

ORCHARD NETWORK

For Commercial Apple Producers

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In this issue…

Orchard Management

2021 Season Overview

Erika DeBrouwer, Tree Fruit Specialist, OMAFRA

Lessons Learned

In 2012, Leslie Huffman released an article discussing the lessons learned throughout the growing season. Considering this past season has thrown just about everything at growers, this was a year where growers were also “waiting impatiently for this harvest season to end” – and rightfully so. The extreme weather that slammed the province affected apple yields in different ways – frost caused small and misshapen fruit, hail damage caused major losses, warm nights during harvest caused colour inconsistencies, and spring droughts could lead to future challenges.

Taking something from Leslie’s notes - what can we learn from this past season and how can these hurdles aid us in the future?

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A few degrees can make a difference. This is especially prominent in spring, where a few degrees can play a dramatic role in frost. This is also true in the heat of summer where a few degrees can impact the marketability and storability of your fruit.

Orchard location is important. Orchards close to a large body of water are less likely to have dramatic changes in temperature and weather, as the water acts as a regulator. Orchards close to Lake Erie and Lake Ontario had a solid crop load in comparison to other more central areas of the province.

Topography can help and hurt: Orchard blocks that are near slopes keep air moving, but more flat orchards often have frost pockets.

Frost protection works, *sometimes:* Certain areas were hit harder with frost than others. No matter the method of frost protection (helicopters, frost machines, sprinkler systems etc.), an inversion is needed to trap warm air above the orchard. If the temperature drops below the critical temperatures for an extended period or suddenly after a warm spell, and if there is not an inversion present, there is not much that can be done to protect your trees.

Cultivars, rootstocks and tree health affects frost tolerance: Some cultivars can be more tolerant than others, however it is difficult to determine as location differences and other factors play a role. Rootstocks being another factor; where M.9 rootstocks tend to carry blossoms closer to the ground, making them more vulnerable to frost damage. Tree health is another factor that is important for any sort of resilience during a tumultuous growing season. This includes nutrient accessibility, carbohydrates reserves, water availability, among others.

Secondary blooms produce lackluster fruit: Rattail bloom was common throughout the province, although this could act as a “backup”, these blooms rarely – if ever – produce fruit of high quality or size for market.

Frost is not the only weather risk: Although spring frosts caused a lot of damage this year, hail caused a range of damage. Dry weather in the spring caused stress on trees, along with our hot and intense sunshine this summer and fall. Extreme rainfall in some areas had trees sitting in water as well.

Given all of this information, the most beneficial strategy to produce high quality apples is through the incorporation of resilience and efficiency with orchard systems. Whether that be managing nutrient reserves, timely implementation of irrigation, implementing beneficial plants (pollinator plants, cover crops, windbreaks, etc.), use of available tools and equipment (hail netting, platforms, etc.).

Soil Health and Apples

Anne Verhallen, Soil Management Specialist - Horticulture, OMAFRA

The term soil health is becoming increasingly familiar, no matter what your cropping system is. Usually it is defined as “the continued capacity of the soil to function as a vital living ecosystem that sustains plants, animals and humans” (USDA-NRCS, 2012). Most of the research work that has been done on soil health has tended to focus on annual crops rather than perennial crops like apples. Even in annual crops one of the challenges with soil health has been to measure it. A recent project with Soil Health Institute (https://soilhealthinstitute.org/) measured more than 30 soil health indicators and three soil health test packages in a wide variety of long term research plots across North America in an attempt to define the most robust set of soil health tests. The sampled areas were all in annual crops or perennial forages.

Does soil health mean the same for an annual crop and an orchard? The growing knowledge suggests that there may be differences in the key soil health indicators depending on the production system. Probably the most comprehensive project looking at soil health in apple orchards is the one titled Measuring and Managing Soil health for Productive Orchards in Washington (http://treefruit.wsu.edu/orchard-management/soils-nutrition/soil-health-in-orchards/) . Lead by Tianna Dupont, this project looks at the link between soil health and apple yield and fruit quality in central Washington orchards. They have identified a minimum data set for assessing soil health under their conditions. They suggest % available water capacity, % sand and root health combined with standard fertility analysis is appropriate. The root health combines a root health rating performed with snap beans from the Cornell CASH and a measurement of root lesion nematodes. Tianna will be presenting some of her findings at the Soil Health and Cover Crops for Fruit production session at the Ontario Fruit and Vegetable Conference February 24 at 3pm.

Crop Protection

Degree Day Development for Apple Leafcurling Midge

Kristy Grigg-McGuffin, Horticulture IPM Specialist, OMAFRA

In the last few years, apple leafcurling midge (ALCM, *Dasineura mali*) has become relatively well established in many orchards across the province. Injury from this pest can now be found in all growing regions, with pressure ranging from minimal (<1% of terminals infested) to severe (>80% of terminals infested) in both dwarf and semi-dwarf blocks.
Typical damage caused by this gall-forming midge can cause leaves to form a tight curl (gall) around the insect (Fig. 1). The galls interfere with or stunt normal growth and development of trees, especially in nursery or young plantings. In most cases, impact is minimal on older trees except when pest pressure is high (>60% leaf area damaged). Reduction of photosynthetic leaf area can adversely affect total carbon acquisition, fruit size and bud formation (Allison et al., 1995).

Figure 2. Typical damage caused by apple leafcurling midge.

Figure 2. Daily trap catch of apple leafcurling midge can be in the ‘000s in high pressure orchard blocks.

Monitoring

Several studies from Europe have demonstrated a relationship between the number of ALCM caught on a pheromone trap for a particular generation and the number of galls that developed subsequently (Cross et al., 2009). It was estimated that a single ALCM male caught corresponds to approximately 140 galls/ha for that generation, provided there are sufficient shoots and new growth. In high pressure orchards monitored in the province, the average trap catch at petal fall has been upwards of 1,500 – 2,000 ALCM / day (Fig. 2), which equals the potential for 210,000 – 280,000 galls / ha / day for a single generation alone.

Current monitoring includes:

- Trapping – Deployed at tight cluster.
- Scouting – Presence of a) females laying eggs in new terminals (Fig. 3a), b) presence of orange eggs in unfurled leaves of terminal (Fig. 3b), c) early onset of leaf curling (Fig. 3c) or d) change of larva colour from cream to orange prior to pupating (Fig. 3d).
- For more detailed description of life stages, see a previous Orchard Network Newsletter article, Apple Leafcurling Midge: What to Look For and When.

Figure 3. Scouting for apple leafcurling midge (ALCM) includes detecting presence of: (a) female ALCM laying eggs in unfurled leaves of terminal, (b) eggs in folds of newest leaves of terminal, (c) newly formed galls and (d) late instar ALCM larvae which turn bright orange before dropping to soil to pupate.

Development of Degree Day Model

While the biology of ALCM is becoming well understood, management still remains a problem. Even with a systemic insecticide such as Movento, application timing is critical to target the appropriate life stages. Typically, growers don't notice there is a problem until galls appear which is often too little, too late. A degree-day model could help provide information necessary to know when appropriate measures should be applied.

