

ORCHARD NETWORK

For Commercial Apple Producers

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Orchard Management

Nibble Thin for a Quality Bin

Erika DeBrouwer, Tree Fruit Specialist, OMAFRA

There are a multitude of ways to reach your desirable crop load within your apple orchard, but feasibility, time management, and calculation need to be considered when making decisions. This article will go through precision crop load importance, the many ways to nibble thin your crop throughout the season, when to nibble thin and updates of ongoing research.

Precision Crop Load Management

By reducing crop load through precision management, an increase in fruit size is apparent (Table 1). Crop load management is not only important in growing larger apples, but also quality apples with desired colouration. When managing crop load there are a few methods that growers can use (1) pruning (2) chemical thinning and (3) hand thinning. Pruning is a common practice to adjust crop load but is utilized for practices other than crop load management, including training tree shape and removing unhealthy/dead wood. Chemical thinning, although tedious, is starting to become more popular due to a decrease expense in regard to labour. Hand thinning has become less popular in recent years due to the cost associated with labour, along with the energy utilized by the tree for fruit that will eventually be taken off. These three methods are used to enhance efficiency and feasibility regarding crop load, and they define precision crop load management.

This newsletter is brought to you by the Ontario Apple Team:

Erika DeBrouwer, Simcoe
ONNL Editor
Tree Fruit Specialist
(226) 931-4098
erika.debrouwer@ontario.ca

Kristy Grigg-McGuffin, Simcoe
ONNL Editor
Horticulture IPM Specialist
(519) 420-9422
kristy.grigg-mcguffin@ontario.ca

Dr. Jennifer DeEll, Simcoe
Fresh Market Quality Specialist
(519) 426-1408
jennifer.deell@ontario.ca

Dr. John Cline, Simcoe
University of Guelph
(519) 426-7127, ext. 331
jcline@uoguelph.ca

Hannah Fraser, Guelph
Entomologist - Horticulture
(905) 708-8014
hannah.fraser@ontario.ca

Anne Verhallen, Ridgetown
Soil Management Specialist - Horticulture
(519) 359-6707
anne.verhallen@ontario.ca

Dr. Jason Deveau, Simcoe
Application Technology Specialist
(519) 209-1883
jason.deveau@ontario.ca

Josh Mosiondz, Guelph
Minor Use Coordinator
(226) 971-3407
joshua.mosiondz@ontario.ca

Katie Goldenhar, Guelph
Pathologist - Horticulture
(519) 835-5792
katie.goldenhar@ontario.ca

Denise Beaton, Guelph
Crop Protection Specialist
(519) 400-3636
denise.beaton@ontario.ca

Nibble Thinning

The nibble thinning approach is to thin a little at every opportunity, including the application of chemical thinners at various growth stages (blossom, petal fall/early fruitlet and early fruitlet stages). Nibble thinning is a great way to thin apples, as it allows growers time between applications to assess their crop load and get closer to the target amount of fruit. Another benefit of utilizing nibble thinning is that you don't have to rely on a small number of applications or wait for the perfect thinning weather within the staging window. Another potential benefit is the reduction of biennial bearing crop loads in varieties like 'Honeycrisp', as the crop load will be adjusted with earlier bloom applications.

Although there's some reluctance regarding the application of chemical thinners before determining the fruit set after a spring frost event or other trauma, apple trees are resilient and only require 5 to 10% of blooms to achieve a full crop load. Growers should know that more confidence in utilizing chemical thinners will be achieved as more information regarding apple frost injury, bee activity, pollination and fertilization becomes available. Starting early with chemical thinners allows you the opportunity to achieve your ideal crop load over time and lowers the chance of over-thinning at later growth stages.

One of the most important aspects before managing your crop load is to assess the health of your trees and observe your fruit set. Assess fruit buds for signs of damage following freezing temperatures or onset of frost. The "Evaluating Frost Damage on Buds in Tree Fruit" article on the ONfruit Blog, and "Frost Damage Evaluation On Apple Buds" on the OMAFRA website go into more detail regarding how to assess your apple crop from frost damage.

Regarding thinning with frost damage, please refer to the following articles:

- Thinning of Tree Fruit – Amanda Green and Kathryn Carter (http://www.omafra.gov.on.ca/english/crops/hort/thinning.htm#apples)
- Chemical Thinning of Apples in the Response to Frost Damage to Flowers – John Cline (https://onfruit.ca/2020/06/05/chemical-thinning-of-apples-in-the-response-to-frost-damage-to-flowers/)

For information regarding suggested rates and various chemicals used for chemical thinning, refer to the Thinning of Tree Fruit, apple section on the OMAFRA website and on the Crop Protection Hub. Information regarding ATS and Lime Sulphur specifically can be found in the March 2022 and April 2021 issues of the Orchard Outlook Newsletter (ONNL) titled "Bloom Thinning with Lime Sulphur and ATS" and "Preliminary Results of Blossom Thinning with Lime Sulphur and ATS" by Dr. John Cline.

Thinning Models

Below are brief descriptions of each modelling system, how to utilize each, and the benefits and challenges of each. Remember that every modelling system should be utilized in conjunction with previous thinning decisions, grower experience and weather forecasts and that these systems become better through incorporation and use within the orchard. I also want to point out that **you do not have to utilize these strategies on every variety** – maybe it's only worth the time to perform these data collection methods for high-value or biennial cropping varieties, but that decision is up to you.

Table 1. Effect of fruit size in relation to crop load (Number of apples required per tree for given tree density (trees/acre), desired yield (bu/ac) and fruit size)

Minimum Size		Tree Density (trees per acre)							
		272 Trees/Acre		500 Trees/Acre		1,000 Trees/Acre		1,500 Trees/Acre	
		Projected Yield (bu/ac)							
mm	inch	400 bu/ac	600 bu/ac	500 bu/ac	750 bu/ac	750 bu/ac	1,250 bu/ac	1,000 bu/ac	1,500 bu/ac
57	2 1/4	320	480	218	327	163	272	145	218
60	2 3/8	286	429	194	292	146	243	130	194
64	2 1/2	266	400	181	272	136	226	121	181
67	2 5/8	245	368	167	250	125	208	111	167
70	2 3/4	225	338	153	230	115	192	102	153
73	2 7/8	204	306	139	208	104	174	93	139
76	3	185	277	126	188	94	157	83	126
79	3 1/8	163	245	111	167	83	139	74	111
83	3 1/4	144	216	98	147	73	122	65	98
85	3 3/8	131	196	89	133	67	111	60	89
89	3 1/2	118	176	80	120	60	100	53	80
92	3 5/8	105	157	71	107	53	89	47	71
95	3 3/4	92	137	62	93	47	78	41	62
98	3 7/8	78	118	53	80	40	67	36	53

Carbohydrate (Carbon Balance/MaluSim) Model

This model was developed by Dr. Alan Lakso and Dr. Terence Robinson from Cornell University and has progressed into estimating the timing and amount of chemical thinning applications for improved efficacy. The model is based on the theory that carbohydrates (energy) are needed to keep fruitlets growing and to remain on the tree. When there is low energy or carbohydrates, fruitlets should thin more easily and drop, where the opposite would occur if generous amounts of carbohydrates are available for fruitlets to resist thinning and set fruit well. The Carbohydrate model predicts daily energy supply and demand to determine fruitlet sensitivity to chemical thinning. This is why the model can be applied throughout the season, utilizing knowledge of growth habits and staging within apples. This model assists in predicting how sensitive fruitlets will be to thinning strategies.

Benefits	Challenges
- More precise then estimating the effectiveness of thinners - Once started it is easy to continue - Can be used in collaboration with other thinning tools currently available - Can be used at multiple time points during the thinning period	- Requires a weather station to utilize - Web application only available in the U.S. - Takes time to set up and become comfortable with - Growers have to count, enter and interpret data - Doesn't factor in tree architecture, specific varieties, or training systems

Pollen Tube Growth Model

The Pollen Tube Growth Model (PTGM) is one of the newer modelling systems, currently being utilized across the U.S. This modelling system was developed by Virginia Tech and is only available for certain varieties. A "universal" PTGM is currently being developed by Dr. Greg Peck. The PTGM model uses the ideal number of king blooms for a target crop load, weather data and king style length to determine the best timing for bloom thinner application. This modelling system uses the theory that based on style length, a certain amount of time needs to pass for proper fertilization of the flower.

