productivity.

2016 Labour Tracking Project Key Findings at Harvest

Background

In 2016 we timed many hand-labour operations in 13 different orchards across all five districts in Ontario. The operations that we timed were pruning, hand thinning, planting and harvesting. For each operation we timed the number of cycles performed, i.e. for harvesting we measured these cycles as the number of baskets harvested. We also broke down the operation into different activities. For harvesting from a ladder, we broke the harvesting operation down into the activities found in Table 1. For harvesting from the ground or platform we recorded the same activities with the exception of ladder movement.

Table 1. Activities involved in the operation of harvesting

Activity	
1	Walk from bin to tree
2	Move and/or climb ladder
3	Picking apples
4	Move and/or climb ladder
5	Walk from tree to bin
6	Empty bag

We observed harvest crews in high- and medium-density orchards. We timed orchards from 11 different cultivars including Gala, Ambrosia and Honeycrisp. We were also able to time some crews in platforms.

Key Findings

One key finding was that efficiency was gained with smaller crews as seen in Figure 1. There was a clear trend that as crew size increased, so did the time it took to harvest a bushel of apples. An explanation for this trend is that as crew size increased, the crews tended to

have a greater spread in their formation in the orchard while harvesting and spent more time doing a non-value-add activity of walking to and from a bin. The term non-value-add activity comes from the lean manufacturing concept of breaking down an operation into value-add and non-value-add activities. The value-add activities are the actions that add value (or make you money) which include picking the apples and placing them with care into the bin. The non-value-add activities are necessary for the operation but do not increase the value of your production and include walking to and from the bin and ladder usage. You want to focus your crews' time and energy on value-add activities and minimize the time on non-value-add activities. Figure 2 shows a comparison of the time it took for workers to walk to and from bins from different placements in the orchard relative to the bin, i.e., inside of a row next to a bin, on the outside of that row, or picking from the next row over from the bin. As a worker gets further from the bin, it takes more time to pick the same unit of apples. We also saw that with a larger crew picking into one bin, some time was used up waiting for space at the bin to unload their basket.

We also found that using a platform instead of ladder to harvest greatly reduced the time to pick a bushel of apples, almost by half (Figure 3). When analyzing operations and breaking down the different activities involved in harvesting apples with ladders (Table 1), we found that a large percentage of time was spent moving the ladder (10%), as well as moving to and from the tree being harvested (10%) (Figure 4). Compare that to platform picking with which 93% of the time was spent picking and 7% of the time was spent emptying a basket (Figure 5).

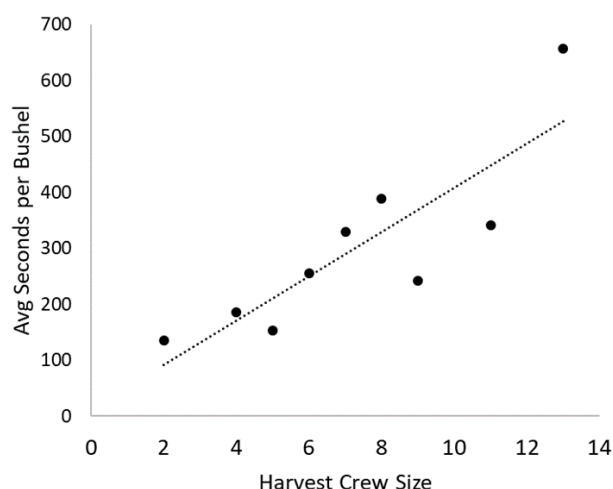


Figure 1. Average time to harvest a bushel of apples for different crew sizes

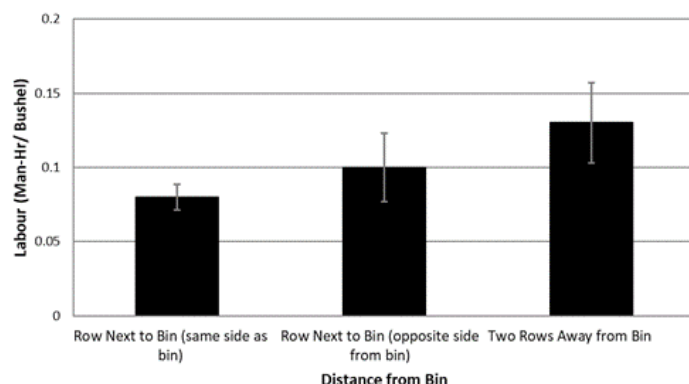


Figure 2. Comparison of the labour cost of harvesting based on the position of the person relative to the apple bin.

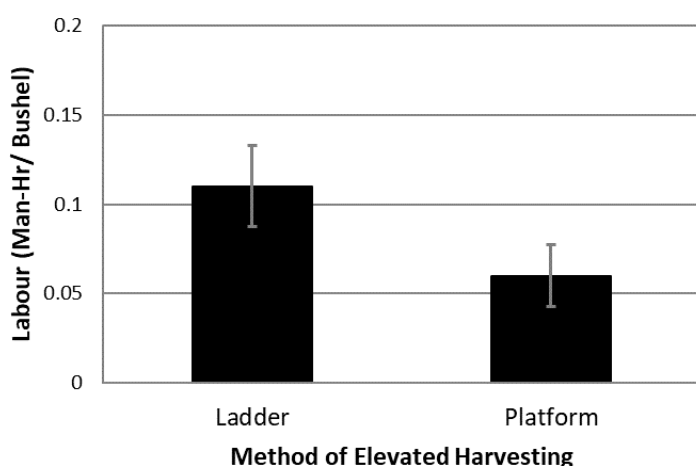


Figure 3. Comparison of the labour cost of harvesting using a ladder vs using a platform.

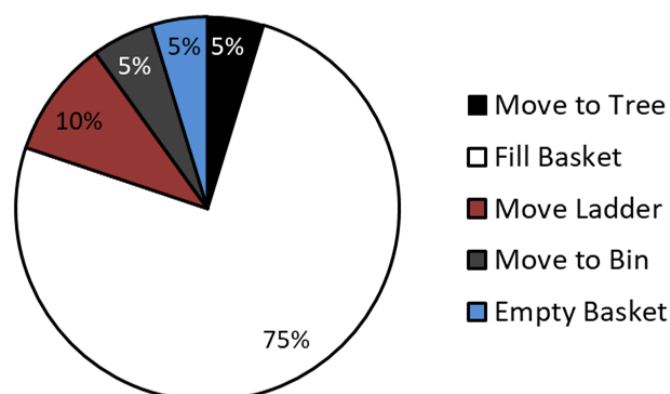


Figure 4. Orchard harvest operation with a ladder broken down into different activities. The pie graph indicates the % of time taken for each activity.

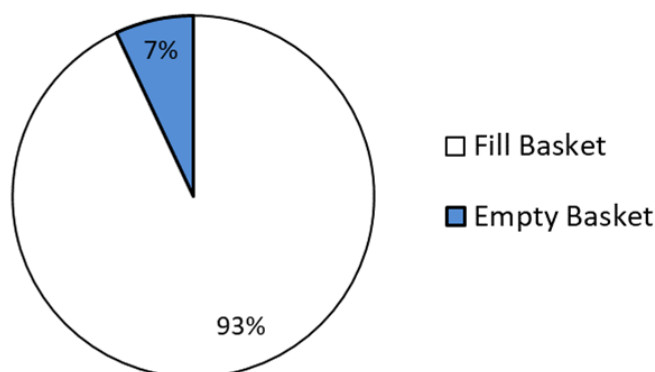


Figure 5. Orchard harvest operation with a platform broken down into the different activities. The pie graph indicates the % of time taken for each activity.

2018 Case Study

Background

In 2018 we performed a case study working with one orchard that had multiple crews. The crew sizes ranged from 12-17 and consisted of a leader, workers who would only pick from the ground, and workers whom mostly picked from a ladder with some ground picking. The leader would manage and adjust bin placement, give some direction to the crew, and also pick out leaves.