Since 2018, seasonal trap catch and weather data from 38 sites across Canada, including 16 sites from Ontario, have been used to determine 5, 50 and 95% adult emergence for each generation (Table 1). This model development is being led by the Bioclimatology and Modelling Research Team with Agriculture & Agri-Food Canada in Saint-Jean-sur-Richelieu, QC.

Regional models have been developed due to the variation in Canadian climate from wet/warm (lower Fraser Valley, BC) to wet/cool (Maritimes) to temperate/dry (Quebec and Ontario) as well as varied winter temperatures and snow cover. All models are using a biofix of March 1st and base temperature of 9˚C.

In 2020 and 2021, preliminary models have been validated in Ontario based on trap catch from orchards in Norfolk County, ON. Figures 4 and 5 show a comparison of the predicted adult emergence period to the actual ALCM activity in each year. While both the national and regional models accurately predicted the 3 generations per year, as expected the Ontario-focused model tended to be more precise. However, emergence of 1st generation adults earlier than degree day model predictions can occur due to other factors, as seen in 2021 (Fig 5). This could include a spring following a mild winter (earlier ground thaw, less winter kill) and significant daily temperature fluctuations causing an underestimation (above base temperature for part of day despite no degree day accumulation). Validation of these models will continue.

Using Degree Day Model in Ontario

Growers looking to use degree day models to help determine targeted management should consider timing controls at or shortly after peak adult emergence for each generation, or 50% emergence threshold.

Table 1. National and Ontario degree day models (March 1st, base 9˚C) for apple leafcurling midge adult emergence, 2014-2020 (Agriculture & Agri-Food Canada, Saint-Jean-sur-Richelieu, QC)

Model	Generation	Threshold (% adult emergence)	DDC	RMSE	N	R^2
National	1	5	**85**	6.33	111	0.96
		50	**148**	4.92	118	
		95	**246**	6.13	118	
	2	5	**444**	5.57	128	
		50	**571**	5.24	128	
		95	**734**	7.59	128	
	3	5	**923**	7.99	86	
		50	**1075**	8.24	95	
		95	**1287**	16.14	86	
Ontario	1	5	**76**	5.53	32	0.97
		50	**132**	4.50	33	
		95	**235**	5.62	33	
	2	5	**430**	4.46	38	
		50	**556**	4.34	38	
		95	**701**	5.09	38	
	3	5	**942**	6.82	27	
		50	**1160**	9.75	28	
		95	**1459**	12.57	27	

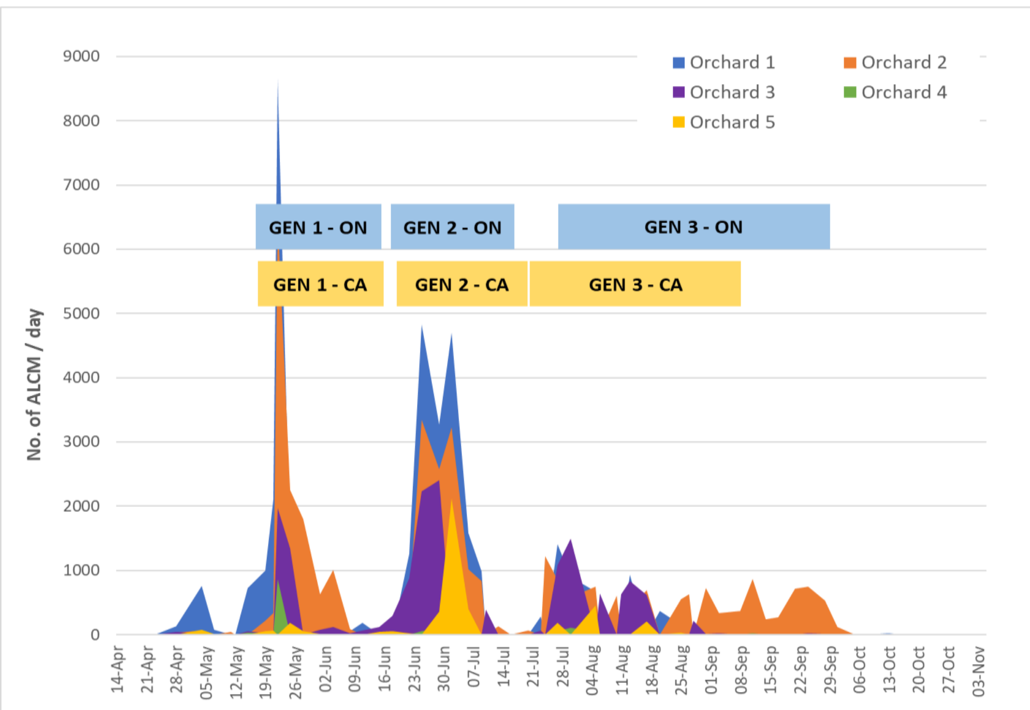

Figure 44. Number of apple leafcurling midge adult males trapped per day from 5 orchards in Norfolk County, ON from April to November 2020. Blue and yellow boxes represent predicted period of activity for first, second and third generations based on a regional degree day model for Ontario (Gen 1 – ON, Gen 2 – ON, Gen 3 – ON) and a national degree day model (Gen 1 – CA, Gen 2 – CA, Gen 3 – CA), respectively.

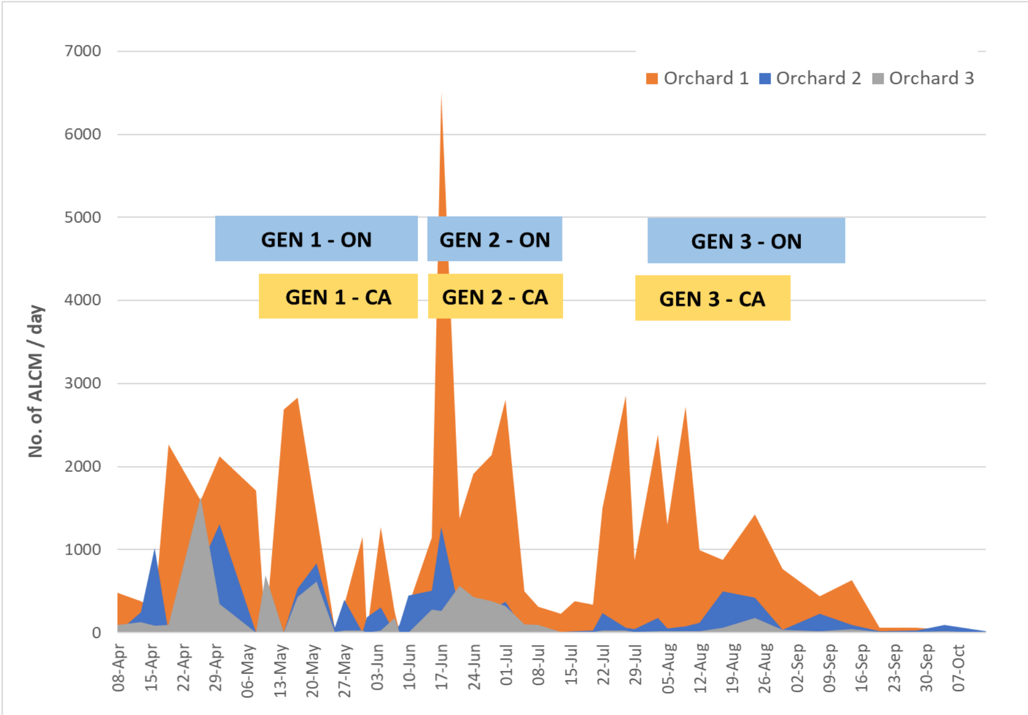

Figure 55. Number of apple leafcurling midge adult males trapped per day from 3 orchards in Norfolk County, ON from April to October 2021. Blue and yellow boxes represent predicted period of activity for first, second and third generations based on a regional degree day model for Ontario (Gen 1 – ON, Gen 2 – ON, Gen 3 – ON) and a national degree day model (Gen 1 – CA, Gen 2 – CA, Gen 3 – CA), respectively.