How To Use:

1. Assess orchard to determine target crop load
2. Move to step 3 when king blooms equal target crop load
3. Measure 25 to 50 king styles
4. Input style length into modelling system
5. Model provides best time and date for effective bloom thinning application using weather data

Benefits	Challenges
- Early bloom thinning tool - One-time data collection	- Requires weather data - Precise timing for thinning applications - Only available for certain varieties - Not available and currently being validated in Ontario - Unknown cost associated with use

Fruitlet Growth (Fruitset) Model

This tool is utilized to help predict thinning efficacy 7 to 9 days after thinning application. The Fruitlet Growth Model was developed by Dr. Duane Greene from the University of Massachusetts and utilizes the growth rates of fruitlets to determine chemical efficacy. This is based on the assumption that the fruitlets that will not abscise will be growing at a faster rate than the abscising fruitlets. In the past, growers have found that two measurements separated by 3 to 5 days suffices. This model can be used at multiple points during the season and can be continuously used with other tools and modelling systems.

How To Use:

1. Select 5 trees per variety/block
2. Mark 14-15 clusters on each tree (7 on each side in trellised orchard)
3. Determine target crop load
4. Take diameter measurements 3 days after applying thinner
5. Take second diameter measurement 3 or 4 days after second application
6. Input data into excel file (output will occur automatically)

Benefits	Challenges
- Doesn't require a weather station to utilize - More precise then estimating the effectiveness of thinners - Once started it is easy to continue - Can be used in collaboration with other thinning tools currently available - Can be used at multiple time points during the thinning period - No cost associated with use	- Takes time to set up and become comfortable with - Growers have to count, enter and interpret data

Tools to Assist with Crop Load Management Models

To make the process easier when utilizing various modelling systems for growers, there have been different strategies explored:

Schwallier Spreadsheet
This is the original spreadsheet utilized to interpret the data collected from the orchard after chemical thinning has been applied. The spreadsheet gives growers a better idea of fruitset and requires you to label each individual fruitlet.

Ferri Spreadsheet
This spreadsheet was adapted from the Schwallier Spreadsheet utilizing the same method but doesn't require labelling each individual fruitlet. The spreadsheet automatically arranges fruitlet size from largest to smallest and will predict how many fruitlets will set and how many will abscise.

Ferri Model Application
The Ferri Model Application is currently in a beta trial and was developed to give growers a better idea of fruitset after thinning. This application is hoping to give real-time answers during collection measurements and would replace the excel spreadsheet previously listed. Currently only available in apple products.

Perennia: Orchard Tools Application
The Perennia: Orchard Tools Application was developed to capture data for the fruitlet growth rate model. This application assists with collecting data but would have to be exported into an excel sheet or the MaluSim application to fully utilize fruit set prediction. This application can be used in the orchard to collect fruitlet sizes and is currently only available on apple products.

Malusim Application
The MaluSim application can be used for the fruitlet growth model, the carbohydrate model, along with irrigation models and records. Currently, the MaluSim application requires a U.S. address in order to connect with weather stations.

Thinner Effectiveness Table
This table was made by Michigan State University based on research from Cornell University, stating general comments and guidelines on PGR thinner use.

Climate Condition	Prediction
Warm Conditions (>18^{o}C)	All thinner work best
Dark Cloudy Weather	Greater stress, greater thinning response, greater drop
High Night Temperatures (>18^{o}C)	Great stress, high demand and use of energy for night respiration, greater drop
Very High Day-Time Temperatures (>29^{o}C)	Great stress, high energy demand, greater drop
Very Cool Temperatures (<18^{o}C), Greater Set	Reduced stress, reduced energy demand, greater set
High Light	Increased supply: harder to thin
Low Light	Reduced supply: easier to thin
Low Temperatures	Low demand: harder to thin
High Temperatures	High demand: easy to thin
Worst	Low light and warm temperatures

Adapted from Cornell University and Michigan State University

Overall, these are modelling systems and tools that should be utilized in conjunction with previous thinning decisions, grower experience and weather forecasts, along with your own knowledge. These are guidelines for how to manage your crop load effectively and drive your efficiency as a grower. Not all tools are going to be for everyone, but the use of some could make your farm more efficient and help you make decisions throughout the season.

If you have used any of these tools or utilize tools that aren't currently listed, be sure to share your experience with Erika DeBrouwer through text, email, or social media (226-931-5226, erika.debrouwer@ontario.ca, @FruitWiTheSpurs)

Further Reading and Resources:

Carbohydrate Model

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Fruitlet Growth Model

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Preliminary Results of Plant Growth-Promoting Microbes for Treating Apple Replant Disease

Meaghan A. A. Mechler and John A. Cline, University of Guelph

Background Information

Apple replant disease (ARD) is a complex and poorly understood soil issue. Many factors contribute to ARD, though the main ones are microbial[1]. ARD occurs after planting new trees in soils that previously supported apples and appears worse in high-density plantings[2]. In high-density plantings, ARD can delay fruit-bearing by several years and decrease orchard profitability by up to 50% in its lifespan[3,4]. Tree mortality and poor yields amount to accumulated losses as high as $20-60K/ha over the life of the orchard[5-7]. Conventionally, chemical fumigants have been used to suppress soil pathogens, though due to health and environmental concerns, the number of available products is decreasing[8-10]. Studies have also demonstrated that fumigation treatments are not always effective against ARD and effectiveness wanes over time[4,9-11]. The growing restrictions on fumigants and their limited consistency mean there is a need to develop and explore novel alternatives. Agriculture and Agri-food Canada[12] has identified a need for low-risk alternatives to soil fumigation[13]. Our research aims to reduce long-term ARD outbreaks in Ontario orchards with biocontrol soil treatments, using beneficial soil microorganisms to suppress and outcompete the pathogenic ARD microorganisms.

Experimental Details

For this project, three replant field experiments were established in Norfolk County in 2020.

1. High-Density Orchard – Replant Site
    a. Commercial farm in Vanessa, ON
    b. Wilsonville fine sandy soil
    c. Previous orchard was planted in 2003 with 'Mutsu'/M.9 and was removed in 2019

d. The new planting consisted of 'Ambrosia'/B.9, trees were spaced 0.61 m x 3.96 m (4140 trees ha^{-1}) and trained to a vertical axis orchard system
e. Hand watered in 2020, drip irrigated in 2021

2. Medium-Density Orchard – Replant Site
   a. University of Guelph Horticultural Experiment Station, Simcoe, ON
   b. Brady sandy loam soil
   c. Previous orchard was planted in 2006 with 'Gala'/B.9 and was removed in 2020
   d. The new planting consisted of 'Aztec Fuji'/M.9 T337, trees were spaced 1 m x 4 m (2500 trees ha^{-1}) and trained to a vertical axis orchard system
   e. Drip irrigated

3. Low-Density Orchard – Replant Site
   a. Commercial farm in Simcoe, ON
   b. Fox-Brady sandy loam soil
   c. Previous orchard was planted in 2012 with 'Gala' on a mix of rootstocks (M.111, M.106, and M.7) and was removed in 2019
   d. The new planting consisted of 'Ambrosia'/M.9 T337, trees were spaced 1.83 m x 4.5 m (1216 trees ha^{-1}) and grown as free-standing trees
   e. Sprinkler irrigated

Treatments consisted of:

1. Untreated control
2. Chemical Fumigation
   Chloropicrin (85.5%; PIC PLUS, TriEst Ag Group, Inc., Greenville, NC) shank injected at two depths, 16" and 20", within the tree row at a rate of 162 L/ha one month before planting
3. Plant Growth Promoting Fungi (PGP-F)
   The following three commercial microbial products were used to introduce several species:
   i. *Trichoderma harzianum* and *T. virens* (Rootshield Plus, Bioworks)
   ii. *Glomus intraradices, G. mosseae, G. aggregatum,* and *G. etunicatum* (MycoApply Ultrafine Endo, Valent BioSciences)
   iii. *Gliocladium catenulatum* (Prestop, Lallemand)

4. Plant Growth Promoting Rhizobacteria (PGP-R)
   The following two commercial microbial products were mixed and used as a root spray to introduce:
   i. *Bacillus subtilis* (Serenade Soil, Bayer)
   ii. *Streptomyces griseoviridis* (Mycostop, Lallemand)

5. PGP-Mix (combined treatments 3 and 4)
   The same products and species were used and mixed at the same concentrations. The *Trichoderma* treatment was applied as a pre-treatment dip at the same concentration.