In this case study we temporarily reduced the crew size for 1-2 hours to see if efficiency was gained. We recorded the number of bins filled in a certain amount of time first with the crew in its original size and then reduced the crew and recorded again. Recordings were done within the same morning or afternoon block of time in the same orchard block to minimize effects on the recorded timings. We recorded the harvesting time for both Gala and Red Delicious.

Key Findings

The results we found were promising; we found that the man-hours per bin was less with a smaller crew size (Table 2), ultimately reducing labour cost. We found that there was an 11% and 58% improved productivity from reducing the crew size in Gala and Red Delicious, respectively. Not surprisingly, we found that bin fill time in Gala, was higher for a small crew compared to the larger crew. More surprisingly, we found that it took less time for a small crew to pick a bin in Red Delicious. It's important to note that these results were from a case study of a single orchard and results in your orchard may be different. These results, however, do demonstrate the opportunity for improved productivity by reducing the crew size.

Table 2. A comparison of the labour cost to fill a bin for different crew sizes harvesting Gala and Red Delicious.

Cultivar	Crew Size (number per crew)	Bin Fill Time per Crew	Man-Hours/ Bin	Labour Cost/ Bin (@\$14/ hr)	Percent Improvement from Reducing Crew Size*
Gala	Large Crew (12-17)	0.233	3.308	\$ 46.32	10.64%
	Small Crew (8)	0.370	2.957	\$ 41.39	
Red Delicious	Large Crew (14-16)	0.158	2.321	\$ 32.49	58.45%
	Small Crew (9)	0.107	0.964	\$ 13.50	

**Note that these results were taken from one orchard and results may be different in your own orchard*

Table 3. Average time spent filling a picking bag/basket for workers picking from the ground, ladder, or a mix of picking from the ground and ladder.

Harvester	Crew Size	Average Time per Bag (sec)	Avg Time for Fill / Empty	% Value Add*
Ground	Large Crew	120.77	105.27	87.17%
	Small Crew	105.75	91.12	86.17%
Ground / Ladder	Large Crew	211.84	138.7	65.47%
	Small Crew	184.64	151.34	81.96%
Ladder	Large Crew	177.35	122.25	68.93%
	Small Crew	191.7	147.7	77.05%

** % Value Add is the percent of total time per bag spent filling and emptying the basket.*

The time it took for individual workers to fill a picking bag was also recorded and broken down into the time spent doing value-add activities (filling and emptying the bag) and non-value-add activities (walking to and from the bin, and moving and climbing a ladder) (Table 3). We categorized workers as: only picking from the ground, only picking from the ladder or a mix of picking from the ground and the ladder. Picking from the ground took less time to pick a bag than picking with a ladder and there was a higher percentage of time spent picking and emptying the bag. While the percentage of time spent on value-add activities for ground harvesting in large and small crews was similar, improvement in worker productivity was found for ground/ladder and ladder harvesting in the small crews. These results indicate that when working in small crews, workers using ladders spend less time walking and moving ladders and more time on value-add activities.

Some drawbacks or barriers to reducing the crew size includes adapting the workers to a new formation and adjusting how you manage the crews. The workers generally didn't favour the smaller crew as they felt that

they were moving through the orchard slower, especially compared to larger neighbouring crews advancing faster. This sentiment may be mitigated if all crew sizes are reduced and picking at a similar pace. At this orchard, each crew had a leader and with smaller crews, more leaders would be needed. The roles of the leaders would also have to be adjusted as there would be less management required for a smaller crew; crew leaders should have the understanding that they should be spending more time picking with a smaller crew. Alternatively, the team approach could be changed with a smaller crew with which you eliminate the leadership role, have more initial team training, and encourage more communication amongst the team.

Recommendations to take forward:

- Try to break your crews into smaller groups; we do realize that this could be limiting due to the equipment you have.

- Try to minimize time spent doing non-value-add activities, ie. ladder usage, walking to and from the bin. Moving to and from a bin can take, on average, 10% of the time spent harvesting. This could be minimized by keeping bins close to workers with bin wagons, front end loaders, or bin movers. If your operation places bins out ahead of time, try to move the next empty bin to be filled closer to the crew. You could also have the workers who are at
- If you use ladders, try to have as many apples as possible harvested from the ground. To ensure this, you could have harvesters pick as much as possible from the ground first and then use ladders or have your ground-only harvesters go through first, followed by your harvesters picking from ladders.
- Platforms are more efficient for harvesting and other hand-labour operations than using ladders. For harvesting, consider that your crew spends 18% more time doing a value-add activity of picking than with ladder use. By a rough calculation, if your crew is spending half the time picking from a ladder, 9% of your total harvest labour cost is ladder movement and placement, climbing up and down a ladder and walking to and from a bin. This might help you to consider if investing into a platform is worthwhile for your operation. You could also consider that workers on platforms would be less fatigued and more productive than workers climbing up and down a ladder all day.
- If you have crew leaders, make sure they are providing active leadership and giving direction to other crew members to pick more efficiently (ie. stop harvesters from crowding in one tree, having some members start filling up the next bin ahead if the current bin is almost full, or move the next empty bin closer) otherwise, have them actively picking unless to move the trailer, tractor or bin.
- Time can be lost with shifting from one block from another. Try to plan your crew's location to minimize crew movement from orchard block to orchard block. If you know you will be picking more than one block within a day, start your day by dividing your crews between these blocks strategically to minimize movement time between blocks.

Crop Protection

Suspect you have herbicide resistant weeds? Participate in a genetic testing sampling project

Kristen Obeid, Weed Management Specialist – Horticulture, OMAFRA

Do you suspect that you have herbicide resistant weeds on your farm? If so, why not get them tested for free through a genetic testing sample project. So far there are 16 (5 more in progress) genetic quick tests to assist in identifying herbicide resistance in 12 weed species. Some of these tests were implemented from scientific literature and two are new discoveries. Traditional resistance testing in the greenhouse can take from three months to a year to get results back to growers, whereas these new tests deliver a diagnostic and a recommendation to the grower within the same growing season. These new tests use leaf tissue instead of seed and DNA is extracted from the tissue to determine if there is a change in the sequencing resulting in a mutation conferring resistance.

Tests have also been developed to differentiate between *Brassica* and *Amaranthus* (pigweed) species. Tests differentiating pigweed species have been instrumental in confirming new cases of waterhemp in Ontario (25), Manitoba (7) and Quebec (9). Once confirmed, the waterhemp was tested for Groups 2, 5, 9 and 14 resistances.

If you suspect you have any of the above herbicide resistant weeds and would like to get your fields tested for free (through project funding), Contact Kristen Obeid for sample collection kits and sampling protocols.

Email: kristen.obeid@ontario.ca Phone: 519-965-0107

DUE TO COVID-19 we have a new process this year.

Samples need to be sent directly to the lab and a submission form filled in on-line at: www.harvestgenomics.ca

**Harvest Genomics
c/o Chris Grainger
5420 Highway 6 N, Orchard Park
Guelph, Ontario
N1H 6J2**

519-635-4470

For all samples, please send an email to Kristen Obeid and Chris Grainger (chris.grainger@harvestgenomics.ca) to let us know that a sample is being sent to the lab. Please document the tracking number of the package in the email.

If you would like to drop off a sample to the lab you must call ahead and let Chris Grainger know it is coming.

Collaborators:

- Ontario Ministry of Agriculture Food and Rural Affairs: Kristen Obeid and Mike Cowbrough
- Saint-Jean-sur-Richelieu Research and Development Centre: Dr. Marie Josée Simard and Dr. Martin Laforest
- Harrow Research and Development Centre: Dr. Robert Nurse and Dr. Eric Page
- Pest Management Centre: Dr. Cezarina Kora

- Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec (MAPAQ) Pest Diagnostic Lab: David Miville
- University of Guelph: Dr. Darren Robinson and Dr. Peter Sikkema
- Since September 2019: Ontario Fruit and Vegetable Growers Association, Ontario Apple Growers, Fresh Vegetable Growers of Ontario, Ontario Processing Vegetable Growers, Bayer, FMC and Syngenta Canada.

This project was partly funded through the Pest Management Centre's [Pesticide Risk Reduction Program](#).

