

ORCHARD NETWORK

For Commercial Apple Producers

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In this issue…

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Orchard Management

Wanted: Harvest Assessment Participants

Erika DeBrouwer, Tree Fruit Specialist, OMAFRA

As part of a baseline study, I am hoping to assess various technologies and strategies that growers are currently utilizing in the orchard during harvest.

I specifically want to look at various ways growers are harvesting, some ideas include:

- ladders and/or platforms
- stripping trees vs spot picking
- bin carriers
- variety variance
- crew sizes
- time of day
- early season harvest vs late season harvesting
- logistics etc.

I am hoping to look at 'Honeycrisp', Gala, and Ambrosia specifically across the province, where I am hopeful to have at least one of each variety from every district. I hope to look at the variance within the industry of apple harvest and share any efficiencies, technologies, and strategies that could be shared and integrated throughout the industry.

What would I need from you? If you are interested in participating, please reach out to me directly to discuss when we can schedule a day where I can come and see harvest crews in action.

If interested, please contact Erika DeBrouwer at 226-931-4098 (call/text) or email me at erika.debrouwer@ontario.ca

Pollen Tube Growth Model: Reflection on 'Honeycrisp' Field Data

Erika DeBrouwer, Tree Fruit Specialist, OMAFRA

Model Background

The pollen tube growth model (PTGM) was developed to better inform growers when to apply chemical bloom thinners by Virginia Tech and has proven to aid in this decision in various states across the U.S. The model is currently being validated in Ontario and was trialled at various locations across the province starting in 2020. The PTGM uses temperature, amongst other weather-related aspects, to calculate ideal timing of thinning. The model is based on flower fertilization timing, which is why it is cultivar specific, although a "universal" PTGM is currently being developed by Dr. Greg Peck. Models for various varieties have been developed, one of those being Honeycrisp, in hopes of addressing the biannual bearing nature of the cultivar. The model is not currently accessible in Ontario.

How To Use:

1. Growers start by assessing their orchard to determine their target crop load
2. Multiply 1.5 by your target crop load
3. Once the amount of open king blooms is equal to 1.5 x target crop load, move on to step 3
4. Collection and measurement of 25 to 50 king styles per block
5. King style lengths are input into the modelling system
6. Based on weather forecasting, the model will suggest the best time for effective bloom thinning application
7. Application of chemical thinner is applied
8. Grower assesses if a second or third thinner application is necessary
9. Model will be restarted if needed for additional applications

Benefits and Challenges of the PTGM

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

Project Overview

The model uses percent fertilization as the indicator to apple bloom thinner and it is recommended to spray once the model reaches 100%. In 2021 we had 6 days from collection to ideal bloom application timing, while in 2022 we had 3 days. This is caused by various factors, but it is something to consider if this is a tool you want to try on your orchard. The model can be restarted to apply as many bloom thinners as you wish.

PTGM: Pollen Tube Growth Model
GT: Grower Timing
LS: Lime Sulphur
ATS: Ammonium Thiosulphate
1: 1 application of bloom thinner
2: 2 applications of bloom thinners
Control: No bloom thinner applications

2020/2021 Trial

Site A Data

Treatment	Fruit Count Per Tree at Harvest	Floral Return Bud Count	Vegetative Return Bud Count	Vegetative : Floral Return Bud Count
GT ATS	44	10	56	28 : 5
PTGM ATS 1	53	16	58	29 : 8
PTGM ATS 2	52	9	57	19 : 3

Site B Data

Treatment	Average Fruit Count	Average Fruit Weight (grams)	Average Return Bloom Count
Control	249	245	6
PTGM LS	195	286	15
PTGM ATS	203	264	12

2020/2021 Takeaways

Site A Data Overview:

- PTGM ATS 1 had the highest fruit count at harvest, while the GT ATS had the lowest
- PTGM ATS 1 had the lowest vegetative to fruit return bud ratio, while PTGM ATS 2 had the highest

Site B Data Overview:

- Control had the highest fruit count at harvest, while PTGM LS had the lowest
- Control had the lowest weight, while PTGM LS had the highest
- Control had the lowest return bloom, while PTGM LS had the highest

Overall:

- Bloom thinners decreased the average fruit count, but increased fruit weight and return bloom.
- Highest return bloom was seen in treatments with one bloom thinner application. This suggests that the timing of chemical bloom application is more important than multiple chemical applications.
- One GT ATS application was compared to PTGM timing, where the PTGM timing demonstrated higher return bloom. This suggests that modelling systems can aid growers in more effective bloom thinning decision making.