Applications

Three days before planting, tree roots were submerged in the *Trichoderma* product. The other products were compatible for mixing and added at the recommended concentrations to a 25 L spray tank in the field immediately before application and applied at a rate of 2 L/min to coat root mass with 0.2 L of the product mixtures immediately prior to planting.

Tree Measurements

Aboveground biomass was assessed seasonally at all three orchards. Each June, trunk circumference was measured 20 cm above the soil line with digital calipers, and leaves were collected for nutrient analysis (N, P, K, Ca, Mg). Leaf photosynthetic rate was measured in July. As well fruitlets were collected from the medium-density orchard trees to be weighed and counted. Observations were taken on bud emergence, rosette leaf forms, and tree health throughout the

growing season. Destructive sampling at 1 month and 3 months at the medium-density orchard allowed roots and aboveground biomass to be weighed. Root health was also visually assessed.

Soil Measurements

During destructive sampling at the medium-density orchard, a bulk soil sample was taken at three depths (0-10, 10-20, 20-30 cm) at the root zone. This soil was used to measure soil nutrient levels. Rhizosphere soil was washed off the collected roots and sent for DNA extraction and sequencing. This data will be analyzed to identify changes to the microbial community between treatments and which species are correlated with plant health and disease pressure.

Preliminary Results

High-Density Orchard

The soil treatments had an effect on the relative diameter growth of the trees between 2020 and 2021. The fumigation treatment had greatest relative diameter growth (21%), followed by the PGP-Rhizobacteria (16.7%) and PGP-Mix (16.6%) (Fig. 1). The untreated control and PGP-Fungi had the lowest growth (7% and 6%, respectively). Leaf nutrient levels and leaf photosynthetic rate did not differ between treatments.

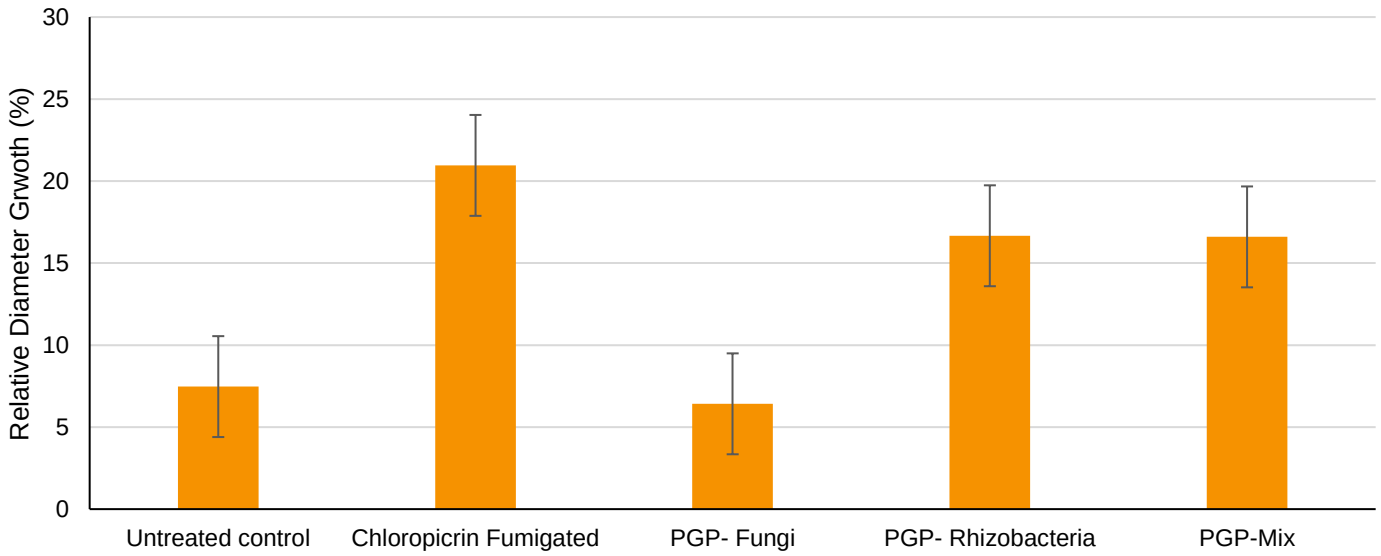

Figure 1. Treatment effect on relative tree diameter growth from 2020-2021 ($p<0.0001$) seen in the high-density orchard trees ('Ambrosia'/B.9), Norfolk County, ON. Bars represent standard error.

Medium-Density Orchard

It was possible to take more data in this orchard than the commercial orchards. Mean shoot and root weights were greatest in the fumigation and PGP-Rhizobacteria treatments. The development of fruitlets seemed to also follow this pattern (Table 1). In general, soil treatments did not appear to significantly impact soil nutrient levels in the spring or autumn of 2020. However, between the three growing months of 2020, NO_3^- levels fell in the control, PGP-Fungi, and PGP-Mix treatments. In contrast these concentrations seemed to rise in the fumigant and PGP-Rhizobacteria treatments (Fig. 2)

Low-Density Orchard

Plant growth and chlorophyll fluorescence (which can be indicative of plant stress) did not seem to be impacted by treatment in this planting. However, soil treatments appeared to have an effect on the percent of trees with rosette leaves present. Surprisingly, the fumigation treatment had the most trees with rosette leaves (9.9%), followed by the PGP-Rhizobacteria treatment (9.0%). 8.6% of PGP-Fungi treatment trees had rosette leaves, while the untreated control and PGP-Mix treatments had the lowest percent of trees that expressed rosette leaves (5.6% and 5.4%, respectively). In this orchard, it was more certain that leaf potassium (K) levels differed among the different treatments. All other nutrient levels did not appear to be influenced by treatment. Trees that received the fumigation treatment had the highest leaf K

concentration (1.9%), followed by the control (1.7%), PRP-Mix (1.6%), and PGP-Rhizobacteria (1.6%). PGP-Fungi had the lowest K concentration with 1.5%.

Table 1. 2021 Plant growth metrics at the medium-density orchard in Norfolk County Ontario

Treatment	Leaf Magnesium (%)	Mean Shoot Weight (g)	Mean Root Weight (g)	Number of Fruitlets per Tree
Control	0.27	236.5	137.2	5.6
Chloropicrin	0.24	307.0	150.0	9.9
PGP-Fungi	0.28	218.1	129.7	8.9
PGP-Rhizobac	0.29	251.9	180.6	9.0
PGP-Mix	0.24	222.8	132.2	5.4
P	0.0016	0.0350	0.0288	0.0768

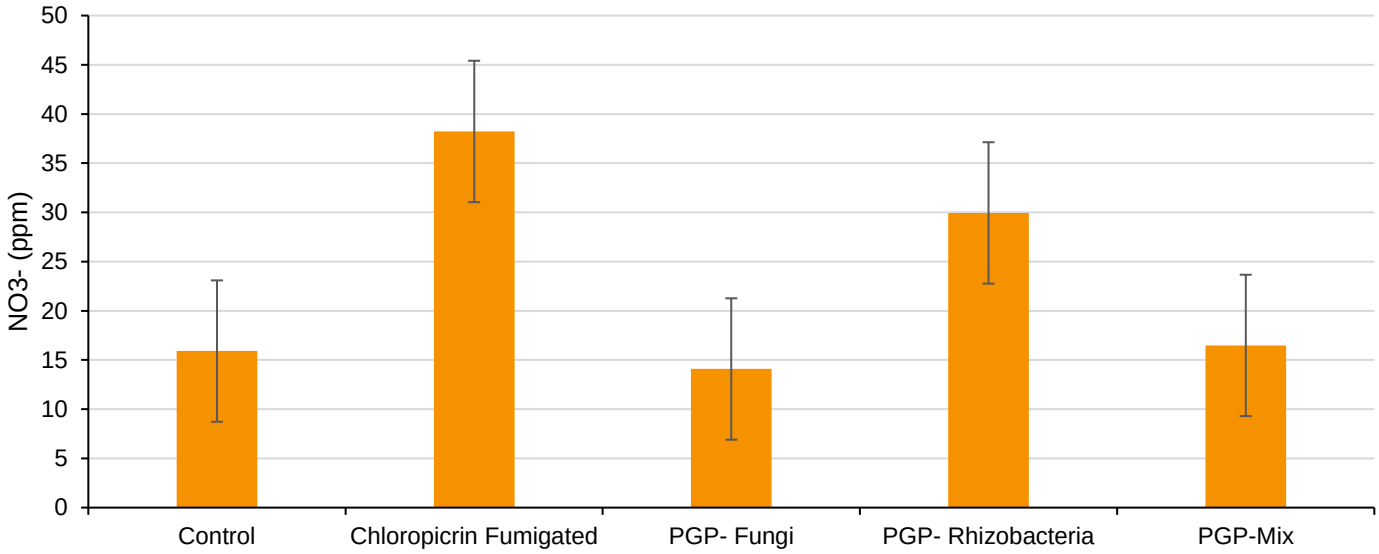

Figure 2. Treatment effect on soil nitrate concentrations (p=0.0172) at the medium-density orchard (Simcoe Research Station, 'Aztec Fuji'/M.9) in autumn 2020, Norfolk County, ON. Bars represent standard error.