Table 1. Genetic Tests Available

Weed Species	Herbicide Group	Resistance & Tests
Large crabgrass	1	Target-site: ACCase gene amplification
Common chickweed	2	Target-site (P197Q & unpublished)
Common ragweed	2	Target-site (W574L)
Eastern black nightshade	2	Target-site (A205V)
Green pigweed	2	Target-site (S653N & W574L)
Giant foxtail	2	Target-site (unpublished)
Redroot pigweed	2	Target-site (S653N & W574L)
Waterhemp	2	Target-site (S653N & W574L)
Common ragweed	5&7	Target-site (V219I)
Green pigweed	5&7	Target-site (A251V, S264G**, V219I & F274L)
Lamb's-quarters	5	Target-site (S264G)
Redroot pigweed	5&7	Target-site (A251V, S264G**, V219I & F274L)
Waterhemp	5&7	Target-site (A251V, S264G**, V219I & F274L)
Brassica spp.	9	Presence of transgene
Canada fleabane	9	Target-site (P106S)
Waterhemp	9	Target-site: EPSPS gene amplification
Waterhemp	14	Target-site (Δ G210 in PPX2L)
Amaranthus spp.	-	Species identification
Brassica spp.	-	Species identification

*Several of these tests were developed by other researchers (Francois Tardif) and reproduced from the scientific literature.

**S264G mutation only induces resistance to Group 5 herbicides, not Group 7.

The Latest on Bitter Rot

Katie Goldenhar, Pathologist-Horticulture, OMAFRA
Dr. Asifa Munawar, Research Associate, University of Guelph

Kristy Grigg-McGuffin, Horticulture IPM Specialist, OMAFRA

Biology & Symptoms

Bitter rot has consistently been identified by growers, consultants, and extension specialists as a threat to the apple industry since 2012. All growers are encouraged to scout for this disease on fruit at this time of year. It has been found in all apple growing regions of the province, particularly those orchards that have had both warm temperatures followed by rain.

Bitter rot is a late season disease, caused by fungi in the *Colletotrichum* genus, that can severely impact fruit quality. The spores of the pathogen are suspected to infect fruit at any time from as early as petal fall right up until harvest. However, symptoms often show up mid-late season after a period of warm weather accompanied by rain or a thunderstorm. The hemibiotrophic life cycle of the pathogen allows it to infect and live within the host with no visible symptoms. This leads to the sudden appearance of symptoms on apple fruit at or close to harvest causing crop loss. Symptoms can also appear in storage.

Initial bitter rot infection appears as small reddish or brown spots (Figure 1a) that quickly enlarge into circular sunken light to dark brown rots on infected fruit (Figure 1b). As the external fruit lesions enlarge, a diagnostic V-shaped rot may progress towards the core (Figure 1c), but this does not always occur. Warm temperatures hasten the rotting process until the fruit becomes shriveled and completely rotten. Severely rotten fruit often fall from the tree prematurely. During humid conditions, cream- to salmon-coloured masses of spores are produced on the surface of the rotting fruit which are very diagnostic (Figure 1c). These spores can then be rain splashed to other fruit resulting in further infections. If the spores land on fruit just before or during harvest, infection can occur and small bitter rot lesions will develop slowly while in cold storage. Often a few small black spore-producing structures develop within the lesions during cold storage. These small lesions will begin to enlarge within a few days after the fruit is removed and sits at room temperature.



Figure 1. A-Initial bitter rot lesion, B-progressed lesion, C-V shaped internal rot with cream- to salmon- coloured spores formed on the outside of the fruit.

The pathogen can overwinter in infected mummified fruit left on trees or on the orchard floor. It can also colonize cankers caused by other pathogens such as fire blight or black rot. There have been reports of bitter rot appearing in orchards that also had fire blight, possibly due to the pathogen surviving in the fire blight cankers and spreading to fruit later in the growing season.

Current Management

Management of bitter rot is through good orchard sanitation. Removing old fire blight, black rot and other cankers will reduce the potential of an over-wintering source of this disease in the orchards. Mulching or removing fruit on the orchard floor following hand thinning and harvest will also help reduce inoculum and the potential of spreading the disease.

While Allegro (PHI 28 days), Pristine (PHI 5 days), Granuflo T (PHI 28 days) and Maestro/Supra Captan (PHI 15 or 19 days depending on orchard density) are registered for control of bitter rot, some other scab fungicides may also provide protection. Summer applications should be made every 10-14 days if there is a history of rot in the orchard but shortened to 7 days if frequent rain is experienced. If possible, time an effective fungicide application just prior to a rain to protect healthy fruit from rain-splashed spores. Always rotate fungicide groups to reduce the potential for resistance development.

New York *Colletotrichum* Species Research

The recent study [Identification and characterization of *Colletotrichum* species causing apple bitter rot in New York and description of *C. noveboracense* sp. nov.](#) at

Cornell University has identified the primary *Colletotrichum* species associated with bitter rot. Previous studies have shown that *Colletotrichum* species belonging to different species complexes have different sensitivities to fungicides as well as temperature preferences for infection and sporulation. In the study, 400 samples were collected from apple orchards with symptomatic fruit. The results showed that 60% of symptomatic fruit samples were caused by *Colletotrichum fioriniae*. The results are consistent with preliminary survey results from OMAFRA in 2013 where samples collected from symptomatic apples were primarily identified as *C. fioriniae*.

In the Cornell study, two other species were identified as causing bitter rot, *C. chrysophilum* and *C. noveboracense*. This is the first time that *C. chrysophilum* has been described on apples. It was previously identified on other fruit crops but may be important in bitter rot in apples. *C. noveboracense* is a novel species that has never been identified on any crop. Both *C. chrysophilum* and *C. noveboracense* belong to the *Colletotrichum gloeosporioides* species complex, which is typically associated with warmer environments, due to the species having higher temperature preferences for growth and sporulation.

Ontario 2019 Survey Results

In Ontario, the incidence of bitter rot in field and storage has not been fully studied. The University of Guelph's pathology team at Simcoe conducted a bitter rot survey in 2019 as part of their ongoing research project to better understand the impact of this disease and effective management measures.

Who participated in the survey?

In September 2019, 13 orchards from four apple [districts](#) (1, 2, 3, 5) were surveyed based on the previous history of bitter rot, willingness of growers to participate in the study and willingness to provide fruit for storage assessment.

What was scouted?

Two susceptible cultivars, 'Empire' and 'Ambrosia' were scouted in each orchard for visible symptoms of bitter rot. In case an orchard did not have either one of the cultivars mentioned above, the next choice was either 'Honeycrisp' or 'Gala'. A minimum of every 10th or 25th tree in each orchard was visually examined for bitter rot lesions depending on the size of the orchard. Number of infected fruit and number of infected trees in a block/rows were assessed. A tree was considered infected if at least one fruit from that tree had bitter rot lesions.

Additionally, from each orchard, 10 asymptomatic trees of each susceptible cultivar were selected, and 10 asymptomatic fruit were randomly collected in separate bags from each tree. The fruit was stored at 4-5°C for five months and were then placed at 20°C for two weeks before assessed for bitter rot symptom development.

What did we observe?

Overall, due to the cool, wet season in 2019, bitter rot pressure was low to moderate across the province. The field pressure (incidence) of bitter rot for orchards in District 1 ranged from 0-12%, in District 2 from 0-38%, in District 3 from 0-4% and in District 5 from 0-14% (Figure

2). District 2 had higher average disease pressure compared to the other districts. The number of fruits infected in the field remained low, the highest being 0.4% in District 2.

The disease pressure was high in storage for most districts compared to field pressure. District 2 had the highest average tree and fruit infection (25% and 5%, respectively) followed by District 1 (13% and 2%, respectively), District 5 (10% and 1.3%, respectively) and District 3 (0%). District 3 had no bitter rot infection in storage.