2022/2023 Trial

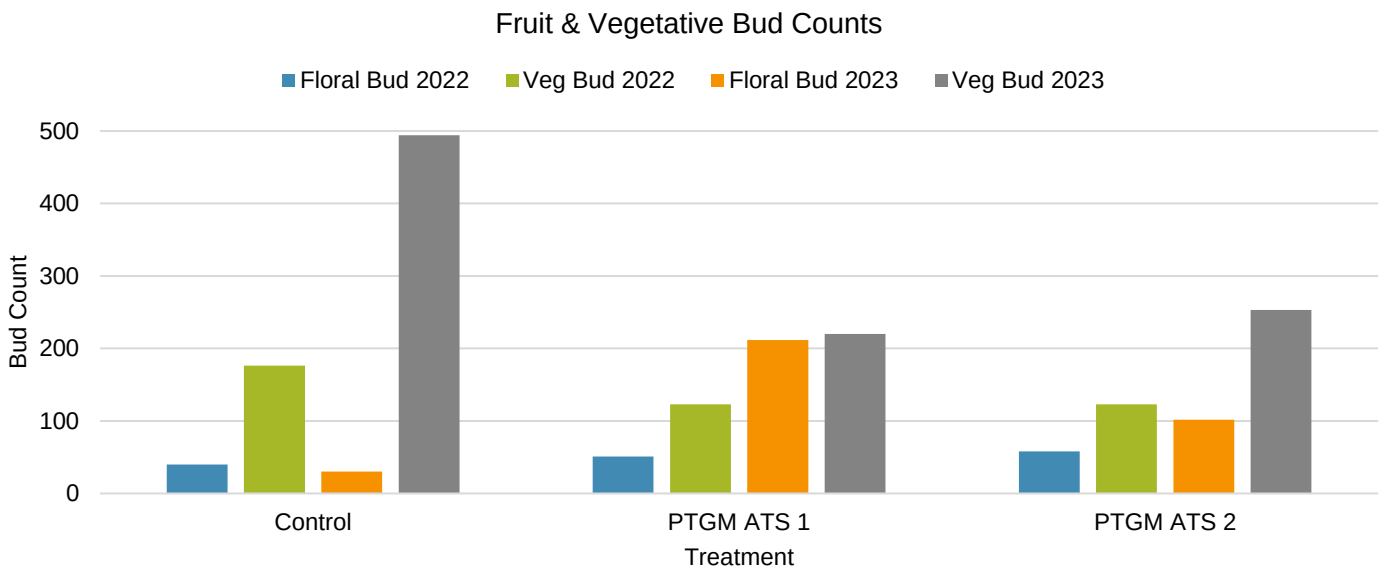
Treatment	Control	PTGM ATS 1	PTGM ATS 2
Treatment Details	- Pruned - No Bud Thinned - No Fruitlet Thinned	- Pruned - Bud Thinned - Not Fruitlet Thinned - 60% application	- Pruned - Bud Thinned - Not Fruitlet Thinned - 60% and 100% application

2022 Data

	Fruitlet Size 2022 (mm)			Fruit Count 2022			Fruit Harvest 2022 (grams, mm)		
Treatment	**Julian Day 159**	**Julian Day 244**	**Change**	**Julian Day 159**	**Julian Day 244**	**Change**	**Weight**	**Size**	**Fruit Count**
Control	13.95	62.55	48.60	208	118	-89	264.28	63.78	163
PTGM ATS 1	13.67	71.90	58.22	251	67	-184	381.10	73.24	102
PTGM ATS 2	13.75	70.32	56.57	208	68	-140	379.98	73.52	102

2022/2023 Data Comparison

Treatment	2022 Size (mm) Julian Day 208	2023 Size (mm) Julian Day 207	Change	2022 Fruit Count Julian Day 208	2023 Fruit Count Julian Day 207	Change
Control	49.34	61.83	12.49	184	8	-176
PTGM ATS 1	55.98	61.95	5.97	109	37	-72
PTGM ATS 2	54.44	60.33	5.89	108	23	-85



2022/2023 Takeaways:

2022 Data Overview

- PTGM ATS 1 had the largest increase in fruit size and largest decrease in fruit count, with comparable numbers of weight and size from PTGM ATS 2 treatment in 2022.
- The Control treatment had the least increase in size, lowest fruit count change, along with the lowest weight, and size at harvest.
- Control had the highest amount of fruit at harvest

2022/2023 Data Comparison Overview:

- Fruit size in 2023 is larger across all treatments, this has also been seen across the province in most varieties, where the largest sizing is in the PTGM ATS 1 treatment
- Fruit count in 2023 is less than 2022, where the PTGM ATS 1 has the highest amount of fruit and Control has the lowest
- The Control treatment had that largest vegetative to floral bud numbers in 2022 and 2023
- The PTGM ATS 1 treatment had comparable vegetative to floral bud numbers as the PTGM ATS 2 in 2022
- PTGM ATS 1 had the best vegetative to floral bud numbers in 2023, with almost a 1:1 ratio

Overall:

- Overall, both thinning applications demonstrated that without any crop load strategies fruit would be smaller and be in abundance
- PTGM ATS 1 had the most success regarding size, weight, and crop load, indicating that timing is critical for chemical blossom thinning efficacy

Project Summary

When dissecting the data, we see that this trial showed the role of bloom thinner application on ‘Honeycrisp’ trees.

- Bloom thinning timing is critical to the success of ‘Honeycrisp’ trees
- Return bloom can be increased with bloom thinner application
- Models can be developed to aid in decision making during critical times throughout the season
- More tools, means more grower ability to be successful

Grower Comments

All growers stated that the model would be worth using in the future, as it is another tool to become more efficient with chemical thinning. It is a guideline that could be invaluable when utilizing chemical thinners, where one grower stated that it requires less work than other models currently being used. A grower also stated that the PTGM could be used across the province on various orchard production styles. Most growers were interested in utilizing the PTGM specifically in ‘Honeycrisp’ apples due to the biennial nature of the variety. The biggest challenge associated with the PTGM would be

the integration and access of the model for Ontario growers. One grower had never utilized bloom thinners and has since integrated ATS into their thinning program.

This past spring, I ran the model for a few growers who had not utilized it before, where they stated they had effective results in application timing. This season was a challenging thinning year, where many growers struggled to get their crop load down to their target, and from what I have heard most growers were successful in bloom thinning application.

Final Notes

If you are considering blossom thinning, I suggest you do a trial block in a small area of your orchard, read the label and do some research about the chemical, discuss with other growers in your area who have experience, and expect petal browning a few days after application. ATS and Lime Sulphur have shown to increase russeting of certain varieties.

This preliminary trial demonstrated that chemical thinners could decrease the biennial nature of ‘‘Honeycrisp’’ apples, but further research should be conducted, trialing the Pollen Tube Growth Model on different cultivars with various thinners and applications. This trial also demonstrated that the PTGM could have a place for use in Ontario, showing positive results in blossom thinning, return bloom and crop load management.

Acknowledgements

Thank you to Dr. John Cline who assisted with analysis and the growers who permitted trialing the model on their orchards.

For further information about the Pollen Tube Growth Model please refer to “Grower Trial on the Pollen Tube Growth Model” in the August 2021 ONNL and “Nibble Thin for a Quality Bin” in the April 2022 ONNL.

Vineland Research and Innovation Centre’s Apple Breeding Program Update 2023

Rachael LeBlanc, Research Scientist, Vineland Research and Innovation Centre

Producing apples that highly appeal to consumers continues to be our focus. As we expand our testing network and increase our capacity for selection, we will be advancing material that is adapted to Canada’s changing climate and disease pressures.

Vineland’s Test 1 (T1) block now contains approximately 17,000 unique seedling trees with about 3000 being added and removed each year. 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. We plan to expand these efforts over the next five years by validating and deploying a more advanced method of predictive pre-screening of material for complex traits, such as tolerance to fire blight and scab, called genomic selection. Using this selection method, we will bring further efficiencies to our breeding program to develop successful varieties for apple producers.

Vineland’s Test 2 (T2) block contains 107 selections that are replicated and grafted on various rootstock (M9, G41 or B9). Each year fruit from up to 25 trees in the T2 block is profiled by Vineland’s trained sensory panel and described for aroma, flavour, taste and texture characteristics. Apples are grouped based on flavour profile due to differences in characteristics such as high versus low sweet, acid tastes and also crisp, juicy versus soft or mealy textures. Data from the trained sensory panel is then used to predict consumer liking of Vineland’s selections. This data is critical to ensure that our breeding program continues to advance apples with high consumer appeal.

This year we expanded our testing program by adding four additional selections at grower sites (Test 3) across Canada. In total, we now have eleven sites in Ontario, three in Quebec and two in Nova Scotia. Fruit from the 2021 plantings will be harvested this fall and will be evaluated for fruit quality characteristics. Tree performance will also be assessed. Vineland is also excited about our recently announced collaboration with the Associated International Group of Nurseries (AIGN), a world leader in tree fruit intellectual property management. This new collaboration will advance apple variety development in our breeding program by combining Vineland's multi-disciplinary research, innovation capabilities and intellectual property management skills with AIGN's expertise in tree production and commercialization. AIGN will work closely with Vineland to contribute to the evaluation, selection and commercialization of new apple cultivars for Canadian consumers and beyond. We look forward to working with AIGN to maximize the impact of Vineland's breeding program. For more information about our apple program, please contact Rachael LeBlanc Rachael.leblanc@vinelandresearch.com

This research has been 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

Wanted: Bitter Rot

Kristy Grigg-McGuffin, Horticulture IPM Specialist, OMAFRA

As part of an OMAFRA-University of Guelph Alliance project, we're looking for grower cooperators from all growing districts that are interested in participating in a bitter rot survey.