Conclusions

- In the high and medium-density orchards, the chemical fumigation treatment and the plant-growth promoting rhizobacteria treatment resulted in the greatest tree growth.
- In these same orchards, plant-growth promoting fungi did not alleviate replant issues and, at times, resulted in lower growth than the control.
- These patterns were also seen in the number of fruitlets per tree that developed in year two at the medium-density orchard.
- The soil treatments only seemed to influence leaf nutrient levels in the medium and low-density orchards.
- The characterization of soil microbial communities (data being processed) will help with understanding what made some treatments more effective and aid in understanding the factors that contribute to ARD in this growing region.

Additional findings, apple replant reviews, project information, and contact details are available on Meaghan's project website and blog at applereplantdisease.wordpress.com.

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Vineland Research and Innovation Centre's Apple Breeding Program Update 2022

Rachael LeBlanc, Research Scientist, Vineland Research and Innovation Centre
Amy Bowen, Director, Consumer, Sensory and Market Insights, Vineland Research and Innovation Centre

Producing apples with a high consumer appeal continues to be the focus of the breeding program.




Vineland's Test 1 (T1) block now contains about 23,000 unique seedling trees with about 3000 being added and removed each year. All T1 selections are evaluated over three seasons of fruiting before being considered for removal. Vineland's genomics laboratory pre-screens all seedlings using molecular markers with the goal of enriching the

population for key traits such as texture, flavour, acid content, firmness, storage stability and disease tolerance. A focus over the last two years has been the addition of molecular markers used to screen for seedlings that will produce aroma chemicals contributing to apple flavour.

Vineland's Test 2 (T2) block contains 93 selections that are replicated and grafted on M9 rootstock. Fruit from 35 of these 93 trees in the T2 block was profiled by Vineland's trained sensory panel and described for aroma, flavour, taste and texture characteristics. Apples were grouped based on flavour profile due to differences such as high versus low sweet and acid tastes and crisp, juicy versus soft or mealy textures. Key aromatic differences grouped apples based on honey, floral, green and lemony descriptions. This data is critical in ensuring that our breeding program is continuing to advance apples with high consumer appeal.

A key milestone was achieved in the fall of 2021, where fruit from 15 selections (Vineland T2 and commercial) was evaluated by 227 consumers in the Greater Toronto Area. This was the first time that apples from our breeding program were evaluated by consumers. Overall the Vineland apples performed very well with consumers. All of the Vineland apples selections were liked 'as much as' or 'more than' commercial varieties Honeycrisp and Gala. Overall, consumers liked apples that they described as juicy, crisp, sweet and aromatic.

In addition to rating their liking of the apple, consumers were asked about their apple purchasing habits and attitudes. Surprisingly almost one third of consumers could not name 3 apples varieties without prompts. The most recognized apple varieties were Gala, Granny Smith and McIntosh. Overall, Gala and Granny Smith were the most purchased varieties even though consumers stated Honeycrisp as their preferred variety. The most stated reasons for purchasing apple were 'convenience' and 'as part of a healthy diet'.

Another exciting development in 2021 was the planting of test trees at grower sites (Test 3) across Ontario. Three Vineland selections were planted at five Ontario sites (one in each district) and one additional selection will be planted in 2022. Five additional growers in Ontario will be added to the testing program in 2022.

For more information about our apple program, please contact Rachael LeBlanc Rachael.leblanc@vinelandresearch.com

This research is supported by Ontario Apple Growers through the Agriculture and Agri-Food Canada AgriScience Program and through the Ontario Ministry of Agriculture, Food and Rural Affairs-University of Guelph Partnership Program.

Crop Protection

Apple Scab Resistance Testing Available

Katie Goldenhar, Plant Pathologist – Horticulture Crops, OMAFRA

Apple scab is an endemic disease in Ontario orchards that growers are challenged with managing every growing season. Fungicides are an important tool to manage scab in apples.

In 2011 and 2012, a survey of apple scab populations across Ontario, New Brunswick, Nova Scotia, British Columbia, and Quebec showed that there is resistance to FRAC group 11 (also known as strobilurin/QoI) fungicides via a stable, genetic mutation. At that time, some locations in Ontario had sensitive scab populations where Group 11's would still be effective to manage apple scab. Since apple scab spores do not move long distances, testing on farm is important.
This season as a follow up to the 2011/2012 national survey, OMAFRA has funding available for growers interested in having their apple scab tested at no cost for resistance to Group 11's. Knowing if your apple scab is resistant or sensitive to Group 11's can help inform your fungicide applications and protect the remaining fungicides in your toolbox.

Fungicides registered in apples containing a Group 11 include Flint (**trifloxystrobin**), Merivon (**pyraclostrobin** + fluxapyroxad) and Pristine (**pyraclostrobin** + boscalid). Note that Group 11 fungicides are still effective on other apple pathogens, including bitter rot.

Contact Kristy Grigg-McGuffin (519-420-9422; kristy.grigg-mcguffin@ontario.ca) or Katie Goldenhar (519-835-5792; katie.goldenhar@ontario.ca) if interested in participating.

For a summary of the 2011/2012 Canadian apple scab resistance survey results, see: https://agriculture.canada.ca/en/agriculture-and-environment/agricultural-pest-management/agricultural-pest-management-resources/resistance-apple-scab-pathogen-fungicides-canadian-orchards-knowing-and-managing-risk

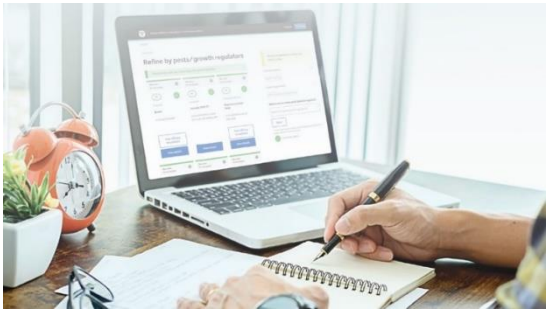
For a listing of registered crop protection products for apple scab and other common diseases, refer to the Ontario Crop Protection Hub: https://cropprotectionhub.omafra.gov.on.ca/

Introducing the Ontario Crop Protection Hub

Kristy Grigg-McGuffin, Horticulture IPM Specialist, OMAFRA

The Ministry of Agriculture, Food and Rural Affairs (OMAFRA) is transforming the way crop protection information is provided to better serve clients through an online digital application called the **Ontario Crop Protection Hub**.

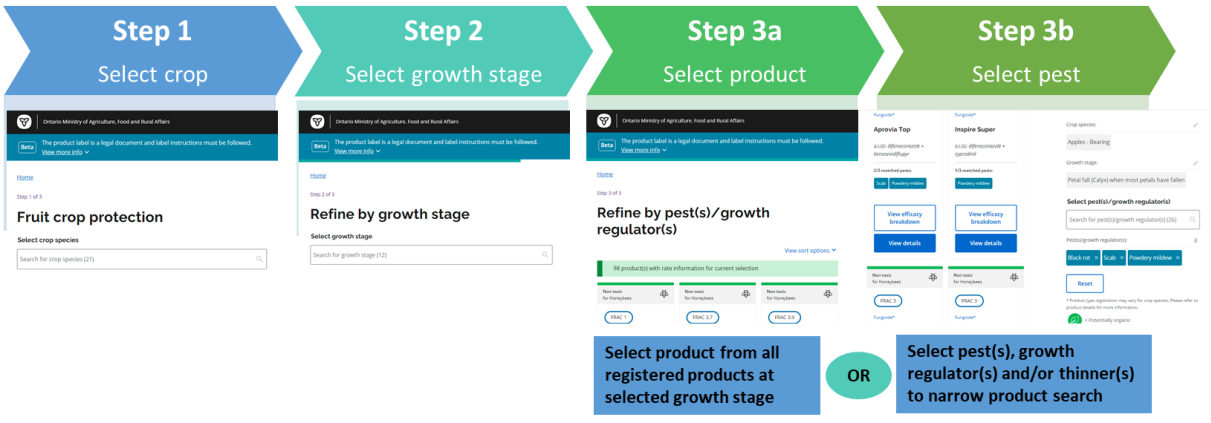
The Ontario Crop Protection Hub is now available and ready for you to access the latest crop protection information at ontario.ca/cropprotection.