For the Ontario-based model, the target thresholds would be:

- 132 DDC for 1st generation
- 556 DDC for 2nd generation
- 1160 DDC for 3rd generation

based on March 1st biofix and base 9˚C (Table 1).

However, slower-acting systemic products such as Movento may need to be applied earlier. More work will be done in this area in future growing seasons.

Acknowledgements

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Post-harvest Incidence and Timing of Infection of Bitter Rot on Apple

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Study Team

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Introduction

Bitter rot of apple is an emerging disease in Ontario since 2010. Previously, the disease was mostly documented in the southern USA, Central, and South America. In Ontario, bitter rot is predominantly caused by the fungus *Colletotrichum fioriniae*. This fungus can live asymptomatically in apple fruit before inducing visible symptoms. This cryptic nature of the fungus makes it challenging to know the timing of its infection in the field and usually results in sudden appearance of symptoms, especially in storage.

University of Guelph's pathology team at Simcoe undertook this project in 2019 to determine the 1) incidence of bitter rot and 2) timing of infection in Ontario. There is also on-going research as a part of this project on fungicide sensitivity and efficacy on bitter rot. The results from 2019-20 incidence surveys and 2020 timing of infection study are discussed below.

1. Post-harvest incidence of bitter rot from 2019-2020

Methods

In the fall of 2019, 13 orchards from four apple districts (1, 2, 3, 5) and in 2020, 15 orchards from all five apple districts were surveyed based on their previous history of bitter rot.

In each orchard, 200 fruit were collected from twenty asymptomatic trees of two susceptible cultivars, 'Empire' and 'Ambrosia'. If an orchard did not have either one of these cultivars, 'Honeycrisp' or 'Gala' was used. Fruit was stored at 4-5°C for five months and then stored at 20°C for two weeks. The fruit was assessed for bitter rot symptoms.

Results

In 2019 and 2020, 2600 and 3000 apples were assessed for bitter rot. In 2019, the disease incidence ranged from 0-8% in District 1, 0-20% in District 2, and 0-6% in District 5 (Fig 1). None of the fruit from orchards in District 3 developed bitter rot symptoms in storage. In 2020, the disease incidence ranged from 0-9% in District 1, 0-61% in District 2, 1-12% in District 3, 0-1% for District 4, and 0-8% for District 5. In both years, District 2 had higher disease pressure (Fig 2) followed by Districts 1 and 5 in 2019 and Districts 3, 5, 1, and 4 in 2020.

Amongst the most scouted cultivars, 'Empire' had a higher disease incidence than 'Ambrosia'.

Summary

While the incidence of bitter rot varied from orchard to orchard, the orchards in District 2 had high disease pressure over both years of this study. This is consistent with the OMAFRA survey in 2013. Disease pressure remained low to moderate in 2019 and low to high in 2020, depending on region.

Amongst the two main cultivars, 'Empire' had a higher disease incidence than 'Ambrosia'. 'Honeycrisp' and 'Gala' were also susceptible to bitter rot infections; however, fruit incidence was generally lower.

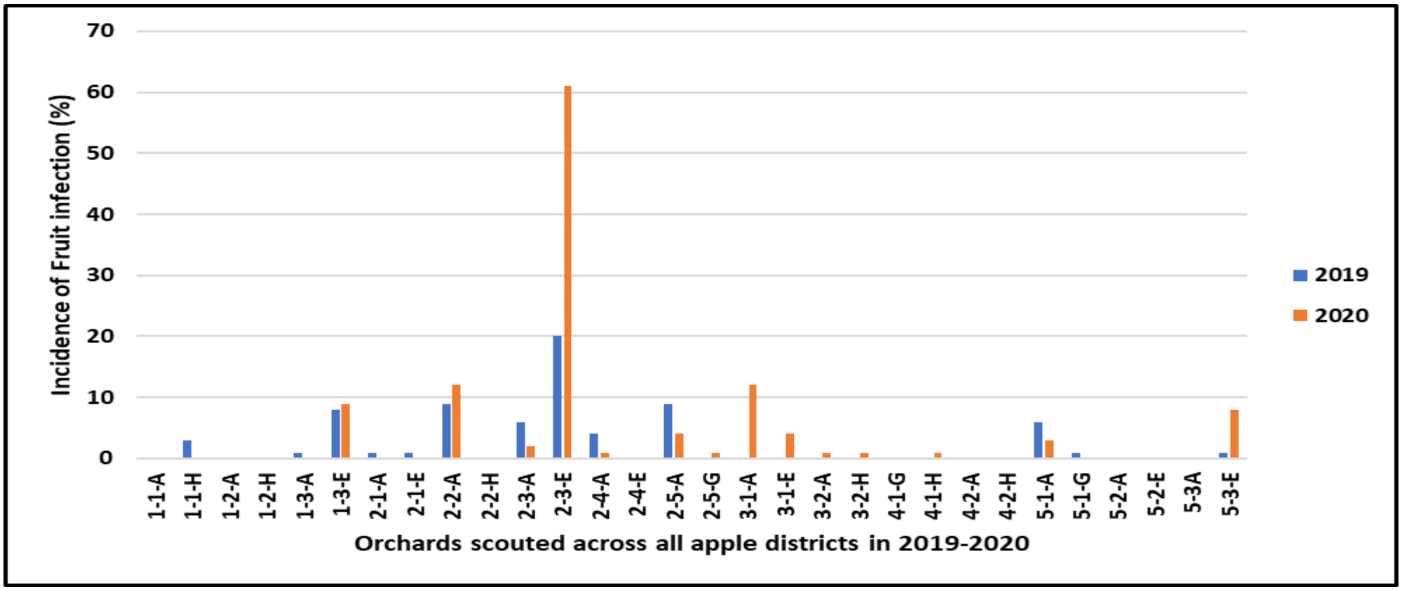


Figure 1. Post-harvest incidence of bitter rot in each apple district from September-November 2019 and 2020 in Ontario. Orchards in District 4 were only sampled in 2020. On the horizontal axis, the first number indicates the district, the second number indicates the orchard, and the alphabet letter indicates the cultivar. For example, in 1-1-A, the first 1 represents the district, the second 1 represents the orchard and A represents the cultivar 'Ambrosia'. The abbreviation E stands for the cultivar 'Empire', H for 'Honeycrisp', and G for 'Gala'.