Summary

The disease pressure of bitter rot remained low to moderate in 2019 and was variable from orchard to orchard. Overall, District 2 had higher pressure. Amongst the most scouted cultivars, 'Empire' had higher disease incidence than 'Ambrosia'. The results of field incidence data were similar to the OMAFRA bitter rot survey conducted in 2013 where Districts 2 and 5 had higher disease incidence followed by Districts 1, 4 and 3.

Surveys will be conducted again in 2020. Fungicide sensitivity testing of Ontario collected *Colletotrichum* strains is also on-going.

Acknowledgements

The survey study team Asifa Munawar, Vivian Adam, Cathy Bakker and Katerina Jordan. The pathology research team at Simcoe is grateful to the Ontario Apple Growers and the Ontario AgriFood Innovation Alliance Research Programs for providing funding for this research.

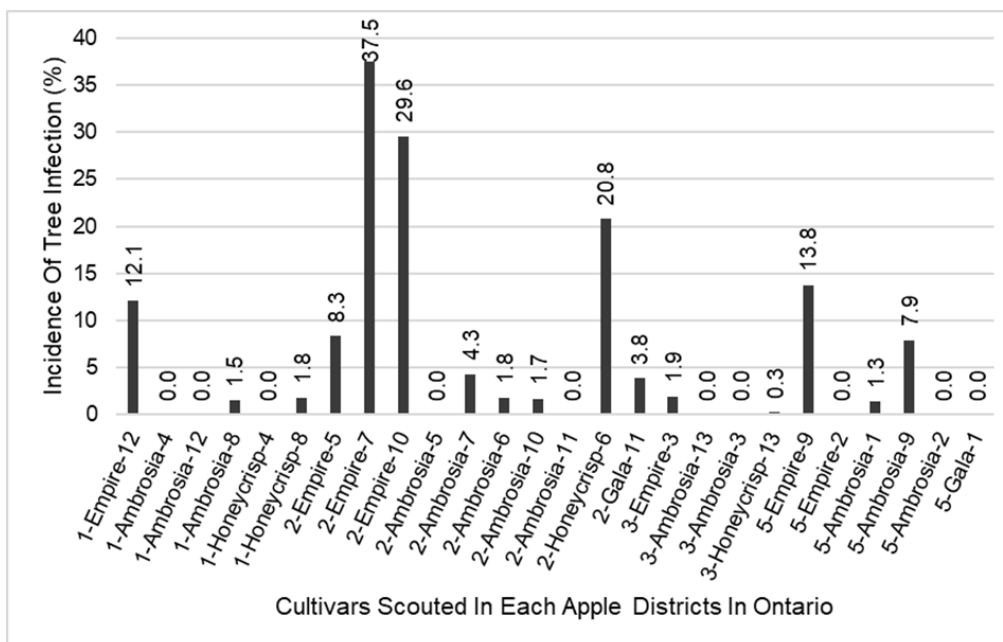


Figure 2. Bitter rot disease pressure (incidence) in each apple districts in September-November 2019 in Ontario. The number before the cultivar indicates district and after the cultivar indicates orchard number.

Late Arrival? Late Season Apple Maggot Management May Still Be Needed

Kristy Grigg-McGuffin, Horticulture IPM Specialist, OMAFRA

With the hot, dry season in 2020, apple maggot activity has been fairly low in most orchards. However, regions that have experienced some rain in recent weeks are seeing an increase in adult flight. Emergence is closely linked to soil moisture - in dry years, pupae can remain in the soil until environmental conditions become more favourable, even into the following growing season. If more rain continues in the weeks leading up to harvest, there is a possibility of seeing a spike in apple maggot activity. This activity can carry on until the first hard frost, which means late season sprays may be needed if insecticide residues are no longer present (generally 2-3 weeks, depending on product). While harvest will undoubtedly take most of a grower's attention, it is still important to continue monitoring maggot activity since if left uncontrolled can wreak havoc on a potentially good crop.

Apple maggot adults (Fig 1) emerge from pupae in the soil from June through until September, with peak flight occurring in August. Females can lay up to 300 eggs in their 30 day lifespan. Eggs are deposited individually, under the skin of the developing fruit. The larvae emerge within 3-7 days and begin burrowing into the fruit and feeding. Larvae remain in the apple for 20-30 days, after which they exit the fruit and tunnel into the soil to pupate. Although apple maggots have only one generation per year, they can be active in an orchard until the first hard frost.

Apple maggot damage can occur in two ways. The adult female creates oviposition stings on the fruit surface by laying her eggs under the skin, leaving a sunken or dimpled appearance (Fig 2). After hatching, the larvae tunnel within the fruit and cause breakdown and discoloration of the pulp (Fig 3). Invasion by disease fungi, such as *Alternaria* spp. and *Pseudomonas* spp. leads to further decay and heavily infested fruit can become completely rotten.

Monitoring apple maggot populations is critical for timing spray applications to ensure effective control of this pest. In Ontario, we use 5 yellow sticky traps with lures to monitor apple maggot. In mid- to late June, traps should be placed 30 feet apart in trees along the edge of the orchard near wooded areas, at eye level, and positioned so they are surrounded by fruit and foliage. Check traps twice a week for adult apple maggot, which can be distinguished from related fly species by the F banding on its wings (Fig 4).

There is zero tolerance for fruit infestation from this pest in conventional orchards in Ontario. Insecticide sprays should be applied 7- 10 days after the first adult maggot is caught on a yellow board. Make subsequent applications every 14-21 days, or as continued trap catches warrant. Use shortened intervals in orchards where trap catches are continuous and high. Also be aware products may vary in residual activity, so some products may need to be applied more frequently than others.

Table 1, adapted from John Wise, Michigan State University (2019), summarizes the characteristics of apple maggot products. Organophosphates (Imidan) and neonicotinoids (Assail, Calypso) are the only insecticide groups that have activity on the adults as well as a curative effect on the eggs and larvae due to their ability to penetrate into the flesh of the fruit.

The timing of apple maggot sprays usually coincides with codling moth control applications, and as a result a single insecticide spray can often be used to manage both of these pests. It is important to remember that while some of the newer chemistries (Altacor, Delegate) provide effective management of codling moth, they will only provide apple maggot suppression in low pressure orchards. Exirel seems to have good activity on apple maggot. However, this product cannot be tank-mixed or used in sequential applications with strobilurins, copper or captan fungicides. The previously mentioned products as well as the neonicotinoids, Calypso and Assail have residual activity that lasts 10-14 days, so re-application will be necessary. The organophosphate, Imidan is effective in managing both codling moth and apple maggot in orchards, and the residual lasts 18-21 days.

Surround (kaolin clay) can be an effective tool for managing apple maggot. However, applications must be applied to orchards prior to adult emergence, and be maintained as long as flies continue to be captured. At this point in the season, it is too late to begin using this product effectively if it is not already in place. In orchards where Surround is being applied, use starch iodine tests to monitor fruit maturity in the last 2 weeks of crop development.

For most products registered for apple maggot, re-application will likely be necessary following a significant rainfall (>1 inch rain). Refer to the Orchard Network Newsletter article in this issue, "Rainfastness of insecticides and fungicides on fruit" for more information.

Border sprays of organophosphate insecticides applied to the outer 20 m of an orchard without a resident maggot population may sufficiently intercept any adults flying in from surrounding wild hosts. However, with consistently high trap catches or if damage is detected during routine monitoring of the orchard, return to a full cover spray program. The efficacy of border sprays using alternative chemistries, such as Calypso, Assail, Exirel, Altacor, Harvanta, Delegate or Surround is not yet established, and border sprays using these products are not recommended at this time.

Sanitation measures, including the removal and destruction of culled fruit following harvest will eliminate any larva that have not yet exited the fruit to pupate. Removing alternative hosts, including hawthorn or wild apple within 100 m of the orchard may also reduce pressure from migrating flies the following year. To eliminate any live larvae in harvested apples, a cold storage period of 8 weeks at temperatures below 5°C is effective in killing them. This practice may satisfy the export restrictions of some countries.