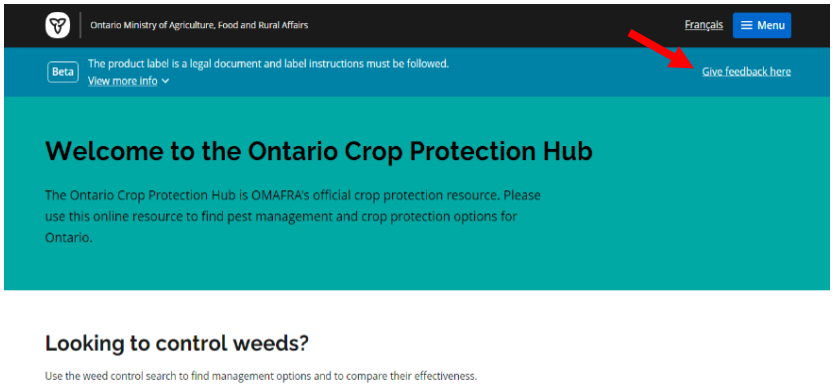
The Ontario Crop Protection Hub is…

- accessible through **any device** (tablet, computer, smart phone),
- allows you to **customize** and find information based on your specific business needs, and
- replacing **PDF and print** crop protection publications, which can quickly become out of date.

Find the crop management solution in only a few simple steps:

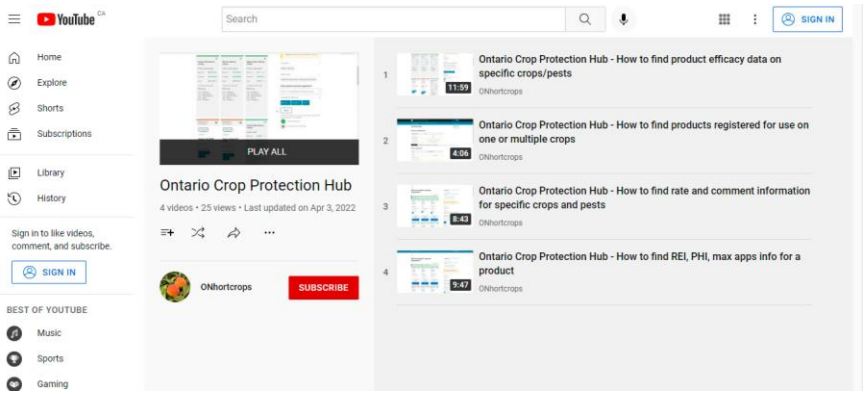


To ensure the application meets the needs of the agri-food sector and that we understand how best to support users with the transition to this new digital tool, OMAFRA will be conducting user testing along the way and engaging producers and stakeholders for feedback. This is the **first (beta)** version of the application, and you will see changes to features and content over time as we continue to improve this digital service.



Your feedback will help this improvement! There is a feedback form link at the top of the webpage and available here: https://forms.office.com/r/ jCh0uW5LRw

For how-to videos, check out the Ontario Crop Protection Hub playlist on the ONhortcrops YouTube channel at https://www.youtube.com/channel/ UCJr20gvrwcOzO-Xr20OAu3A.



Questions? Contact Kristy Grigg-McGuffin by email at kristy.grigg-mcguffin@ontario.ca or phone 519-420-9422.

Green Tip is Here – Are You Prepared for Early Spring Pest Management?

Kristy Grigg-McGuffin, Horticulture IPM Specialist, OMAFRA

Orchard Sanitation: First Line of Defense

The first line of defense for pest management in an orchard is prevention. There is no silver bullet to eradicate something like disease once it becomes well established. This means management is a year-long process to reduce inoculum in the orchard and prevent the spread to healthy trees or fruit.

- Prune out dead or diseased branches and rotten or mummified fruit that often habour overwintering pests, such as fire blight, black rot or bitter rot.
- Get rid of wood or cull piles and stumps that may have provided overwintering sites for insects, such as codling moth and plum curculio.
- Clean up the orchard floor of leaves, branches and fruit.

Fire blight

Pruning cankers

If you haven't already, early spring is a good opportunity to clean up any remaining infected limbs, cankers or – in the case of rootstock blight – trees that will act as sources of inoculum and get as much fire blight out of the orchard as

possible. These overwintering cankers will be the source of disease in the coming year as the bacteria is sitting in vascular tissue in the canker margins. As the tree begins to push in the spring, these cankers become active and the bacterial cells start to multiply. Generally, as temperatures increase above 18ºC, the enlarging cankers start oozing bacterial-laden sap that may or may not be visible. The bacteria are then carried by insects or rain splashed to developing tissue – whether that's blossoms or shoot tips.

Dormant pruning is effective for many reasons. Firstly, the fire blight pathogen, *Erwinia amylovora* is not active in the cold temperatures and therefore will not spread on pruning shears, tools or infected tissue. This means there's no need to disinfect tools between cuts like with summer pruning. Secondly, the cankers are easier to see in the orchard without foliage blocking or shading your view.

Spend some time to thoroughly scout for cankers while pruning. Try to do this more than once during the early spring and at different times during the day to have different light direction. While this does take additional time, that extra work may save you trees down the road by removing inoculum sources.

For more information on what to look for when pruning fire blight infected trees, see the February 2021 Orchard Network Newsletter article, *Put Out the Fire – Part 1: Managing Rootstock Fire Blight*.

Plan ahead

It's time to also start thinking about in-season fire blight management as bloom can come quickly. Having products ready and at your fingertips will allow you to act fast should conditions for infection occur. Don't get caught unprepared!

- Have enough control product to cover all rows of susceptible blocks every 3 days during bloom.
- Become acquainted (or refresh your memory) with forecasting models such as Cougar Blight or MaryBlyt if you will be running these for your farm. Otherwise, bookmark the Ontario Fire Blight Prediction Maps in your browser for quick reference during bloom. These maps are updated 3 times per week with a 7-day predicted risk forecast.
- Make a plan for management
    - What products you will use? Consider your options: antibiotics (Streptomycin, Kasumin), coppers (Cueva), biologicals (Blossom Protect, Serenade, Double Nickel, Lifegard), Apogee/Kudos, etc.
    - How will you use them? Keep in mind, the newly registered Lifegard should be applied prior to bloom and again at petal fall. Biologicals often need to be applied preventatively ahead of an infection to give time to multiply, invade the area, initiate a plant response, etc. A good resistance management practice to maintain the life of antibiotics is chemistry rotation.
    - Don't forget to consider your action plan in case of trauma blight.

But first and foremost, be prepared to apply a dormant copper spray at silver tip to ½" green to help protect the spread of bacteria from any oozing cankers that were missed during dormant pruning.

Dormant copper

The effectiveness of a dormant copper spray really comes down to how it is applied and post-application weather. Copper provides an unfriendly environment over the bark and bud surfaces of the tree, preventing bacteria from getting established or spreading. Thus, it must be applied as a high-volume spray to ensure sufficient coverage.

Dormant copper such as Copper Spray, Copper 53W, Cueva, Parasol and Kocide can safely be applied up to ¼" green (possibly ½" green) without risk of phytotoxicity. However, the use of a softer copper registered for season-long control such as Cueva could be extended in those early spray timings to ½" green or tight cluster in blocks with low scab inoculum (ie., free of scab last year) to provide some scab protection.

Residual activity typically last about 7-10 days under ideal spring conditions. However, once rainfall exceeds 2" from last copper application, it should be assumed all residue has been washed off. Using 1-2% dormant oil, unless the label states otherwise, will act as a sticker/spreader to help with copper as well as provide efficacy on scale, European red mite and suppression of powdery mildew. However, Cueva is formulated with a fatty acid so there is little benefit to adding oil as a sticker for this product. Keep in mind if using dormant oil, do not apply captan or sulphur products within 14 days of

application since oil can enhance penetration of these products into sensitive tissue, resulting in phytotoxicity issues. There are other cautions around the use of oil, which will be discussed below.