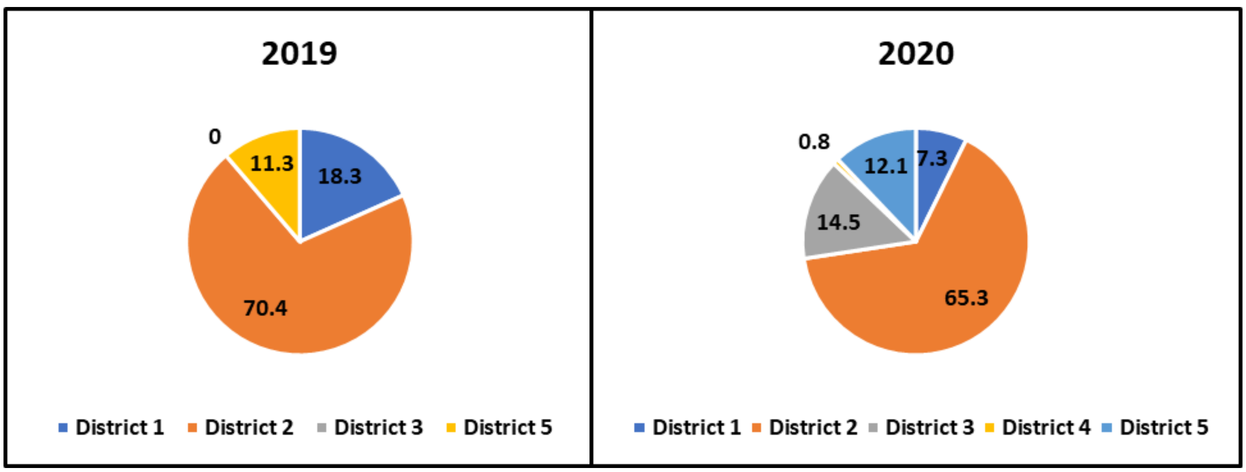


Figure 2. Post-harvest incidence (%) of bitter rot by districts in Ontario in 2019 and 2020.

2. Timing of infection of the fungus (*Colletotrichum fioriniae*) on apple fruit

Methods

The pathology team conducted two experiments in the 2020 growing season:

Experiment 1

In the first experiment, twenty-five asymptomatic fruit were inoculated with fungal conidial solution along with twenty-five control fruit that were only treated with water. The fruit were treated weekly starting from fruit set (fruit size 5mm) to harvest (fruit size 58 mm). The fruit were marked at the site of the treatment and kept covered with a clear plastic bag until harvest (Fig 3). The symptoms on the fruit were assessed bi-weekly and diseased fruit were removed from the tree. At harvest, the fruit were stored at 4°C for five months and assessed for symptoms after 2-weeks at 22°C.

Nine rain traps (3 traps/tree) were set up inside the tree canopy to determine the inoculum presence in the orchard (Fig 3). HOBO weather station was used to collect the weather data to identify periods of high risk of infection.

Experiment 2

In experiment 2, fifty asymptomatic fruits were collected weekly starting from fruit set to harvest and half of these fruit (25) were stored at 4°C for five months and assessed for bitter rot after 2-weeks at 22°C. The small pieces were cut from the remaining 25 fruit and placed on fungal growth media to detect for fungal presence.

Figure 3: Fruit inoculated with *Colletotrichum fioriniae* solution and controls treated with water only were marked and covered with a clear plastic bag.

Results

In Experiment 1, the symptoms were observed on some inoculated fruit 14-28 days after inoculations in the field especially if the weather conditions were suitable for disease development. The earliest symptoms were recorded on the fruit inoculated on 25th June (fruit size 28mm) followed by symptom appearance on 9th July (fruit size 32mm) (Fig 4). The symptoms were also observed on inoculated fruit smaller than 28 mm fruit size later in the season. This showed that immature fruit can become infected and symptomatic. None of the control fruit developed bitter rot symptoms in the field.

Figure 4. Inoculated apple fruit showing bitter rot symptoms 14 days post inoculation, fruit size 32 mm.

After storage, the inoculated fruit had significantly higher infection than control fruit, ranging from 74-92% in June, 80-96% in July, 88-96% in August and 100% in September (Fig 5).

The bitter rot infection on the control fruit was an indication of the presence of inoculum in the study orchard. In June, 12-20% of the control fruit became infected with bitter rot, while 16-36% and 17-24% became infected in July and August, respectively (Fig 5). This coincided well with the rain-trap and weather data. High peaks of fungal conidia were detected in rainwater in June and July compared to August (data not shown). Weather data (data not shown) also indicated some low to medium infection risk events in June and medium to high infection risks events for July – August for disease development.

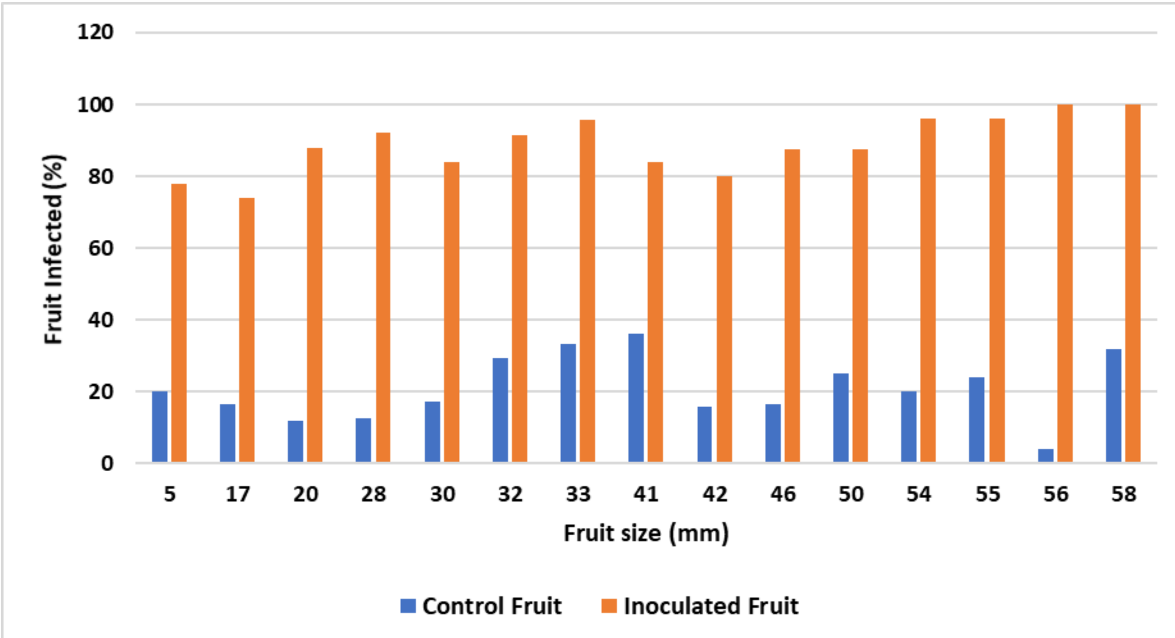
In Experiment 2, the fungus was isolated from the fruit pieces as early as the 17 mm (June 11) and 28 mm (June 25) fruit size (Fig 6). The fungus was not detected thereafter from the fruit plated on growth media though symptoms were observed on the stored fruit starting from the 42 mm fruit size (July 30) (Fig 6) until harvest. This may have been due to the applications of the fungicide Pristine applied by the grower in late June and early July 2020. The results showed the fungus can be detected in immature fruit and symptoms were observed on fruit size 28 mm, 42-56 mm and 58 mm fruit size.