Table 1. Summary of insecticides used to manage apple maggot*

Product Name	Chemical Group	Life-Stage Activity	Efficacy	Residual Activity	Mite Flaring Potential
Imidan	Organophosphate	Eggs, larvae, adults	Excellent	14+ days	Low
Ambush, Mako, Perm-Up, Pounce, Up-Cyde	Pyrethroid	Adults	Fair-Good	7-10 days	High
Delegate, TwinGuard, GF-120 Fruit Fly Bait	Spinosyn	Adults	Fair	7-10 days	Moderate
Assail, Calypso	Neonicotinoid	Eggs, larvae, adults	Good-Excellent	10-14 days	Low-Moderate
Altacor, Exirel, Harvanta	Diamide	Adults	Fair-Good	10-14 days	Low
Surround	Not classified	Adults (deterrent)	Fair	7-10 days	Low

*Adapted from John Wise, MSU: <https://www.canr.msu.edu/news/managing-apple-maggots-with-insecticides>



Figure 1. Apple maggot flies. Note the rounded abdomen of the male (left) and pointed abdomen of the female (right). (Photo: Dr. Rob Smith, retired, AAFC Kentville)



Figure 2. Apple maggot oviposition sting on fruit.



Figure 3. Internal breakdown and discoloration of fruit as a result of apple maggot larval feeding.



Apple maggot or blueberry maggot fly



Cherry fruit fly



Black cherry fruit fly



Walnut husk fly (eastern)

Figure 4. Wing patterns of apple maggot and related species.

Feeling the Burn of Fire Blight

Kristy Grigg-McGuffin, Horticulture IPM Specialist,
OMAFRA

Ontario's Fire Blight Situation: 2020

A number of orchards across the province felt the burn of fire blight this year. Based on the Ontario fire blight prediction maps which use the Cougar Blight model, infection risk was high to extreme throughout bloom for all areas of Ontario except the far southwest since this area was in bloom a week prior. Some of the most damaging fire blight epidemics in the past have occurred under these weather conditions, including in orchards that have never experienced fire blight before. With that in mind, the Ontario situation could have been much worse than it was overall, indicating that with aggressive and proactive management programs, significant economic loss can be avoided.

Blossom blight

Since bloom, there have been steady reports of both blossom and shoot blight. A number of reasons came into play to create the perfect storm for blossom infection:

- While bloom happened quickly, this may have actually left the blossoms at greater risk of infection.
- Blooms were opening rapidly so if antibiotics were only applied every few days, this left a significant window (in bacterial infection terms) where new – and highly susceptible – blossoms were unprotected.
- Antibiotics applied prior to a blossom opening does not protect that new bloom; even those blooms that open shortly after a spray is applied.
- With the hot, humid weather, the bacterial populations would have been multiplying rapidly to the point where very little moisture (e.g. morning dew) would be needed to wash large amounts of this bacteria into the floral cup.
- Fairly substantial secondary, or rat-tail bloom was reported in varieties such as Ambrosia, Gala, Empire, Cortland and Crimson Crisp.

If infection risk conditions remain high for several days, consider how many new blossoms have opened when determining the interval between sprays. While this may seem labour intensive, for the short period that bloom is, this may save you time and money in the long run.

Shoot blight

Following bloom, conditions continued to be ideal for fire blight spread. Infection could be found moving from blossom blight and oozing cankers to the developing shoots, as well as some regional spread due to windy conditions. In that early timing shortly after bloom when shoots are rapidly growing, they are at their most vulnerable to shoot blight as this expansion causes micro-tears that act as entry points for the bacteria.

- The hot, humid weather hastened the bacterial spread through the vascular tissue. In a number of orchards, this movement was so fast that ooze could be found before the more characteristic symptoms were really evident. Typically, ooze can be found with the early morning dew before drying up with the sun. However, with such high humidity, ooze could easily be found throughout the day and for several weeks in some blocks. This meant that with strong winds, insect movement or spread by contaminated equipment (platforms, hedgers, pruning tools) or clothing, bacteria could be readily moved throughout a block. Secondary infection continued with the ideal conditions until terminal bud set in most areas.
- For information on pruning out fire blight strikes, see the ONfruit article, [Fire Blight Risk: Are You Out of the Woods?](#) or watch the Michigan State University video, [Fire Blight: Pruning Shoot Blight Strikes](#).

Important points to remember:

- Shoot blight management includes:
 - 1) Plant less susceptible varieties where possible
 - 2) Plant blocks such that more resistant varieties surround susceptible ones
 - 3) Control blossom blight
 - 4) Reduce inoculum by pruning out cankers and infected tissue
 - 5) Apply Apogee to manage vigour (except on Empire, Stayman or Winesap)
- Prune out infections early if just a few strikes per tree. Excessive pruning can stimulate growth, potentially making the situation worse.
- Continue managing fire blight throughout the season as infection can still occur through open wounds caused by strong winds, heavy rain and hail, insect feeding, pruning or mechanical damage.
- Inoculum can be spread large distances throughout a region during storms.
- Rescue treatments of Streptomycin need to be applied less than 24 hours after a trauma event, ideally 4-12 hours before bacterial growth progresses beyond Streptomycin's ability to control.
- The preharvest intervals for Streptomycin and Kasumin are 50 and 90 days, respectively.
- Cueva and Double Nickel are registered for the control of shoot blight following a trauma event. Studies have shown control is improved when Double Nickel is used in combination with Cueva.
- Like all coppers, there is the risk of russetting with Cueva. However, if fire blight is active in your orchard at the time of trauma, better to lose some fruit this season than trees later.

- Limit any hand labour activities such as thinning, pruning or removing suckers in dry conditions to avoid the potential spread of bacteria.

Hot Off the Press: Recent Fire Blight Research

Fire blight management has been a hot topic (pun intended!) lately for researchers in the northeastern US. I have summarized 3 research questions below.

Incorporating biologicals

The use of antibiotic-alternatives in early bloom has become more widely discussed for fire blight management in recent years. The early timing for products like biopesticides is important for a number of reasons.

- Firstly, because most of these products work by competitive exclusion, inhibiting growth or triggering a defense mechanism in the plant, they need time to colonize and become established.
- Many of these products provide only limited control under high pressure or during certain environmental conditions.
- Using these suppression products when there are few blooms and risk is lower, allows you to save your uses of antibiotics like Streptomycin and Kasumin for peak bloom and high infection risk events.

Research trials by Quan Zeng (Connecticut Agricultural Experiment Station [CAES]), Dan Cooley (UMass) and Neil Schultes (CAES) looked at non-antibiotic control methods such as Double Nickel, Blossom Protect, Bloomtime, Cueva and Oxidate over 4 years on Red Delicious. Blossom Protect consistently out-performed the other products as a stand alone program and was not significantly different from Streptomycin control in some years. This efficacy was only improved with the addition of the surface sterilant, Oxidate. The recipe for the most effective non-antibiotic method they found were:

- Early to full bloom – 2 applications of Blossom Protect
- Full bloom – 1 application of Oxidate
- 24 hours after bloom – 1 application of Oxidate, if pressure is high or if there is a history of fire blight in the orchard

Rethinking Apogee

Apogee use for fire blight management is becoming more common in the province. Most growers try to aim for king bloom petal fall for management of fire blight shoot infection; however, some growers are applying Apogee earlier between pink to bloom if there is terminal growth. This product works by:

- 1) Reducing vegetative growth of susceptible shoots and limiting spread of fire blight infection
- 2) Thickening the cell wall to provide a physical barrier from bacterial infection

- 3) Stimulating plant defense system and production of antimicrobial compounds to reduce infections.

Following the label, Apogee can be applied between 2.5-5.5 cm of new shoot growth. That early range can easily occur prebloom depending on the spring.

Since the use of Apogee has been known to reduce shoot blight largely due to the thickening of the cell walls within the shoot, recently published research by Anna Wallis and Kerik Cox from Cornell University proposed Apogee could do the same to reduce blossom blight by thickening the cell walls of blossom pedicels. With their trials on mature Gala, they saw over 70% control of blossom and shoot blight with a pink application of Apogee and minimal effect on tree growth.