Scab

Reducing primary inoculum

Practical and inexpensive, inoculum-reducing strategies such urea and mowing can be an important component to an effective scab management program and contribute to the reduction of overwintering ascospores that will infect green tissue at the start of the season. This is especially important given the reduced arsenal of available fungicides effective against scab Ontario growers now face. Table 1 summarizes research from New Hampshire that looked at the impact of inoculum pressure on primary scab infection the following spring. An orchard with 20% overwintering leaf scab has the potential to produce 7,000 times more ascospores than an orchard with less than 1% overwintering leaf scab (Gadoury and MacHardy, 1986).

Table 1. Primary scab infection activity based on overwintering inoculum levels, New Hampshire[1]

Leaf scab in fall (%)	Ascospore production the following spring		
	Total ascospores produced/acre ('000)	Ascospores/acre released at green tip ('000)[2]	Potential lesions/acre from green tip infection period[3]
<0.5	888	18	0.18
1-3	9,262	185	1.85
4-10	242,559	4,851	48.5
20	6,090,000	121,812	1,218

[1] Adapted from Gadoury and MacHardy (1986)

[2] Assuming 2% of ascospores released.

[3] Assuming 1% of released spores cause infection. Actual infection will vary depending on climate and spraying conditions.

You can save time and money usually invested in fungicide applications by reducing the initial scab pressure going into the season:

- In a typical year, only a small proportion of ascospores are actually mature early season. Therefore, reducing (or eliminating) the risk of infection, and potential need for chemical control, at green tip.
- Scab spores do not travel far and most infections start from within the orchard. Again, getting the inoculum out greatly reduces the risk of infection.
- Most fungicides tend to work better in low-inoculum orchards, particularly when dealing with our Ontario spring weather.
- The trend in new product registrations is towards single-site fungicides which have high resistance potential. Reducing scab inoculum means less selection pressure placed on these products (ie., longer life of these products).

Applying urea

Urea works in a number of ways:

1) It directly inhibits the development of ascospores,
2) It stimulates the growth of naturally occurring organisms that are antagonistic against the scab fungus, and
3) It facilitates the breakdown of the leaves.

Since the early 2000's, research has shown this practice to be effective in reducing over-wintering spores. Research from the University of New Hampshire showed a 97% reduction in ascospore productivity in leaves sprayed with 5% urea just before leaf-fall, 50% reduction when urea was applied to the leaf litter when approximately 95% of the leaves had fallen, and 70% reduction when urea was applied to the leaf litter in spring (Sutton et al., 2000).

For the later areas of the province, if you haven't already done so this spring, apply 45 kg of agricultural urea per 1,000 L of water/ha to the orchard floor before bud break.

Leaf shredding

In addition to a urea application, scab inoculum can be reduced 80-90% by shredding overwintering leaves (Sutton et al., 2000; Vincent et al., 2004). Rake or blow leaves from under trees and shred them using a flail mower. This helps encourage leaf decay and may re-orient the leaves to prevent spores from discharging up into the trees.

Early season management

Consider the following:

- Leaves are susceptible to infection as soon as green tissue is present, especially if you had scab in your orchard last year.
- Green tip to tight cluster is a period of extensive new growth. Keep covered with a good protectant fungicide program and re-apply every 5-7 days during periods conducive to disease development or following heavy (greater than 1") rain.
    - Protectant fungicides such as captan, folpet or mancozeb do not provide effective post-infection or anti-sporulant activity.
    - That means if sprays are applied in less than ideal conditions, ie., windy, alternate rows, or washed off in rain, the risk of scab infection is increased.
- Ascospores mature slowly early season and infection takes longer, peaking over bloom period so plan to save your systemic scab products for when infection risk is greatest.
    - For example, more than 20 hours of leaf wetness are required for primary ascospore infection at an average temperature of 5ºC. This goes down to only 6 hours during average temperatures of 15-25ºC.
- During cool, wet springs, protectant fungicides may not be enough. Consider tank-mixing with post-infection products such as Syllit, Scala, Inspire Super, Luna Tranquility or Buran.

Powdery Mildew

Dormant buds infected with powdery mildew are typically feathered, pointed or shriveled and usually break dormancy later than healthy buds. This means susceptible, green tissue may already be present when the first conidia are produced. If conditions are ideal, even a small powdery mildew population can quickly explode if not managed properly. With the high powdery mildew pressure across the province last year, be prepared for early season management of this pest.

Protectant fungicides used for early season scab management do not have activity on powdery mildew. Tank-mixing a low rate of sulphur (3-5 kg/ha) with captan and/or an EBDC, beginning at ½" green, will provide good activity on scab while also suppressing powdery mildew. This early season program will help free up other chemistries, such as the sterol inhibitors (Nova, Fullback, Cevya, Inspire Super), SDHIs (Aprovia, Fontelis, Sercadis, Excalia, Luna Tranquility) and strobilurins (Pristine, Merivon, Flint) for later use when plenty of new growth is present.

Some key points for effective powdery mildew control this year include:

- Maintain a tight spray schedule with high rates during primary scab infection period. Powdery mildew does not invade mature leaf tissue, so spread of mildew ceases when trees stop producing new terminal leaves.
- Rain deters powdery mildew development by washing off spores. Instead, mildew thrives in dry weather and high relative humidity. So, protectant sprays may still be required during dry periods when there is little risk from apple scab.
- Getting good mildew control following an outbreak will take several seasons. Mildew infected white shoots from last year's failure will persist through the season, but does not indicate current fungicides are failing. The current season mildew program is designed to prevent spread that would lead to primary infection for next year.
- Include a mildewcide, such as sulphur in all sprays beginning at ½" green until temperatures are greater than 25°C or when applying oil. Sulphur lacks post-infection activity, so must be applied early season. A tank-mix that includes captan, EBDC and sulphur provides excellent protection against scab, rust and mildew.
- If pressure was low last year, oil applied for mites may provide suppression of powdery mildew. Use a 2% solution (20 L/1,000 L water) for dormant sprays or a 1% (10 L/1,000 L water) solution for summer sprays. Do not use captan- or sulphur-containing products within 14 days of an oil application.
- Where they are working, include fungicides from other groups, including sterol inhibitors, strobilurins or SDHIs during the critical infection period, generally at pink and petal fall.

Dormant oil

Spring-applied dormant oil can seem at times a risky game to play, hoping the right growth stage will align with the right weather conditions. However, by preparing early for this spray and following the forecasted weather, dormant oil can be an effective tool for managing some rather difficult-to-control pests. Insect development and activity is driven by temperature; the milder it is, the faster the insect matures. This improves the efficacy of how oil works as well as ensures a lower risk of phytotoxicity concerns.

Over the years, there has been some question whether oil may reduce the overall health of the trees. To date, there is no scientific evidence to support these claims. Oil has been used for many years across apple growing regions of the world to control various overwintering pests with no ill effects on the health of the tree when properly applied.

How Does It Work?

Oil sprays work mainly by suffocation. Coating the insect – which means in a high-volume spray to reach all the cracks in the tree bark – prevents normal respiration from the air holes (spiracles) where they breathe. This works best on the immobile and immature stages where:

1) the insect can't move away to avoid the spray,
2) the scale coverings have still not hardened and oil can penetrate, and
3) respiration rate is the highest.

However, oil can also interfere with egg development, prevent settling of scale crawlers and deter feeding by pests such as aphids which is why summer oil programs are also worthwhile.

What Pests Does It Target?

There are several species of scale insects affecting apples; San Jose scale (SJS) is the most common in Ontario orchards. This insect overwinters as an immature scale under bark and emerges just prior to bud break. As the immature scales feed, they exude a waxy substance that forms a protective layer. Dormant oil sprays are the best timing for this pest before they develop that waxy covering.

Without the foliage to block the spray, dormant oil applications can get reasonable coverage of limbs and trunk where the overwintering SJS population is located. Targeting individuals at this stage will help reduce the population that will produce the summer generation crawlers. Postbloom management targets these crawlers which move from the infested area to maturing fruit. These sprays can be very effective at reducing the amount of fruit damage; however, they do not always provide good control of the crawlers that move elsewhere such as to new branches, a different spot on the trunk or to an adjacent tree. In other words, you could find yourself in a continuous cycle of managing fruit damage if the SJS population is not suppressed. While it may be hard to find time and good weather early season, an oil application is well worth it.