Summary

1. The apple fruit can become infected by *C. fioriniae* at any stage of fruit development starting from fruit set to harvest.

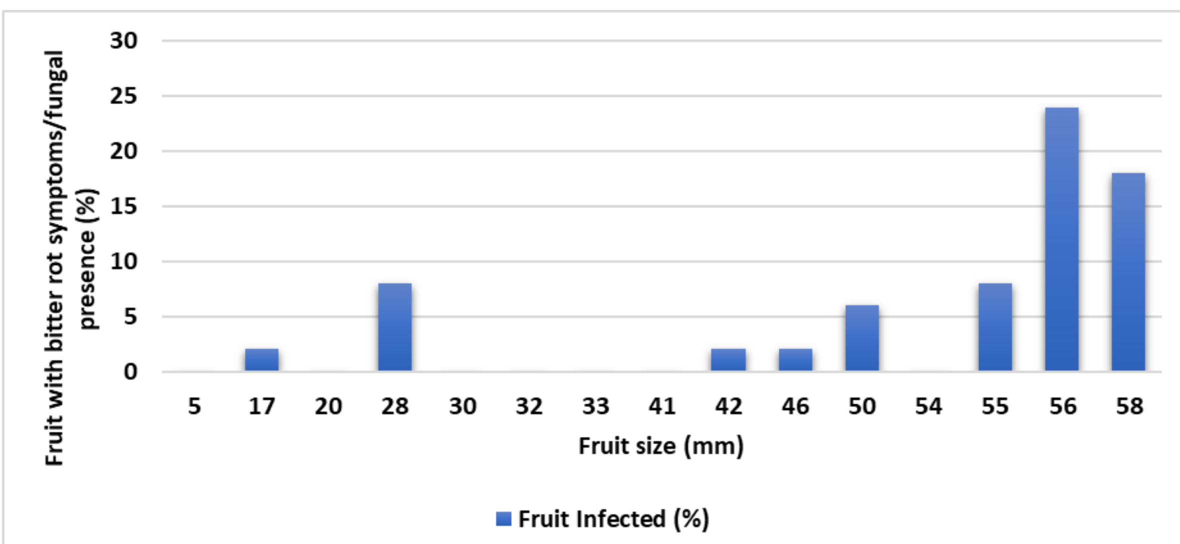
2. The symptoms may or may not appear in the field depending possibly upon the fruit size, and favorable weather conditions. In this study the symptoms appeared on immature fruit starting from fruit size 32 mm. Although symptoms were observed on immature and developing fruit in the field, the majority of the fruit showed symptoms after storage.

3. Other than weather conditions, quantity of bitter rot inoculum in the orchard is a major factor affecting the percentage of healthy fruit. Management strategies that can reduce inoculum in your orchard are necessary.



Fruit size (mm)	5	17	20	28	30	32	33	41	42	46	50	54	55	56	58
Inoculation dates (m/d)	6/03	6/11	6/16	6/25	7/03	7/09	7/14	7/23	7/30	8/06	8/13	8/20	8/27	9/03	9/10

Figure 5. Cumulative (field plus storage) percentage of fruit infected with bitter rot.



Fruit size (mm)	5	17	20	28	30	32	33	41	42	46	50	54	55	56	58
Inoculation dates (m/d)	6/03	6/11	6/16	6/25	7/03	7/09	7/14	7/23	7/30	8/06	8/13	8/20	8/27	9/03	9/10

Figure 6. Asymptomatic apple fruit showing *Colletotrichum fioriniae* presence and symptoms.

Management Considerations

As highlighted by this research, orchard sanitation to reduce inoculum is important for bitter rot management as infection can develop from fruit set to harvest. Mulch or remove fruit on the orchard floor following hand thinning and harvest to reduce inoculum and the potential of spreading the disease for the following year. Removal of dead wood, cankers produced by other disease such as fire blight and fruit mummies (where possible) may also reduce the disease.

This research has demonstrated that apples can be infected at any stage of development, even if symptoms are not seen until after storage. Spores are active as early as June and fungicides need to be applied preventatively – fungicides cannot treat an existing infection. Bitter rot targeted fungicides should start at petal fall and continue on a 14-21 day interval to keep fruit protected. If favourable weather persists (frequent rains with warm conditions), shorten the application interval. If possible, time an effective fungicide application prior to a rain to protect healthy fruit from rain-splashed spores.

Allegro (FRAC group 29, PHI 28 days), Pristine (FRAC group 11 & 7, PHI 5 days), Merivon (FRAC group 11 & 7, PHI 0 days), Maestro/Supra Captan (FRAC group M, PHI 15 or 19 days depending on orchard density) and Regalia Maxx (FRAC group P5, suppression only, PHI 0 days) are registered for bitter rot. Some other scab fungicides may also provide protection. Refer to Table 3-5. *Activity of Fungicides on Apple Disease* in the 2021 Publication 360A, Crop Protection Guide for Apples for all control options available. Always rotate fungicide FRAC groups to reduce the potential for resistance development.

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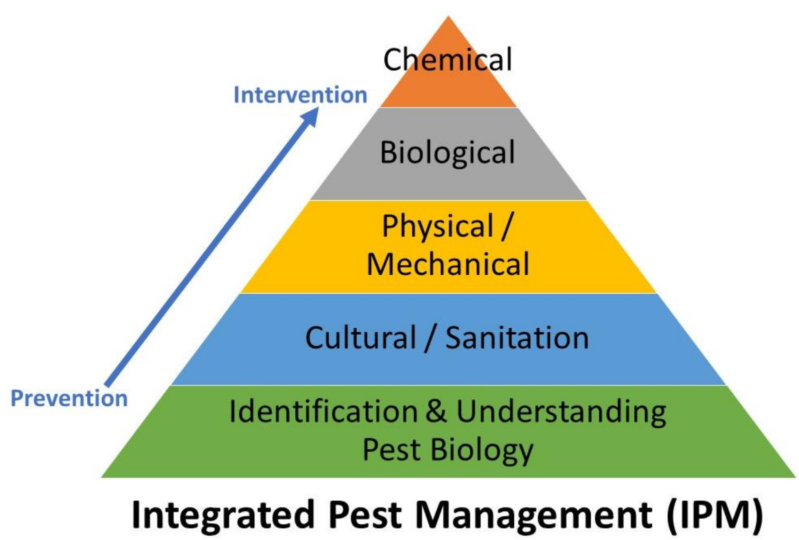
Spotlight on Timing for Disease Management: Part 1 – Disease Cycle

Kristy Grigg-McGuffin, Horticulture IPM Specialist, OMAFRA

There is no denying that product efficacy and rotational partners are critical components to effective pest management. A pest is causing damage; there needs to be as many tools as possible to control it. However, if we take a step back to consider the basics of IPM, the first critical piece to effective management is understanding the pest biology.