Burning the midnight oil

The last food for thought on fire blight management I'd like to leave you with are the recent findings from George Sundin's team at Michigan State University. While there is an optimal temperature range for the fire blight pathogen to multiply, cooler temperatures when preceded by warmer temperatures can still be conducive to infection. If the cells are in the flowers from that warmer period, they can grow even if temperatures then cool down so risk still remains high.

What's even more interesting, Sundin found most growth actually happens overnight between 10:00 pm and 2:00 am. This is likely because the drop in temperature at night results in the formation of dew, which encourages the growth of the fire blight bacteria.

So what does this mean? When there is a potential high risk of infection, you may want to consider spraying the evening before rather than in the morning to avoid a night of significant growth.

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Rainfastness of Insecticides and Fungicides on Fruit: A Reprise

Kristy Grigg-McGuffin, Horticulture IPM Specialist - Apple, OMAFRA

Wendy McFadden-Smith, Horticulture IPM Specialist - Tender Fruit & Grape, OMAFRA

While it may be strange to focus on residue wash-off during a dry year such as this, it is still important to understand rainfastness, or the ability of a pesticide to withstand rainfall, to ensure proper efficacy. While rain events were sporadic in many areas, it seemed when they did occur, the rainfall was heavy. Not only does the amount of rain impact rainfastness but also the age of the spray.

All pesticides require a certain amount of drying time between application and a rain event. Typically, residue loss by wash-off is greatest when rain occurs within 24 hours of spraying. After this point, the rainfastness of a product will depend on formulation, adjuvants and length of time since application.

Rainfastness of Insecticides

John Wise, Michigan State University has studied rainfastness of common tree fruit insecticide groups and his findings are summarized below. For the complete article, refer to https://www.canr.msu.edu/news/rainfast_characteristics_of_insecticides_on_fruit. Note that some products listed in this article may not be registered for use in Canada. Check with your local supplier or refer to the [2020-2021 Publication 360A, Crop Protection Guide for Apples](#) for a complete list of registered products.

According to Wise, the impact of rain on an insecticide's performance can be influenced by the following:

- 1) **Penetration** into plant tissue is generally expected to enhance rainfastness.
 - Organophosphates have limited penetrative potential, and thus considered primarily surface materials.
 - Carbamates and pyrethroids penetrate the cuticle, providing some resistance to wash-off.

- Spinosyns, diamides, avermectins and some insect growth regulators (IGR) readily penetrate the cuticle and move translaminar (top to bottom) in the leaf tissue.
- Neonicotinoids are considered systemic or locally systemic, moving translaminar as well as through the vascular system to the growing tips of leaves (acropetal movement).
- For products that are systemic or translaminar, portions of the active ingredient move into and within the plant tissue, but there is always a portion remaining on the surface or bound to the waxy cuticle that is susceptible to wash-off.

- 2) **Environmental persistence and inherent toxicity** to the target pest can compensate for wash-off and delay the need for immediate re-application.
 - Organophosphates are highly susceptible to wash-off, but are highly toxic to most target pests, which means re-application can be delayed.
 - Carbamates and IGRs are moderately susceptible to wash-off, and vary widely in toxicity to target pests.
 - Neonicotinoids are moderately susceptible to wash-off, with residues that have moved systemically into tissue being highly rainfast, and surface residues less so.
 - Spinosyns, diamides, avermectins and pyrethroids are moderate to highly rainfast.
- 3) **Drying time** can significantly influence rainfastness, especially when plant penetration is important. For instance, while 2 to 6 hours is sufficient drying time for many insecticides, neonicotinoids require up to 24 hours for optimal penetration prior to a rain event.
- 4) **Spray adjuvants** that aid in the retention, penetration or spread will enhance the performance of an insecticide.

The following tables can serve as a guide for general rainfastness to compliment a comprehensive pest management decision-making process.

Table 1. General characteristics for insecticide chemical classes

Insecticide Group	Rainfastness ≤ 0.5 inch (1.25 cm)		Rainfastness ≤ 1 inch (2.5 cm)		Rainfastness ≤ 2 inches (5 cm)	
	Fruit	Leaves	Fruit	Leaves	Fruit	Leaves
Carbamates (1A) <i>Lannate, Vydate</i>	M	M/H	M	M	L	L
Organophosphates (1B) <i>Imidan, Malathion</i>	L	M	L	M	L	L
Pyrethroids (3A) <i>Ambush, Decis, Mako, Matador, Perm-Up, Pounce, Silencer, Up-Cyde</i>	M/H	M/H	M	M	L	L
Neonicotinoids (4A) <i>Actara, Admire, Alias, Assail, Calypso, Closer, Clutch, Cormoran, Sivanto Prime</i>	M,S	H,S	L,S	L,S	L,S	L,S
Spinosyns (5) <i>Delegate, Entrust, Success, TwinGuard</i>	H	H	H	M	M	L
Avermectins (6) <i>Agri-Mek, Minecto Pro</i>	M,S	H,S	L,S	M,S	L	L
IGRs (15 & 18) <i>Rimon, Cormoran, Confirm, Intrepid</i>	M	M/H	M	M	L	L
Diamides (28) <i>Altacor, Exirel, Harvanta, Minecto Pro</i>	H	H	H	M	M	L

H –highly rainfast (≤30% residue wash-off), **M** –moderately rainfast (≤50% residue wash-off), **L** –low rainfast (≤70% residue wash-off), **S** –systemic residues remain with plant tissue

Table 2. Insecticide persistence, plant penetration and rainfastness rating.

Insecticide Group	Persistence	Penetration	Rainfast rating
Carbamates (1A) <i>Lannate, Vydate</i>	Short	Cuticle	Moderate
Organophosphates (1B) <i>Imidan, Malathion</i>	Medium-long	Surface	Low
Pyrethroids (3A) <i>Ambush, Decis, Mako, Matador, Perm-Up, Pounce, Silencer, Up-Cyde</i>	Short	Cuticle	Moderate-high
Neonicotinoids (4A) <i>Actara, Admire, Alias, Assail, Calypso, Closer, Clutch, Cormoran, Sivanto Prime</i>	Medium	Translaminar, acropetal	Moderate
Spinosyns (5) <i>Delegate, Entrust, Success, TwinGuard</i>	Short-medium	Translaminar	Moderate-high
Avermectins (6) <i>Agri-Mek, Minecto Pro</i>	Medium	Translaminar	Moderate
IGRs (15 & 18) <i>Rimon, Cormoran, Confirm, Intrepid</i>	Medium-long	Translaminar	Moderate
Diamides (28) <i>Altacor, Exirel, Harvanta, Minecto Pro</i>	Medium-long	Translaminar	Moderate-high

*Tables adapted from “Rainfast characteristics of insecticides on fruit” by John Wise, Michigan State University Extension, https://www.canr.msu.edu/news/rainfast_characteristics_of_insecticides_on_fruit

Based on simulated rainfall studies to combine rainfastness with residual performance after field-aging of various insecticides, including carbamates (Lannate), organophosphates (Imidan, Malathion), pyrethroids (Capture), neonicotinoids (Assail, Actara, Admire), IGRs (Rimon, Intrepid), spinosyns (Delegate) and diamides (Altacor), Wise recommends the following re-application decisions for apples. Additional work was done on grapes and blueberries; see Wise's article for this information. Among the crops, variation in rainfastness of a specific insecticide occurs since the fruit and leaves of each crop have unique attributes that influence the binding affinity and penetrative potential.

- **½ inch (1.25 cm) rainfall:** All products with 1-day old residues could withstand ½ inch of rain. However, if the residues have aged 7 days, immediate re-application would be needed for all products but Assail, Rimon, Delegate or Altacor on apples.
- **1-inch (2.5 cm) rainfall:** In general, most products would need re-application following a 1-inch rainfall with 7-day old residues, whereas Delegate and Altacor could withstand this amount of rain on apples and would not need to be immediately re-applied. Some products such as Imidan on apples could withstand 1 inch of rain with 1-day old residues.
- **2-inch (5 cm) rainfall:** For all products, 2 inches of rain will remove enough insecticide to make immediate re-application necessary.

It is important to note, not all products registered for the selected pests were included in this study. Refer to Publication 360A for a complete list of management options.