European red mites overwinter as eggs on roughened bark around the bases of buds and spurs, or in the inner parts of the tree close to the main trunk and branches. Oil sprays should be applied before egg hatch, between half-inch green and tight cluster.

While delayed dormant oil applications primarily target scale and mites, you may see some additional efficacy against other pests at this timing including impeding egg hatch and movement of aphids and some spring feeding caterpillars, interfering with egg laying and development of apple leafcurling midge and preventing release of overwintering powdery mildew spores as infected buds open.

Is It Too Late for Dormant Oil?

Depending on the target pest, the term "dormant" oil can be rather misleading as sprays can be applied from the true dormant state prior to bud break up until pink. Unfortunately, optimal dormant timing for scale is not necessarily the same for mites.

If monitoring indicates scale is a bigger issue in the orchard, oils need to be applied before or shortly after bud break. This efficacy against scale is significantly reduced with later oil applications for European red mite as they develop a waxy protective layer that impedes the oil from effectively penetrating and preventing respiration.

However, if European red mite populations are the problem, sprays can be delayed. Ideal timing is half-inch green to tight cluster but can be delayed to pink; however, blossoms can be quite sensitive to oil under adverse conditions so consider using a lower rate at this timing.

Precautions

Original precautions around the use of dormant oil were developed prior to the refinement processes that are carried out now with the commonly registered products. Most impurities that were associated with phytotoxic effects with some of the older "heavy" horticultural oils are removed through extra filtration and distillation. If you have concerns with using oil, especially with sensitive varieties like Red Delicious, Empire, Mutsu and Ambrosia, consider the newer generation oil products such as Purespray Green Spray Oil 13E, Suffoil-X or Vegol as these are registered for both dormant and summer use.

However, even highly refined "summer" oils can cause crop injury when they are applied:

- when temperatures are consistently below 4C
- within 48 hours before or after a freezing event
- in slow drying or prolonged wet conditions
- with or too close to products containing sulphur or captan
    - do not apply oil within 14 days before or after these products
    - restrictions also apply to Vegol Crop Oil with copper compounds
- above label rate
    - higher labeled concentrations can be used for dormant applications vs summer applications (e.g., 2% solution vs 1% solution of Purespray for dormant vs summer use, respectively)
    - High water volumes are essential for good coverage
- to plants are under moisture stress
- when temperatures are very high (above 25°C)

Always read the product label for additional instructions and precautions.

Prebloom Insecticides

In recent years, with the changing spring climate, new or emerging early season pest issues, challenges with immediate post-bloom control and the varying bloom times of different varieties, relying on a petal fall management program alone does not always provide full protection from insect damage. More discussion is happening around the benefits of a prebloom program, which is a practice many growers have tended to move away from. Without prebloom insecticides, natural enemy populations can build, there is less risk of exposure to pollinators and it's money saved on input costs. However, rosy apple aphid, leafcurling midge, European apple sawfly, tarnished plant bug, spring-feeding caterpillars, mullein bug and plum curculio are just some of the pests that can cause extensive early season damage and are strongly dependent on the temperature prior to and during bloom.

Consider the following factors when deciding if a prebloom insecticide is worth it:

1. **Presence of insect pest(s) in orchard that has historically caused injury to developing flowers or fruitlets** – Has the particular pest caused significant economic damage in the past such that injury is anticipated again this year? Understanding the biology and period of activity of the target pest will help determine if control at pink will reduce populations compared to an early petal fall application. For instance, in Ontario:
    a. Monitoring of apple leafcurling midge has found pre-bloom adult activity typically beginning mid-May.
    b. Rosy apple aphid activity starting at tight cluster can be common in cool, wet springs.
    c. European apple sawfly adults emerge pink through to bloom, laying eggs in the flower base.

d. Plum curculio activity generally starts moving back into the orchard at bloom, with the greatest migration occurring within 14 days after petal fall.
e. Mullein bug hatch is typically synchronized with peak emergence at early petal fall, but a cold snap during this time may result in split hatch.

2. **Whether a pink application of a particular product may deter a beekeeper from bringing hives into the orchard** – It might be worthwhile to speak to your beekeeper about your prebloom control considerations. Some may not bring their hives into an orchard that has used a particular product or group of products despite the insecticide being applied prior to the bees coming in.

3. **Likelihood of making a timely petal fall application** – Do your blocks have a mix of early and late blooming varieties that may delay a petal fall application? Is the bloom period predicted to be cool, wet and therefore prolonged? Has there ever been a time that the hives were not removed early enough? Any delay to a petal fall application can have serious implications in an orchard block with high pest pressure such as sawfly, plum curculio, mullein bug or oriental fruit moth.

A number of prebloom insecticide options are available depending on the target pest. Refer to the Ontario Crop Protection Hub for a full list of registered products, efficacy on early season insects as well as toxicity to beneficial insects.

Do not apply insecticides while apples are in bloom. The Bee Act makes it an offence to do so in Ontario. Time any prebloom or immediate postbloom applications to minimize exposure to any native pollinators that may be active in or around the orchard. Under normal circumstances, spraying after 8 pm allows spray to dry before bees are exposed to it the next day. Spraying during early morning is the next best time, when fewer bees are foraging, but spraying should be completed well before 7 am. Always read the most current product label for guidance.

Mild Winter & Pest Pressure

In a typical winter, insect populations often experience winter kill to some degree, depending on many factors within the micro-climate of the orchard, such as air drainage, snow cover and extreme temperature. However, in a mild winter like we just had with very few cold snaps, overwintering survival for most insects is very likely. Even with an extremely cold winter, favourable weather early in the spring like we're experiencing can easily compensate for those pests that survived and may lead to early emergence. With a warm, dry spring, we could see a quick emergence of European red mite, rosy apple aphid, tarnished plant bug, apple leafcurling midge and mullein bug.

Mother Nature typically doesn't give us much reprive from most overwintering disease in a typical year, as inoculum is often well protected from cold weather in infected branches or cankers (e.g., fireblight), in leaves on the orchard floor (e.g., apple scab), in dead wood or mummified fruit in the tree or on the ground (e.g., black rot, bitter rot), or in alternate hosts to be carried in from other areas on wind currents (e.g., rust).

The exception to this would be powdery mildew, which overwinters as mycelium in dormant fruit and shoot buds that were infected the previous season. Conidia grow out of buds in the spring as infected tissue and spread to other leaves causing secondary infection. Overwintering powdery mildew infected buds and shoots lack winter hardiness. In a cold winter with temperatures below -24°C, the survival rate is generally less than 5%. Unfortunately, with the mild winter, growers who had problems with powdery mildew last year should anticipate survival of those infected buds and be prepared for early prevention this season.

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Spotlight on Timing for Disease Management: Part 3 – "Summer" Disease

Kristy Grigg-McGuffin, Horticulture IPM Specialist, OMAFRA

In the December 2021 Orchard Network Newsletter, I began a series of articles focusing on the importance of timing for orchard disease management with *Part 1 – Disease Cycle* and *Part 2 – Powdery Mildew*. Continuing on this topic, let's shine the spotlight on an increasingly problematic disease complex for Ontario growers: summer diseases.

The term 'summer diseases' can be rather misleading when referring to common pathogens of apples such as black rot, bitter rot, fly speck and sooty blotch (FSSB). While symptom development often doesn't really start to appear until later in the summer or into the fall, infection actually occurs much earlier in the season. Missing these timings can cause quite the headache for the remainder of the year.

But firstly, what are these diseases?

Black rot

Lesions begin as sunken black spots (Figure 1) often located in close proximity to mummified fruit left from chemical thinners. Eventually these lesions enlarge into a firm tan or brown rot with concentric rings and black fruiting bodies, or pycnidia (Figure 2). Black rot can be considered a "firm" rot in that the fruit maintains its round shape as the lesion progresses. Varieties which retain mummified fruit such as Gala, Honeycrisp, Cortland and Northern Spy are most susceptible.

Figure 1. Black rot symptoms on fruit and leaves (known as frog-eye leaf spot) on apple

Figure 2. Advanced black rot lesion on apple

Bitter rot

Appear as brown spots that enlarge into sunken lesions (Figure 3) that may be surrounded by a red halo depending on the variety. Especially during wet or humid conditions, masses of salmon-colored spores are produced on surface of lesion. A diagnostic V-shaped rot progressing towards the core can be observed when infected fruit are cut open. Susceptible varieties include Empire, Ambrosia, Gala, Honeycrisp and Idared.