Over the next two issues of Orchard Network Newsletter, this series is going to shine the spotlight on timing for effective disease control. Over recent years, there has been an increase in pressure from some difficult to manage pests such as powdery mildew, fire blight, fruit rot and fly speck / sooty blotch. With the changing climate, new production systems, rootstock/cultivar susceptibility and availability of broad-spectrum fungicides, these pests are becoming more common and causing significant economic loss. However, these issues are often not a result of an ineffective product but rather gaps in control timing for the pest.



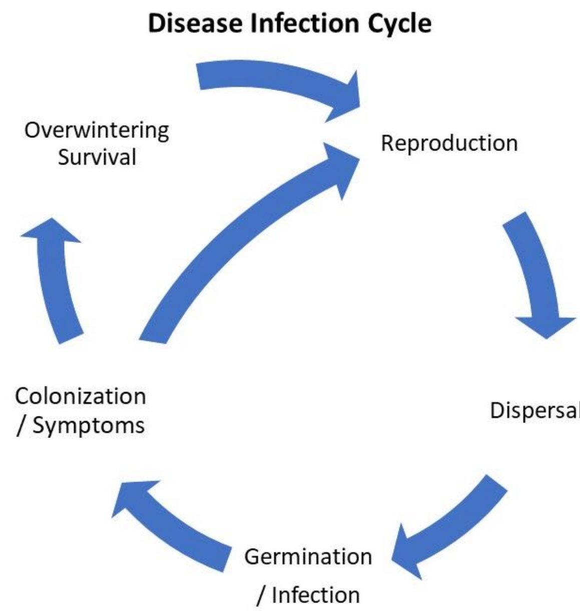
Before focusing on specific apple diseases, let's consider two important factors where understanding pest biology would improve control timing in disease management:

1. Infection period versus symptom development
2. Interval length between applications

Disease Cycle

For disease to occur, there is a series of events in the cycle, as shown.

- Following overwintering survival, initial inoculum matures, often in response to warming temperatures.
- This inoculum is then spread, or dispersed short or long distances by rain, wind, insects, etc. depending on the pathogen.
- Infection can occur through a) wounds, b) natural plant openings, such as stomata on leaves or nectarthodes in flowers, or c) direct penetration when environmental conditions (ie., temperature, moisture, humidity) are favourable.
- Visible symptoms do not always immediately follow infection. For many pathogens, there is a ***latent period*** in which the pathogen incubates.
- Depending on conditions and pathogen involved, this latent period may be only a couple of days such as fire blight infection following a trauma event; while for others such as fly speck or bitter rot, the latent period can be upwards of 4-6 weeks after infection.



With a delayed onset of symptom development, understanding the biology of the pest and conditions required for infection helps to appropriately time control strategies to improve effectiveness.

Application Intervals

Typically, disease should be managed preventatively which means fungicides need to be applied prior to infection and maintained to ensure new growth is protected. The interval between applications, however, depends on the critical growth stages (e.g. rapid shoot growth, bloom) and environmental conditions conducive for infection of a particular pathogen. For instance:

- While apple scab infection is greatest during warm, wet conditions, powdery mildew prefers dry, humid weather.
- Antibiotics may need to be re-applied 1-2 days later to prevent blossom blight if a significant amount of new blooms have opened since the last application.
- Symptom progression of fly speck and sooty blotch can continue late season after scab fungicide residues are diminished.

Knowing the period of activity and favourable environmental conditions for the diseases in your orchard will help take the guesswork out of application timing. Before relaxing spray intervals for one pest, consider the potential pressure or infection risk of other pathogens that may be present in the orchard at that time.

It's important to note that specific fungicide characteristics also factor into reapplication intervals, such as susceptibility to wash-off or UV degradation and need to be considered when determining appropriate interval length. However, for the purpose of this series, the focus will be on pest biology only.

Spotlight on Timing for Disease Management: Part 2 – Powdery Mildew

Kristy Grigg-McGuffin, Horticulture IPM Specialist, OMAFRA

Biology 101

Powdery mildew overwinters as fungal strands (mycelium) in dormant buds that were colonized the previous summer. When the buds open in spring, the fungus grows on the new plant tissue producing chains of conidia, giving the leaves a white powdery appearance (Fig 1). Only new leaves are susceptible to infection and only for a few days after emergence – but fruit become infected between pink and petal fall. The pathogen continues to infect as long as shoot growth continues.

Conidia produced by overwintering mycelium serve as the primary inoculum in spring and are easily dispersed by wind currents to susceptible tissue. Being wind dispersed, powdery mildew is considered a "neighbourhood issue" as it can move many kilometers on air currents to nearby orchards.

Conidia landing on susceptible tissue germinate when temperatures are between 10-25ºC and high relative humidity (optimal 90%). However, some conidia germinate when relative humidity is as low as 70%. Unlike other disease-causing fungi, leaf wetting is not necessary for powdery mildew infections. In fact, conidia will not germinate in free-standing water. Rain or dew frequently washes the powdery mildew conidia off leaf surfaces.

Colonized shoots and buds – particularly on young trees – have reduced vigour, are less productive and more susceptible to cold injury. Temperatures below -24ºC kill most infected buds. Although cold winters reduce the survival of infected bud, they also reduce the inoculum potential of the disease.

Figure 1. Powdery mildew fungus develops on newly emerged leaves, giving a white powdery or felt-like appearance.

Why Was Powdery Mildew So Bad in 2021?

1. **Mild winter** – With the mild 2020/2021 winter, there was greater survival of the overwintering mildew infected buds contributing to higher primary inoculum. This meant that when buds broke dormancy early spring, the fungus was able to quickly resume growth and colonize developing leaf tissue. If protectant fungicide coverage wasn't adequate, the infection was able to take hold.

2. **Dry conditions** – Often called the "dry weather disease", powdery mildew does not require moisture for germination to occur. The moderate spring temperatures with little rain but high humidity – especially at night – made for ideal infection conditions.

3. **Relaxed fungicide intervals** – With the moderate and dry spring conditions in 2021, risk of apple scab infection was relatively low. Like most diseases, scab requires leaf wetness to germinate. Unfortunately, *when scab stays away, mildew comes to play*. Without the risk of scab infection this spring, fungicide application intervals did not always stay consistent or frequent enough to keep new growth protected during optimal conditions for mildew infection.

Timing Take Home

Key timings to remember for effective powdery mildew control:

- **Be prepared early** – Infection can happen as soon as buds begin to break if overwintering inoculum is present, especially on susceptible cultivars. Control can be harder to manage later in the season if early sprays are missed.

- **Wet weather = scab BUT dry weather = powdery mildew** – Maintain tight intervals (7-10 days) with effective mildew products during critical growth stages (ie., until terminal set) even when scab infection risk is low.

- **If shoots are growing, infection is possible** – Mildew requires actively growing tissue. Shoots are at risk of infection until terminal bud set. If growth resumes later in the season, infection can occur at that point as well.

For more information on effective mildew fungicides and susceptibility of common apple cultivars, see Table 3-5. *Activity of Fungicides on Apples Diseases* and Table 3-8. *Disease Susceptibility Ratings of Common Apple Cultivars* in the 2021 Publication 360A, Crop Protection Guide for Apples.

Stay tuned for the February 2022 issue of Orchard Network Newsletter where the spotlight will be on key timings for fire blight and summer diseases.