Rainfastness of Fungicides

There is no comparable research on rainfastness of fungicides and few labels provide this kind of information. Timing fungicides can be a challenge. Infection for most diseases requires rainfall. Fungicides are used mostly protectively so work best if applied before rain. But how well do fungicides stand up to rains that occur after application?

The general rule of thumb often used is that 1 inch (2.5 cm) of rain removes approximately 50% of protectant fungicide residue and over 2 inches (5 cm) of rain will remove most of the residue. Avoid putting on fungicides within several hours before a rainstorm as much can be lost to wash-off regardless of formulation.

When considering any foliar fungicide, the time from application to the next rain event is critical. If contact or systemic fungicides were applied and a significant rain event occurs within 2 hours, it is very likely that a large portion of that fungicide was washed off, and no efficacy should be expected after the rain event. Both contact and systemic fungicides may also be susceptible to some level of wash-off within 12 hours of application. The intensity of the rainfall is also important: one inch of rainfall during a 1-hour period results in greater loss of pesticide efficacy than a slow drizzle lasting several hours.

Publication 360A provides information on whether a product is contact (protectant), locally systemic or fully systemic. Refer to Table 3-5. *Activity of Fungicides on Apple Diseases* for this information.

Systemic vs protectant fungicides

Locally or fully systemic fungicides generally provide better disease control than protectant materials during or after extended rainy periods. Systemic fungicides can generally be expected to be more rainfast because washing the material off just the surface does not fully remove them from the plant. However, you should still apply these fungicides with ample time before a rain event. Plan to apply these fungicides at least 12 hours before rain events, and a rain event within 2-3 hours could be expected to have removed most of the fungicide residues. If you get caught unprotected and you're relying on post-infection activity from a systemic product and sporulating lesions are already present, tank mix with a different fungicide group to reduce resistance selection pressure.

Sticker spreaders and residual activity

Sticker-spreader adjuvants can improve the residual activity of fungicides. However, the effectiveness of sticker-spreaders with fungicides is variable and product/crop specific. For example, in grape research trials, both Dr. Wayne Wilcox and Dr. David Manktelow had consistently better results with sulphur when a spread sticker was added. Indar gives better brown rot control when used with a non-ionic surfactant or other penetrating agent. However, captan, which is intended to stay on the surface, is notorious for causing injury when mixed with oils or some penetrating surfactants that cause them to penetrate the waxy cuticle. Penetrating agents don't help strobilurins; in fact, some fungicide/crop combinations have been associated with minor phytotoxicity due to excessive uptake. Consult labels for minimum drying times for individual products and recommendations for using surfactants.

Annemiek Schilder, Michigan State University, suggests the following to improve fungicide efficacy during wet weather:

- During rainy periods, systemic fungicides tend to perform better than protectant (or contact) fungicides since they are less prone to wash-off.
- Applying a higher labelled rate can extend the residual period.
- Apply protectant fungicides such as captan (Supra Captan, Maestro), mancozeb (Manzate, Dithane, Penncozeb) and metiram (Polyram) during sunny, dry conditions to allow for quick drying on the leaves. These types of fungicides are better absorbed and become rainfast over several days after application.

- Apply systemic fungicides such as sterol inhibitors (Nova, Fullback, Inspire Super), SDHI (Fontelis, Sercadis, Kenja, Aprovia Top, Luna Tranquility) and strobilurins (Flint, Sovran, Pristine) under humid, cloudy conditions. The leaf cuticle will be swollen, allowing quicker absorption. In dry, hot conditions, the cuticle can become flattened and less permeable, so product can breakdown in sunlight, heat or microbial activity or be washed off by rain.

For the complete article, refer to: https://www.canr.msu.edu/news/how_to_get_the_most_out_of_your_fungicide_sprays.

What's Your Apple IPM Report Card?

Kristy Grigg-McGuffin, Horticulture IPM Specialist, OMAFRA

Do you know how effective your pest management program was this year? With only a small time commitment required, a harvest assessment can provide information on what part of your management program went well (or not so well).

Advantages to doing a harvest assessment:

- Knowledge of this year's problems will help you **better prepare** your IPM program next year.
- Provides an accurate read of not only the **type** of damage but also the **extent** of damage in a block or orchard.
- Preparedness for **early season** pest management needs such as sprayer calibration, urea and/or leaf shredding for scab control, dormant oil for San Jose scale or early season copper and other fungicides for fire blight, scab and powdery mildew.
- Understanding what practices worked and what didn't will **save money** in input costs for future management programs.
- Improves **fruit quality** for any late season pest issues that may be observed and can be managed prior to harvest. This is particularly helpful if your scout has finished.
- Highlights any **susceptible varieties** or **hot spots** in a block or orchard, which allows targeted monitoring and potential spot treatments in future years.
- Provides a **historical record** for reference and increased awareness of potential challenges.

How should you do it?

In the field:

- Choose at least 10 (large trees) to 20

(dwarf trees) healthy trees randomly throughout the block.

- Select 200-400 apples (20-40 apples per tree), turning each to see all sides of the fruit without removing it.
- Randomly choose fruit from different positions on the trees: upper, inner and outer part of the canopy.
- Keep records for reference. Use the following [Apple Harvest Assessment Sheet](#) or template from Appendix H in Publication 310: Integrated Pest Management for Apples.

If a field assessment is just not feasible prior to harvest, a post-harvest evaluation of fruit can be done. However, this type of assessment will only provide information on severity of damage and not the location in the block this damage occurred. Examine 400-500 randomly selected fruit for each variety from harvest containers. If damage is found, you may want to increase the sample size in order to thoroughly assess the damage.

What should you look for?

Anything causing **2–5% damage** is of concern. Look for presence of:

- Larvae or larval feeding from oriental fruit moth, codling moth or other caterpillars
 - Oriental fruit moth: tunnel from calyx or stem end; tunnel in flesh of fruit
 - Codling moth: piles of frass at hole which can be side or bottom of fruit; tunnel to seed cavity of fruit
 - European apple sawfly: ribbon-like scar spiralling from calyx
 - Obliquebanded leafroller: surface feeding; scarred and misshapened fruit; leaves often webbed to fruit
- Black caps of San Jose scale and/or halos on fruit surface
- Distorted fruit caused by spring feeding caterpillar or rosy apple aphid
- Pits or stings caused by tarnished plant bug, stink bug or apple maggot
- Raised bumps by mullein bug, plum curculio or other plant bug
- Blotches/lesions caused by scab, sooty blotch/fly speck, rust or calyx end rot
- Lace-like russetting caused by powdery mildew
- Fruit rot
- Black rot: firm lesion; black fruiting bodies
- Bitter rot: sunken lesion; orange to salmon-coloured spores
- Vertebrate feeding such as deer, squirrel/chipmunk, turkey or other birds

As you walk through the orchard, also make note of damage to leaves, branches and graft unions caused by pests such as fire blight, scab, powdery mildew, leafroller, tentiform leafminer, leafcurling midge, mites and borer.

Go to [Ontario AppleIPM](#) for more information on these pests including descriptions and pictures of typical damage.

Which block should you do?

To get the best idea of what's happening in your orchard, assess all blocks. If time is limited, give yourself half an hour to one hour per block and select representative areas of the orchard. If you assess the same block every year, you can compare your results and notice trends over time.

Harvest assessments with reduced labour

In the era of Covid-19, many growers across the province are dealing with a reduced farm crew where daily activities must be prioritized. In situations like this, it is very easy to let harvest assessments drop off the table completely. However, try to consider whether there are still ways to evaluate this year's IPM program that work with your current operation:

- Minimize the number of blocks assessed, focusing on susceptible varieties, high risk or hot spot locations, etc.
- Stagger assessments to focus on key maturing varieties and limit number of blocks assessed per week
- Assign one farm employee with the task of completing assessments
- Consider bringing in outside help such as crop scout or consultant
- Limit time spent per block to ½ - 1 hour at most, ensuring you are still examining several areas of the block including perimeter
- Look for key pest issues that have been problems in the past or would result in greatest economic loss
- Assess fruit postharvest in the bin by selecting approx. 500 fruit/variety

Remember, simply determining this year's IPM report card will put you ahead of the game for next year's management program.