In 2019/2020, a provincial survey looked at the incidence and distribution of bitter rot. In addition to the known dominant bitter rot species, *Colletotrichum fioriniae*, a new species of this pathogen was also identified that has not been reported in Ontario before. This fall, the research team would like to do a more thorough investigation of what species of *Colletotrichum* are found in Ontario orchards and to determine early resistance in different species, if present.

What do we need from growers? If you have had issues with bitter rot in previous years and are willing to participate, our team would collect symptomatic fruit, leaves and weeds within the orchard prior to harvest.

If interested, please contact Kristy Grigg-McGuffin at 519-420-9422 (call/text) or kristy.grigg-mcguffin@ontario.ca or Katie Goldenhar at 519-835-5792 (call/text) or katie.goldenhar@ontario.ca.

What's Your Apple IPM Report Card?

Kristy Grigg-McGuffin, Horticulture IPM Specialist, OMAFRA

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

Advantages to doing a harvest assessment

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

- Highlights any **susceptible varieties** or **hot spots** in a block or orchard, which allows targeted monitoring and potential spot treatments in future years.
- Provides a **historical record** for reference and increased awareness of potential challenges.

How should you do it?

In the field:

- Choose at least 10 (large trees) to 20 (dwarf trees) healthy trees randomly throughout the block.
- Select 200-400 apples (20-40 apples per tree), turning each to see all sides of the fruit without removing it.
- Randomly choose fruit from different positions on the trees: upper, inner and outer part of the canopy.
- Keep records for reference. Looking for a template? Refer to the scouting sheets below for fruit and terminal damage assessments.

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

What should you look for?

Anything causing **2–5% damage** is of concern. For higher value cultivars, consider 1-2% damage for pests causing direct injury to the fruit. Look for presence of:

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

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

Go to Ontario AppleIPM for more information on these pests including descriptions and pictures of typical damage.

Which block should you do?

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

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

Apple Harvest Assessment Sheet (TERMINAL)

Block:
Cultivar:
Date:
Sampling protocol: Established trees - 10 terminals per tree (10 trees total)
Young trees - 5 terminals per tree (20 trees total)

Pest	Tree									
	1	2	3	4	5	6	7	8	9	10
	Number of damaged terminals									
Insect										
Aphid (Green apple aphid)										
Aphid (Rosy apple aphid)										
Aphid (Woolly apple aphid)										
Japanese beetle										
Leafcurling midge										
Leafhopper (Potato leafhopper)										
Leafhopper (White apple leafhopper)										
Obliquebanded leafroller										
Oriental fruit moth (terminal flagging)										
Spring-feeding caterpillar										
Tentiform leafminer										
Mites										
Other										
Disease										
Apple scab										
Powdery mildew										
Frogeye leaf spot										
Rust										
Fire blight										
Other										
Other										
Nutritional										
Deer										
Unknown										
Total damage										

Apple Harvest Assessment Sheet (FRUIT)

Block:
Cultivar:
Date:
Sampling protocol: Established trees - 40 fruit per tree (10 trees total)
Young trees - 20 fruit per tree (20 trees total)

Pest	Tree									
	1	2	3	4	5	6	7	8	9	10
	Number of damaged fruit									
Insect										
Apple maggot										
Codling moth										
European apple sawfly										
Mullein bug										
Obliquebanded leafroller										
Oriental fruit moth										
Plant bug										
Plum curculio										
Rosy apple aphid										
Scale										
Spring feeding caterpillar										
Stink bug										
Other										
Disease										
Apple scab										
Bitter rot										
Black rot										
Calyx end rot										
Fly speck / sooty blotch										
Powdery mildew										
Rust										
Other										
Other										
Deer										
Bird										
Hail										
Russetting										
Unknown										
Total damage										

Making a Stink (Bug) About Apples

Kristy Grigg-McGuffin, Horticulture IPM Specialist, OMAFRA

The invasive brown marmorated stink bug (BMSB) has made waves in recent years with its introduction to Ontario and remains on the radar for many growers. However, this new guy on the scene is not the only one increasing presence in orchards. Damage caused by native stink bugs, such as the green stink bug (*Acrosternum hilare*) (Figure 1) can often be more of an issue across the province in some years.