Update on Mancozeb Re-Evaluations

Kristy Grigg-McGuffin, Horticulture IPM Specialist, OMAFRA

On November 19, 2020, the Pest Management Regulatory Agency (PMRA) released the long-anticipated final re-evaluation decision for mancozeb products (ie., Manzate Pro-Stick, Penncozeb 75 Raincoat, Dithane Rainshield). For the full report, see RVD2020-12, Mancozeb and Its Associated End-use Products.

The new risk-reduction measures **come into effect November 19, 2022** and include:

New rate	4.5 kg a.i. / ha
Minimum interval between applications	7 days
Maximum applications per year	4
Restricted entry interval	12 hours – general re-entry 35 days – hand thinning
Preharvest interval	77 days

Growers may notice updated labels on new product purchases over the next year as registrants make the required amendments. For instance, the updated Manzate Pro-Stick label is now available on the PMRA label search. While PMRA encourages growers to follow updated labels immediately, the previously approved labels are valid until November 2022. Growers will be responsible for acquiring the previously approved label for documentation. This can be provided by emailing PMRA at hc.pmra.info-arla.sc@canada.ca. In your email, be sure to include the product name and registration number of the label you are requesting.

In the last Orchard Network Newsletter article on the recent re-evaluation decisions, Considerations for the Future of Apple Scab Management (April 2021), I mentioned it was still a moving target for how half rates would be accounted for. This is beginning to become more clear (though not ideal for apple growers) after the release of the updated Manzate Pro-Stick label. While the label does state "*Do not apply more than 24 kg/ha/year (18 kg a.i./ha/year)*", it also includes "*Do not make more than 4 applications/ha/year*". This means regardless of whether the application was a full or half rate, growers in Canada will be legally restricted to a maximum of 4 applications per year.

The updated Dithane Rainshield and Penncozeb 75 Raincoat labels have not been released as of writing this article.

Marssonina (Diplocarpon) Blotch Confirmed in Ontario Apples

Katie Goldenhar, Pathologist – Horticulture, OMAFRA;
Kristy Grigg-McGuffin, Horticulture IPM Specialist, OMAFRA

Recent surveys of some Ontario apple orchards in Fall 2021 have confirmed the presence of Marssonina (Diplocarpon) blotch in Gala and Empire blocks. This disease could become a concern for Ontario apple growers as it seems it may be able to build up in orchards, especially with reduced late season fungicide applications.

What Is It?

Marssonina (Diplocarpon) blotch of apples is caused by the fungus *Marssonina coronaria* and was first identified in Ontario in the early 1900s. Despite this, Marssonina (Diplocarpon) blotch has been sporadic in Ontario apple orchards. In recent years, eastern states including Pennsylvania and New York have identified an increase in this disease causing premature defoliation, resulting in lower tree health and yield loss. When foliage infection is severe, fruit lesions can occur, although they are uncommon.

Figure 1. Initial lesions of Marssonina (Diplocarpon) blotch are small with purple borders.

What Does It Look Like?

Symptoms typically appear mid-summer on the upper surface of mature leaves. This fungus needs a long duration of leaf wetness to infect, and symptoms can take as long as 40-45 days after infection to appear.

Lesions start small (5-10mm), have a greyish, brown centre with a darkened, purple border (Figure 1). As the infection progresses, lesions darken and coalesce, with the surrounding tissue turning yellow, resulting in premature defoliation (Figure 2). At any stage of infection, when examined closely with a hand lens or dissecting scope lesions contain raised black dots or bumps which are the fruiting bodies of the fungus (Figure 3).

To distinguish this disease from scab lesions, Figure 4 shows the two diseases on a mature leaf. Apple scab lesions are more web-like and do not contain the black bumps.

Figure 2. Lesions of Marssonina (Diplocarpon) blotch are darkened and coalesce, with surrounding tissue turning yellow. Premature defoliation occurs.

Figure 3. Lesions of Marssonina (Diplocarpon) blotch contain raised black dots or bumps which are the fruiting bodies of the fungus

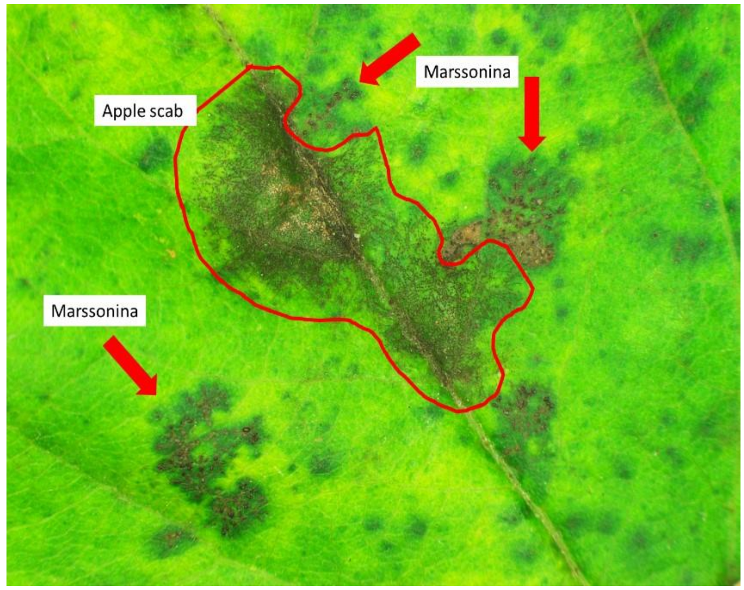


Figure 4. To distinguish between apple scab lesions and Marssonina (Diplocarpon) blotch on leaves: apple scab is more web-like and does not contain black bumps. *(Photo: Kari Peter, Pennsylvania State University)*

Fruit lesions are less common but can be found on trees with severe foliar infection. Fruit spots are small, dark brown/black and stay on the fruit surface with minor indentation (Figure 5).

Figure 5. Less common Marssonina (Diplocarpon) blotch fruit lesions are small dark brown/black minor indentations. *(Photo: Kari Peter, Pennsylvania State University)*

How Can It Be Managed?

This fungus overwinters in infected leaves in the orchard. Sanitization is important in limiting the disease, reducing the inoculum for disease occurrence. This includes fall and/or spring urea application and flail mowing.
There are no registered fungicides in Canada, however research shows that Marssonina (Diplocarpon) blotch is susceptible to most conventional apple scab fungicides. Captan and mancozeb have shown excellent efficacy against this disease, but both have been recently re-evaluated and application numbers reduced, which could lead to an increase of this disease in Ontario.

Cultivars differ in their susceptibility to Marssonina (Diplocarpon) blotch:

Table 1. Apple cultivar susceptibility based on observations and research in Pennsylvania experimental orchard (Kari Peter, Pennsylvania State University)

Cultivar	Susceptibility (to date)
Rome	Very susceptible[1]
Honeycrisp	Very susceptible[1]
Empire	Very susceptible[1]
Scab-resistant varieties	Very susceptible[1]
Cameo	Susceptible
Fuji	Susceptible
Red Delicious	Susceptible
Gala	Susceptible to moderately resistant
Golden Delicious	Moderately resistant
Stayman	Moderately resistant
Cortland	Moderately resistant

[1] if no fungicides are applied early season

If you suspect Marssonina (Diplocarpon) blotch in your orchard and would be interested in participating in a provincial survey, please email or call/text:

Kristy Grigg-McGuffin	kristy.grigg-mcguffin@ontario.ca	519-420-9422
Katie Goldenhar	katie.goldenhar@ontario.ca	519-835-5792

Post Harvest

Risk of Storage Disorders in Apples for 2021-22 Season

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

CIPRA is a computer-based program developed by the research team of Dr. Gaétan Bourgeois (AAFC-QC) that uses weather data to predict the risk susceptibility of apples to specific storage disorders (Bourgeois, DeEll, and Plouffe). According to CIPRA models using weather data up to September 14th (2021) from Delhi (Norfolk County, ON), there is some risk (~9%) of apples developing chilling-related flesh browning disorders during the current storage season (Figure 1).