Provincial report card to date

Early harvest assessments have indicated an overall successful year for pest management despite the extremely hot, humid season. Fire blight pressure was

high in orchards across the province, with the exception of the far southwest. Overall, scab pressure was relatively low. However, conditions were very favourable for powdery mildew. Early signs of black rot and bitter rot were observed as well as both shoot and fruit symptoms of blister spot on susceptible varieties such as Mutsu and Golden Delicious. Damage caused by bloom and early petal fall insect pests such as mullein bug, tarnished plant bug, European apple sawfly and plum curculio can be found in a number of blocks. For most of these orchards, this was likely due to a delay getting bees out quickly enough this spring, preventing early intervention. Leafcurling midge remains a season-long issue in many orchards while others experienced higher pressure from potato leafhopper.

Post Harvest

Effects of 1-MCP Orchard Spray on Apple Quality

Dr. Jennifer DeEll, Fresh Market Quality Specialist – Horticulture, OMAFRA

1-Methylcyclopropene (1-MCP) is an inhibitor of ethylene action, which in turn slows fruit ripening. 1-MCP is the active ingredient in postharvest gaseous treatments, such as SmartFresh and Fysium, which are often used in apple storages to delay fruit ripening and retain good quality.

Harvista™ 1.3 SC is an orchard spray containing 1-MCP and it is currently registered for use in Canada. Application timing is 3 to 21 days prior to estimated harvest date (fruit ripening) and allowable rate is 100 to 300 g a.i. per hectare. Higher rates should be used for more advanced stages of maturity.

The following is a summary of the major effects of Harvista found during our 15 years of study:

For most apple cultivars, Harvista will inhibit ethylene production and therefore, reduce fruit drop, improve apple color and size, and reduce the number of harvests. It will also provide less variability in fruit maturity at harvest and thus allow for more effective postharvest 1-MCP treatments.

'McIntosh' is a high producer of ethylene and therefore, highly susceptible to fruit drop. Harvista can substantially reduce fruit drop in 'McIntosh', allowing for improved color and size. It also helps to improve firmness retention, especially in combination with postharvest 1-MCP treatments. After 3 months in air storage at 0°C, 'McIntosh' with no 1-MCP had 9.7 lb firmness (not marketable), while those sprayed with Harvista 9 days prior to harvest and treated 3 days after harvest with 1-MCP (SmartFresh, 1 ppm) had 14.2 lb firmness (significantly different from 13.2 lb firmness with only postharvest 1-MCP).

'Gala' typically has a wide range of fruit maturity at harvest time. Harvista can slow starch degradation and provide a narrower range of fruit maturity, which can result in fewer harvests. For example, 'Gala' showed starch value ranges of 1 to 2 and 1 to 5 ([Cornell chart](#)) with and without Harvista, respectively, after 6 days of spraying. Harvista can also improve firmness retention in 'Gala' after harvest and during storage, as well as substantially reduce stem cavity cracking and internal flesh browning development during storage. After 8 months in CA storage (2.5% O₂ + 2% CO₂) at 1.5°C, 'Gala' sprayed with Harvista at the highest rate 16 days prior to harvest, or with two half rates sprayed 16 and 10 days prior to harvest, had significantly lower incidence of stem-end internal browning compared to fruit without Harvista (6-7% versus 23% incidence, respectively). After 4 months in air storage at 0.5°C, similar 'Gala' with Harvista had significantly less stem cavity cracking than those without (7-10% versus 26% incidence, respectively). In the same trial, ReTain treated fruit had around half of the reduction in stem cavity cracking, with 16% incidence and not significantly different from non-sprayed 'Gala'. These effects on stem cavity cracking were also observed in the field prior to harvest.

'Honeycrisp' is extremely susceptible to soft scald and soggy breakdown, chilling-related disorders. Harvista can substantially reduce these storage disorders, with the most pronounced effects found using the full high rate. After 6 months of storage at 0°C, 'Honeycrisp' sprayed with 'Harvista' had significantly lower incidence of soft scald compared to fruit without Harvista (i.e. <2% versus 9-18% incidence, respectively (Year 1); 3-11% versus 45-47% incidence, respectively (Year 2)). Similarly, in a year of high soggy breakdown development, Honeycrisp' sprayed with 'Harvista' had significantly lower incidence compared to fruit without Harvista (i.e. 8-9% versus 42% soggy breakdown, respectively). Interestingly, these effects are not found with postharvest 1-MCP treatments.

'Delicious' is very prone to watercore, as sorbitol accumulates due to hastened or advanced fruit maturity. Harvista can reduce watercore development, along with the associated flesh browning during storage. Large improvements to firmness retention (+6 lb) have been found in 'Delicious' with Harvista and no other treatments.

'Ambrosia' loses acidity (flavor) and softens rapidly if not harvested at proper maturity. Harvista can improve acidity and firmness retention in 'Ambrosia' after harvest and during storage. It also can reduce internal/flesh browning and soft scald development in storage.

1-MCP in general, as well as other types of ethylene inhibitors (i.e. ReTain, AVG), will delay red color development as some maturation processes are delayed. Therefore, it is important to think of this aspect as you decide on application timings and rates. This has been especially true for 'Ambrosia', 'Gala', and 'Honeycrisp'. Such ethylene inhibitors will also increase fruit sensitivity to CO₂ and thus the incidence of CO₂ injuries during storage. Therefore, storage regimes should be revised accordingly if diphenylamine (DPA) is not being used on CO₂ susceptible cultivars.

Acknowledgements: Thanks to the Ontario Apple Growers, Norfolk Fruit Growers' Association, Apple Marketers' Association of Ontario, AgroFresh Inc., Pommex Philip Cassidy Inc., GRB Ag. Technologies Inc., Storage Control Systems Inc., Decco US Post-Harvest Inc., and the Canadian Horticultural Council (BC, ON, QC, and NB apple growers) for their continuous support, as well as Sky Lesage, Geoff Lum, and Younes Mostofi for their technical assistance. Recent work was funded in part through the Canadian Horticultural Council's Canadian Agri-Science Cluster for Horticulture 3.

Announcements

Goodbye and Thank You

Amanda Green, Tree Fruit Specialist, OMAFRA

I regret to inform you that after being in the role as the Tree Fruit Specialist for five years, I will be leaving OMAFRA as of September 3rd. I have had some changes in my personal life and will be moving away to pursue the next chapter in my life. I am very gracious for the support that apple growers in Ontario have shown me. I have very much appreciated how approachable you all are at meetings or over the phone and how you have welcomed me into my role. I was rarely turned down when I inquired to growers about co-operating on a project, speaking on a panel at OFVC, or being part of a tour, which made my job so much more easier and I am so gracious for that. I continue to be impressed with how progressive the apple growers in Ontario are and the willingness to share your knowledge openly at study groups and on the Young Ontario Apple Growers WhatsApp chat. I wish you all much success in the future.

Welcome, Cassandra!

With apple harvesting coming up, Cassandra Russell is stepping in to temporarily cover the role of Tree Fruit Specialist with OMAFRA until a formal hiring competition can be held. Cassandra was recently hired with OMAFRA as the Acting Vegetable Crops Specialist covering tomatoes, peppers, eggplants and beets. She holds a BSc from the University of Guelph and is currently finishing up her MSc in Environmental Sciences also at the University of Guelph. Cassandra's background is predominantly in entomology and integrated pest management where her research has helped to improve monitoring strategies for a new pepper pest to Ontario; the pepper weevil. You may already recognize her name if you've tuned into the What's Growing ON podcast that she co-hosts with Kristy Grigg-McGuffin. She has a passion for the agricultural sector, and strong skills in extension and collaboration and is looking forward to working on KTT projects in the apple sector. She can be reached at Cassandra.russell2@ontario.ca. Please give Cassandra a warm welcome as she transitions into her new role.

Agricultural Information Contact Centre: 1-877-424-1300

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