Figure 1. The green stink bug, *Acrosternum hilare* can be a common pest of apples.

What's a stink bug?

Stink bugs are relatively large, shield-shaped insects with small, narrow heads (Figure 2). Nymphs are smaller, rounded and wingless, often a different colour than the adult. The host range for stink bugs is quite extensive, including ornamental and fruit trees, grapes, berries, vegetables and field crops. Most species are well-adapted to a diversity of landscapes so can easily move between hosts to become well established in an area.

In an orchard, beneficial or predatory stink bug species are also present, feeding on aphids, mites and caterpillars. These can be distinguished from their plant-feeding (pest) relatives by the thickness of their proboscis, or beak (Figure 3). Predatory stink bugs have a very thick proboscis for attacking prey while plant-feeding stink bugs have a needle-like proboscis for piercing-sucking.

Stink bugs overwinter as adults in protected areas such as buildings or woodlots, becoming active when temperatures increase above 20ºC in the spring. They are usually present in orchards following bloom or after nearby cereal or forage harvest. However, signs of injury do not often become obvious until later in the summer or after harvest. If you are beginning to see signs of damage now, feeding likely happened weeks earlier and the pest is now gone.

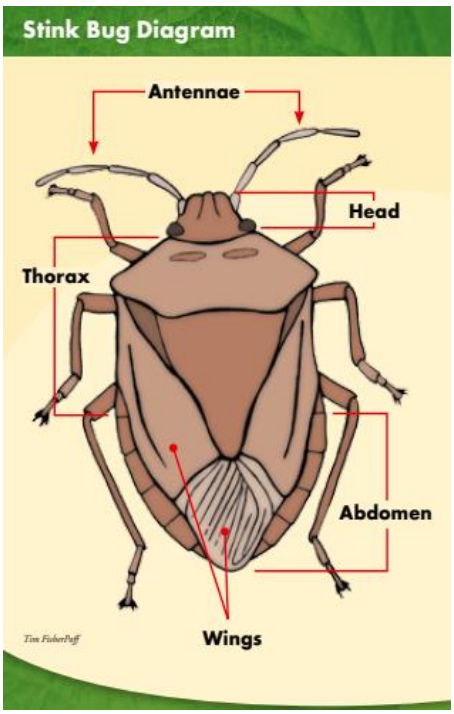


Figure 3. Characteristic shield shape of stink bug. *Source: Virginia Cooperative Extension*

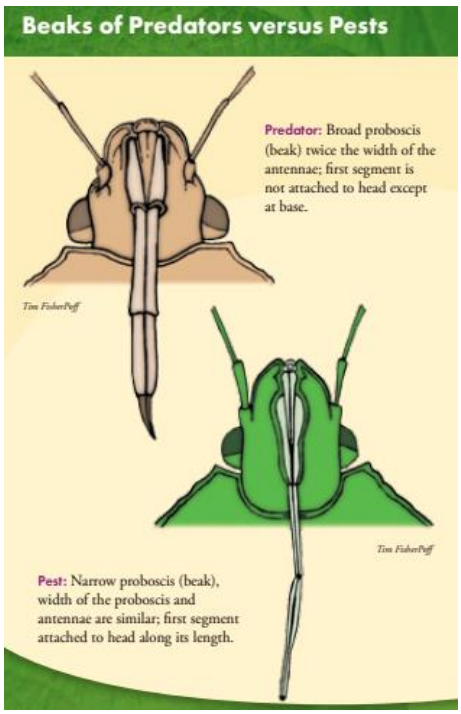


Figure 3. Beak, or mouthpart comparison of a predatory and plant-feeding stink bug. *Source: Virginia Cooperative Extension.*

What's the damage?

Stink bugs (both nymphs and adults) cause direct damage to the fruit using their piercing-sucking mouthparts. Digestive enzymes inserted into the plant result in the formation of small indented areas (Figure 4) at the feeding site with a light brown corky area just under the skin (Figure 5). Cutting the fruit open shows a feeding tube rarely more than halfway to the core.

Since stink bugs are highly mobile, perimeter rows tend to be at greatest risk of damage as these pests migrate in from bordering fields, buildings or woodlots. Damage is also more common in the upper canopy.