Figure 3. Bitter rot on apple

Fly speck

Appear as groups of few to several small (0.5 mm), shiny black fungal bodies, or thyriothecia on the fruit surface (Figure 4). Although these fungal bodies appear to exist individually, they are connected by mycelium to form colonies, typically in round or irregular groups 1-3 cm in diameter. Fly speck often appears together with sooty blotch and does not damage the flesh.

Figure 4. Fly speck on apple

Sooty blotch

Appear as brown to olive green, cloudy blotches with irregular margins on the surface of the skin, often more obvious on light-coloured fruit (Figure 5). These blotches can be removed with vigorous rubbing. In storage, fruit with sooty blotch infection shrivel more readily than uninfected fruit.

Figure 5. Sooty blotch on apple

When does infection occur?

Fruit rot spores can overwinter in dead wood, cracks, cankers and mummified fruit. Black rot infection can occur as early as bud break under high pressure; however, most commonly activity begins between late tight cluster and bloom. Early indication of spore activity is the presence of black rot infection on leaves, known as frog-eye leaf spot. Look for these lesions following a period of wet weather.

While the biology of bitter rot is not as well understood as black rot, especially in Ontario, early evidence suggests this pathogen also begins activity over bloom. Infection can remain dormant for an extended period. Symptom development for fruit rots typically peak mid- to late summer following higher temperatures accompanied by rain or thunderstorms.

Spores of FSSB overwinter on branches, culled fruit and woody wild hosts such as brambles, grapes, oak, ash, elm and maple. These spores are moved into the orchard by wind or rain for 1-2 months beginning after bloom. However, first symptoms typically develop 2-3 weeks after infection. In unsprayed trials, sooty blotch seems to appear first because of a shorter incubation period, beginning approx. 2-3 weeks after petal fall versus 4-6 weeks after petal fall for fly speck. There is a fly speck forecasting model that predicts the start of infection beginning 175 leaf wetting hours after petal fall with symptom development appearing after another 175 leaf wetting hours, or 350 leaf wetting hours from petal fall.

How can these diseases be managed?

Beginning at bloom, consider efficacy of summer disease when selecting scab fungicides. Table 1 summarizes activity of fungicides that could be used for summer disease control. Group M4 (captan, folpet), Group 11 (Pristine, Merivon, Flint) and Group 29 (Allegro) offer the broadest spectrum of control for these diseases.

While infection does occur earlier, late season control of these diseases is still critical, especially when things are beginning to relax back on scab management for the summer. As scab fungicide residues are depleted, these other pathogens can resume growth and produce symptoms. Several studies have shown that while common scab fungicides can stop the in-season development of rots and FSSB, these products may not eradicate infection, leading to issues at harvest or in storage.

For management of summer diseases, follow a 14-21-day application interval until harvest to ensure fruit remains protected. Residual protection will vary depending on the product used. For example, Pristine or Merivon can provide

reasonable residual control of summer disease up to 3 weeks at the labelled rate in ideal conditions; however, captan should not be pushed further than 14-days between sprays particularly since it is not as strong on fly speck and sooty blotch as other control products. In all cases, reduce interval to 7 days during times of hot, wet weather. Re-apply if there has been >2 inches of rain since the last application.

Table 1. Activity of registered fungicides for summer orchard diseases including fly speck / sooty blotch (FSSB), black rot and bitter rot

Product	Group	PHI	Scab	FSSB	Black rot	Bitter rot
captan *Supra Captan, Maestro, Sharda Captan*	M4	19 days*	+++(+)	++(+)	+++(+)	+++
folpet (NR) *Follow, Folpan*	M4	1 day	++(+)	++(+)	++(+)	+++
Senator (NR)	1	1 day	+++	++++	+++	+
Aprovia Top	3+7	30 days	++++	+++	—	—
Inspire Super	3+9	14 days	++++	+++(+)	—	—
Pristine	7+11	5 days	+++(+)	+++(+)	+++(+)	+++(+)
Merivon	7+11	0 days	+++(+)	+++(+)	+++(+)	+++(+)
Flint	11	14 days	++++	++++	+++	++(+)
Allegro	29	28 days	++	+++	+	+++
Phostrol	33	1 day	—	++	—	—
Regalia Maxx	P5	0 days	+(+)	+(+)	++	+(+)

* = PHI 19 days for low/standard orchards, 15 days for high density
NR = Not registered for all pests listed. See label
— = activity is unknown for this pest

Be sure to keep in mind preharvest intervals for all early and late-harvest varieties. Some products that may be most effective for summer disease cannot be used for fruit that will be harvested in the coming weeks. At the same time, residues will need to be maintained on late-harvested varieties into the fall, especially if the hot weather trend continues in September and October.

Timing Take Home

Key timings to remember for effective summer disease control:

1. **Be prepared early** – Fruit can become infected beginning in the earliest development if conditions are right and inoculum is present.
2. **Waiting for symptoms is too late** – Management is preventative. If your summer disease program begins when symptoms start, it's too late. With latent infections, symptom development often does not happen until weeks after infection has already occurred. Fungicides at this point may arrest further development but will not eradicate infection. For late season infection, this could mean symptoms develop in storage.
3. **Relaxed scab program = greatest risk of summer disease** - As scab fungicide residues are depleted, these other pathogens can resume growth and produce symptoms. Maintain a regular preventative fungicide program every 14-21 days until harvest. Reduce interval during periods of hot, wet weather.
4. **Early prevention starts with cultural management** – Remove potential sources of inoculum such as dead branches, fruit mummies (where possible), infected fruit on the orchard floor and alternate hosts including brambles (blackberry, raspberry) from surrounding hedgerows or woodlots. Prune and thin clustered fruit to facilitate drying and improve fungicide coverage. Reduce tree stress by irrigating and/or applying a sun protectant, especially ahead of a heat wave.

Mancozeb Changes A'Coming

Kristy Grigg-McGuffin, Horticulture IPM Specialist, OMAFRA

By now, you are likely aware of the Pest Management Regulatory Agency (PMRA) re-evaluation decision for mancozeb fungicides including Manzate Pro-Stick, Manzate Max, Penncozeb 75 Raincoat and 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

The labels for these products are now updated on the PMRA label search to reflect the new use restrictions. 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.

As indicated in the above table, after November 2022 the maximum allowable applications will be limited to 4 per year. Unfortunately for apple growers, this application limit applies to both full and half rates of mancozeb.

So, what now? As a starting point, the April 2021 Orchard Network Newsletter article, Considerations for the Future of Apple Scab Management looks at how and when to use the tools left to manage scab and summer disease.

Announcements

2022 Apple IPM Workshop

Over the pandemic, the annual Apple IPM Workshop was offered virtually. All presentations in the Apple IPM Workshop Series can be found on the ONhortcrops YouTube channel at https://www.youtube.com/playlist?list=PLjTx-zm9InXAbdQ5PtsyHIzF2_YABqb3c.

This year, we will be offering a hybrid session for anyone interested in chatting the basics of apple IPM from monitoring techniques, safety protocols and tips for success when scouting orchards.

SAVE THE DATE!
Friday, May 6th
10:00 am – 1:00 pm
Simcoe Research Station, Auditorium (1283 Blueline Rd. Simcoe, ON)
Virtual option available via Zoom

Watch the presentation series ahead of the meeting, bring your pest-specific questions and get hands on with samples and equipment. If attending in-person, come prepared to head out to the orchard if the weather is good. Stay tuned to the ONfruit blog for registration details

North American Virtual Apple Meetup Series

Last year various extension specialists across the United States put together a virtual apple meetup series, focusing on 'Honeycrisp' apples. This year, the series will focus on labour and technology in the orchard with representation from across the U.S. and Ontario.

Orchard Efficiency: Labour & Technology

JUNE 2	**7 PM EST**	**Labour – Grower Experiences**
JUNE 16	**7 PM EST**	**Labour – Specialist Panel**
JUNE 30	**7 PM EST**	**Technology – Grower Experiences**
JULY 14	**7 PM EST**	**Technology – Specialist Panel**

These meetups will provide an opportunity to review challenges, best practices, and new recommendations for orchard labor and technology. Led by a panel of scientists, growers, and other experts in labor and technology across North America.

Facilitated by:

- Bernardita Sallato, WSU Extension
- Mario Miranda Sazo, Cornell Cooperative Extension
- Anna Wallis, MSU Extension
- Daniel Weber, PSU Extension
- Kristy Grigg-McGuffin, OMAFRA

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