Using specific models for bitter pit and soft scald development, CIPRA with weather data from Environment Canada shows varying risk susceptibility around Ontario (Table 1). For 2021, the Georgian Bay area has the highest risk of bitter pit, while Delhi and Oshawa have the highest risk for soft scald development during storage.

Regardless of growing season and annual risk susceptibility, it is important to use the recommended storage temperatures and regimes for specific apple cultivars. Disorders can develop in any year when appropriate handling practices and storage regimes are not used. Late harvested apples are also more prone to developing chilling-related disorders, especially flesh browning and soft scald.

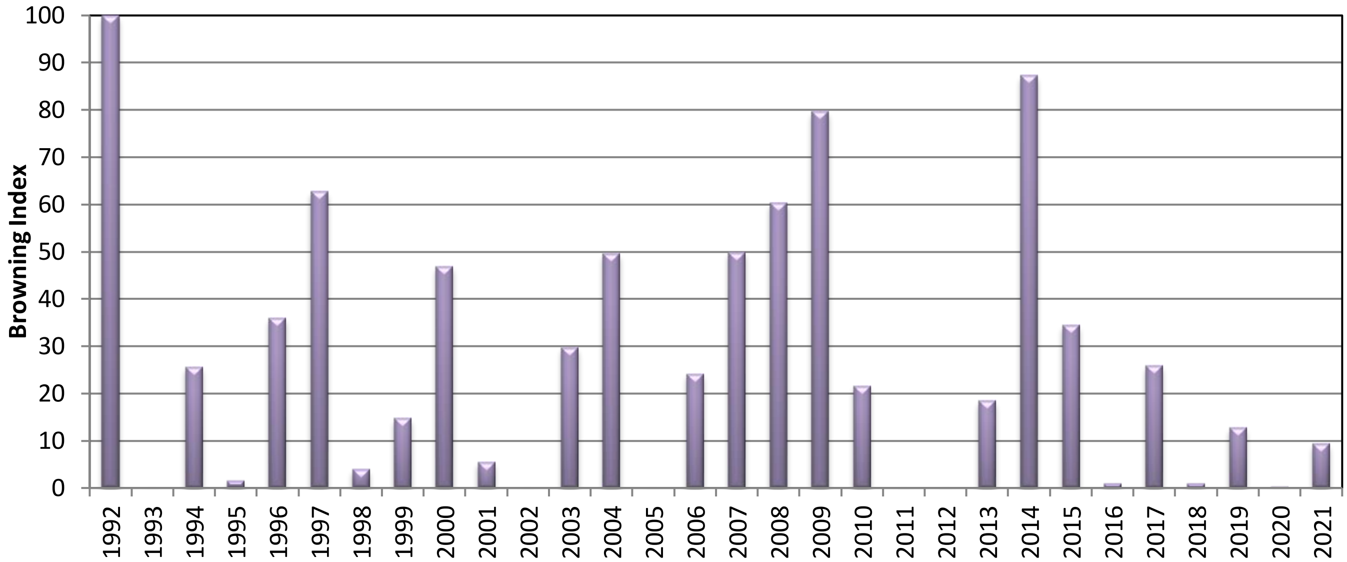


Figure 1. Risk of developing chilling-related flesh browning disorders during the past 30 years (1992-2021), for the region of Delhi (Norfolk County), Ontario.
* Graph supplied by D. Plouffe, AAFC-QC

Table 1. Risk of developing bitter pit or soft scald in four apple producing regions of Ontario for 2021, with comparison to 2020.

Location	2021 Risk % Bitter pit	2020 Risk % Bitter pit	2021 Risk % Soft scald	2020 Risk % Soft scald
Brantford	0	2	2	32
Collingwood	24	0	1	8
Delhi	0	0	17	26
Oshawa	0	21	17	15

* Data supplied by D. Plouffe, AAFC-QC

Announcements

Ontario Fruit and Vegetable Convention 2022

February 23-24, 2022

The Ontario Fruit and Vegetable Convention (OFVC), Canada's premier horticultural event, has announced its return to the Scotiabank Convention Centre in Niagara Falls, Ontario on **February 23-24, 2022**. Their goal is to assist the industry move forward by bringing together exhibitors, speakers and attendees safely under one roof once again.

Online registration will open on January 1. Keep up-to-date by subscribing to the OFVC newsletter or follow on social media.

The Apple Speaker Session will be Thursday, February 24th.

Morning Program

9:30 am **Updates on Molecular Testing and Robotic Weeding**
Kristen Obeid, OMAFRA

10:00 am **Plant Growth Regulator (PGR) effects on storage disorders of Gala and Honeycrisp**
Dr. Chris Watkins, Cornell University

10:30 am **Efforts to effectively integrate biopesticides into management programs using best horticultural practice and disease forecasting**
Dr. Kerik Cox, Cornell University

11:00 am **Integrating biopesticides and biocontrol in Ontario apple orchards - Grower perspective**
Brian Rideout, Manitree Fruit Farms; Pat Johnson, AppleTop Farms; Gerbe Botden, Botden Orchards Ltd.

Afternoon Program

2:00 pm **Protecting and Promoting Pollinators in Apple Production**
Dr. Vicki Wojcik, Pollinator Partnership Canada

2:30 pm **Response of Gala Apple Trees to Blossom Thinning with Ammonium Thiosulphate (ATS) and Lime Sulphur**
Dr. John Cline, University of Guelph

3:00 pm **Integrating current and emerging mechanical technologies in modern apple orchards**
Mario Miranda Sazo, Cornell University

3:30 pm **Orchard management practices of Honeycrisp to mitigate bitter pit**
Mario Miranda Sazo, Cornell University

Other educational sessions that may be of interest to apple growers include:

- Innovations in Ag Robotics
- Diversity & Inclusion in Agriculture
- Incorporating Biopesticides into IPM
- General Labour
- Managing Food Safety Risks
- Soil Health and Cover Crops for Fruit Production
- Getting And Keeping Your Money
- Women In Agriculture Breakfast
- Young Farmer Forum
- ...and more!

For the full speaker program, click here.

Health and safety is will be OFVC's top priority. Everyone that enters the Scotibank Convention Centre including exhibitors, attendees, volunteers, students, media, speakers, contractors, and staff are expected to comply with the health and safety policies outlined here to help safeguard everyone's well-being.

Agricultural Information Contact Centre: 1-877-424-1300
E-mail: ag.info.omafra@ontario.ca
Northern Ontario Regional Office: 1-800-461-6132

www.ontario.ca/omafra