It is not uncommon to mistaken stink bug damage with bitter pit, especially during a year like this where the fruit is large. However, unlike bitter pit which tends to be most prevalent around the calyx end of

the fruit, stink bug feeding can occur anywhere on the apple or may be most common around the shoulder. Use a hand lens to look for signs of a puncture mark in the centre of the indent. Also, the internal corking caused by stink bug injury will meet the skin, whereas bitter pit corking will not. Pay particular attention to where damage was observed in the orchard. Stink bug damage tends to be perimeter-driven whereas bitter pit can occur anywhere in the orchard, not just around the edges.

What's the difference?

Most adult stink bugs are brown or green in colour and can be hard to distinguish between species (Figure 6). While management strategies for different pest species will not differ significantly, the period of activity and when damage may occur can vary so it is important to identify what is present in the orchard. Not only that but there can be non-stink bug look-alikes in an orchard, including numerous beneficial insects such as the spined soldier bug (Figure 7 & 8).

Figure 5. Early stink bug damage appears as discoloured or bruised areas on the apple (left) or pear (right).

Figure 5. Older stink bug damage appears as dark, sunken areas with corky flesh beneath the skin.

How to manage stink bugs

Unfortunately, this is not really a good news story. With limited effective monitoring tools and registered products, control of stink bug can be quite difficult in an orchard.

A few things to keep in mind if considering an insecticide spray:

- There are currently no thresholds. In tree fruit, the presence of adults or nymphs in the crop itself is enough to trigger an insecticide spray.
- Border sprays are sometimes sufficient for limiting damage, unless the pest has become established in the crop.
- Sprays will only control individuals present at the time of application, or shortly thereafter. New waves of adults can migrate into the orchard from adjacent areas.
- Nymphs are typically easier to kill than adults.
- Many insecticides that may be effective against stink bug such as pyrethroids are also harmful to natural enemies active during the summer and should be used only when necessary.
- For efficacy ratings of products available to apple growers, refer to the Insecticide Efficacy Table in the Ontario Crop Protection Hub.

Monitoring for stink bug activity is key. These pests are quite mobile and great at hiding within the canopy so can be difficult to spot in the field, especially when numbers are low. However, low numbers of certain species may still equate to economic injury, especially during dry spells in a season. Make sure to look for signs of stink bug injury when regularly scouting, especially along perimeter rows near woodlots, hedgerows and buildings.

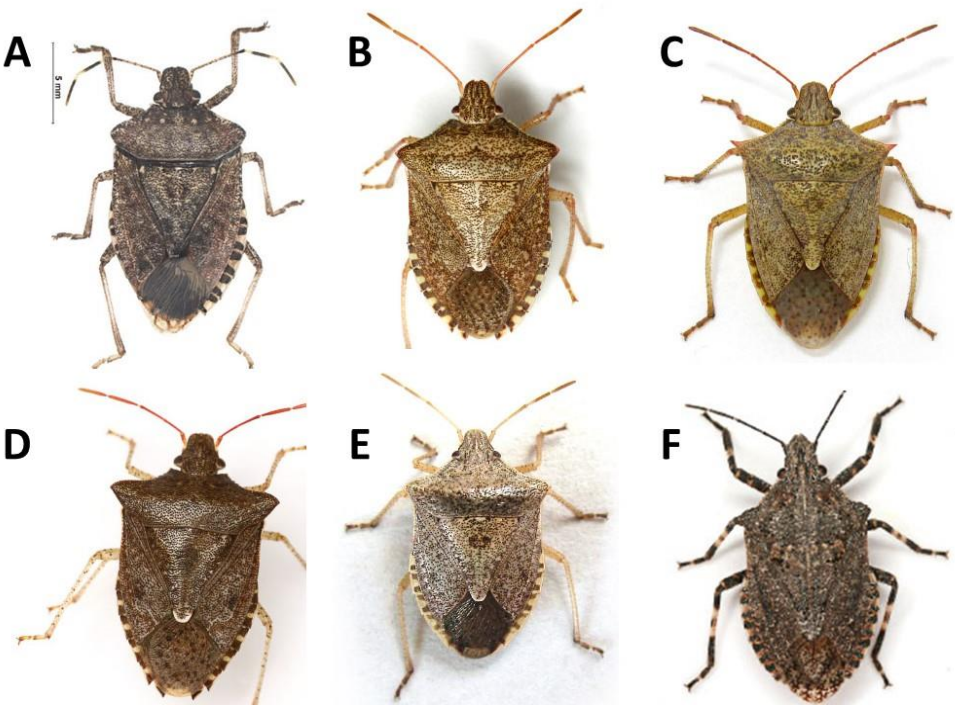


Figure 6.
(A) Brown marmorated stink bug, *Halyomorpha halys* has smooth, rounded shoulders and white bands on antennae and legs
(B) Brown stink bug, *Euschistus servus* has spiny, pointed shoulders
(C) Onespotted stink bug, *Euschistus variolarius* has sharply pointed, orange-tipped shoulders and a black spot on underside of abdomen
(D) Dusky stink bug, *Euschistus tristigmus* is less abundant than other stink bug species with sharply pointed sides of shoulders
(E) Consperse stink bug, *Euschistus conspersus* is more common in western US and Canada with a lighter coloured body, orange legs and darkened tips on antennae
(F) Rough stink bug, *Brochymena quadripustulata* has a "tooth" on each side of the face and spines on the shoulder.
Source: stopbmsb.org

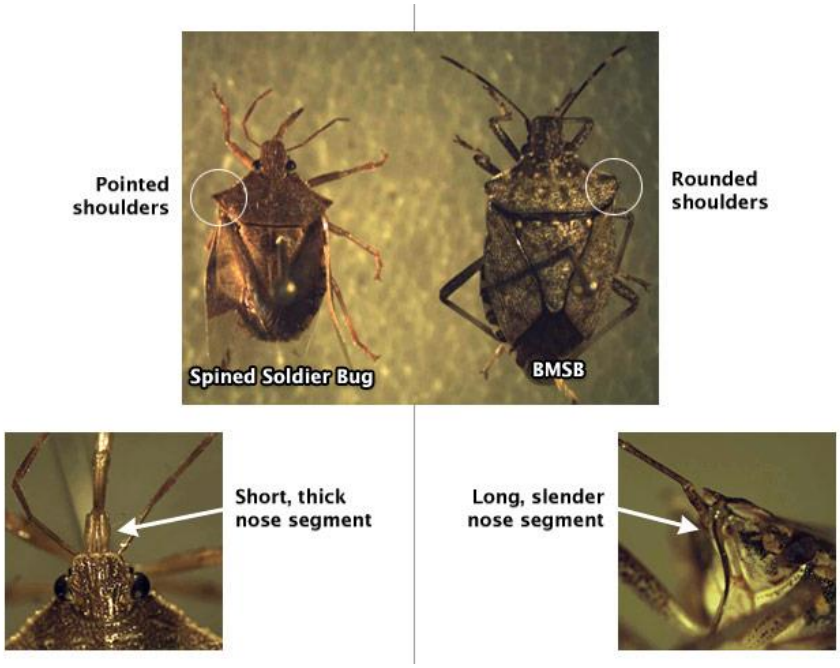
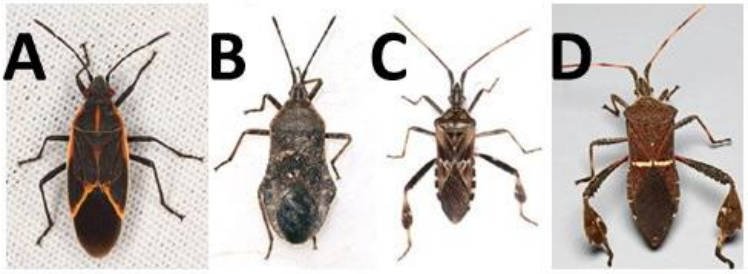


Figure 7. The predatory spined soldier bug has pointed shoulders and a short, thick nose segment on the proboscis. *Source: stopbmsb.org*

Figure 8. Other insects sometimes confused with stink bug include
(A) boxelder bug
(B) squash bug
(C) western conifer seed bug
(D) leaffooted bug
Source: stopbmsb.org



Rainfastness of Insecticides and Fungicides on Fruit

Kristy Grigg-McGuffin, Horticulture IPM Specialist, OMAFRA; Wendy McFadden-Smith, Horticulture IPM Specialist, OMAFRA

With the continued wet season across the province this year, understanding rainfastness, or the ability of a pesticide to withstand rainfall, is important to ensure proper efficacy. Coverage will need to be considered right up until harvest during rainy seasons like this. This will protect fruit from any late disease infection periods from scab or rots as well as insect activity that extends into the fall such as apple maggot or codling moth. Not only does the amount of rain impact rainfastness but also the age of the spray.

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

Rainfastness of Insecticides

John Wise, Michigan State University has studied rainfastness of various common tree fruit insecticide groups and is summarized below. For the complete article, click here.
Note that some products listed by Wise may not be registered for use in Canada. Check with your local supplier or refer to the Ontario Crop Protection Hub for a complete list of registered products.

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

1. **Penetration** into plant tissue is generally expected to enhance rainfastness.
    - Organophosphates have limited penetrative potential, and thus considered primarily surface materials.
    - Carbamates and pyrethroids penetrate the cuticle, providing some resistance to wash-off.
    - Spinosyns, diamides, avermectins and some insect growth regulators (IGR) readily penetrate the cuticle and move translaminar (top to bottom) in the leaf tissue.
    - Neonicotinoids are considered systemic or locally systemic, moving translaminar as well as through the vascular system to the growing tips of leaves (acropetal movement).
    - For products that are systemic or translaminar, portions of the active ingredient move into and within the plant tissue, but there is always a portion remaining on the surface or bound to the waxy cuticle that is susceptible to wash-off.
2. **Environmental persistence** and **inherent toxicity** to the target pest can compensate for wash-off and delay the need for immediate re-application.
    - Organophosphates are highly susceptible to wash-off, but are highly toxic to most target pests, which means re-application can be delayed.
    - Carbamates and IGRs are moderately susceptible to wash-off, and vary widely in toxicity to target pests.
    - Neonicotinoids are moderately susceptible to wash-off, with residues that have moved systemically into tissue being highly rainfast, and surface residues less so.
    - Spinosyns, diamides, avermectins and pyrethroids are moderate to highly rainfast.
3. **Drying time** can significantly influence rainfastness, especially when plant penetration is important. For instance, while 2 to 6 hours is sufficient drying time for many insecticides, neonicotinoids require up to 24 hours for optimal penetration prior to a rain event.
4. **Spray adjuvants** that aid in the retention, penetration or spread will enhance the performance of an insecticide.

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

Table 1. General characteristics for insecticide chemical classes

Insecticide Group	Rainfastness ≤ 0.5 inch (1.25 cm)		Rainfastness ≤ 1 inch (2.5 cm)		Rainfastness ≤ 2 inches (5 cm)	
	Fruit	Leaves	Fruit	Leaves	Fruit	Leaves
Carbamates (1A) *Lannate*	M	M/H	M	M	L	L
Organophosphates (1B) *Imidan, Malathion*	L	M	L	M	L	L
Pyrethroids (3A) *Danitol, Decis, Labamba, Matador, Perm-Up, Poleci, Pounce, Ship, Silencer, Up-Cyde, Zivata*	M/H	M/H	M	M	L	L
Neonicotinoids (4A) *Aceta, Assail, Calypso, Cormoran, Theme* **(Closer, Sivanto Prime may be similar)*	M,S	H,S	L,S	L,S	L,S	L,S
Spinosyns (5) *Delegate, Entrust, Success, TwinGuard*	H	H	H	M	M	L
Avermectins (6) *Agri-Mek, Minecto Pro*	M,S	H,S	L,S	M,S	L	L
IGRs (15 & 18) *Rimon, Cormoran, Confirm, Intrepid*	M	M/H	M	M	L	L
Diamides (28) *Altacor, Exirel, Harvanta, Vayego*	H	H	H	M	M	L

H –highly rainfast (≤30% residue wash-off), **M** –moderately rainfast (≤50% residue wash-off),
L –low rainfast (≤70% residue wash-off), **S** –systemic residues remain with plant tissue
*Table adapted from Rainfast characteristics of insecticides on fruit by John Wise, Michigan State University Extension

Table 2. Insecticide persistence, plant penetration and rainfastness rating

Insecticide Group	Persistence	Penetration	Rainfast rating
Carbamates (1A) *Lannate*	Short	Cuticle	Moderate
Organophosphates (1B) *Imidan, Malathion*	Medium-long	Surface	Low
Pyrethroids (3A) *Danitol, Decis, Labamba, Matador, Perm-Up, Poleci, Pounce, Ship, Silencer, Up-Cyde, Zivata*	Short	Cuticle	Moderate-high
Neonicotinoids (4A) *Aceta, Assail, Calypso, Cormoran, Theme* **(Closer, Sivanto Prime may be similar)*	Medium	Translaminar, acropetal	Moderate
Spinosyns (5) *Delegate, Entrust, Success, TwinGuard*	Short-medium	Translaminar	Moderate-high
Avermectins (6) *Agri-Mek, Minecto Pro*	Medium	Translaminar	Moderate
IGRs (15 & 18) *Rimon, Cormoran, Confirm, Intrepid*	Medium-long	Translaminar	Moderate
Diamides (28) *Altacor, Exirel, Harvanta, Vayego*	Medium-long	Translaminar	Moderate-high

*Table adapted from Rainfast characteristics of insecticides on fruit by John Wise, Michigan State University Extension

Based on simulated rainfall studies to combine rainfastness with residual performance after field-aging of various insecticides, including carbamates (Lannate), organophosphates (Imidan, Malathion), pyrethroids (Capture), neonicotinoids (Assail, Actara, Admire), IGRs (Rimon, Intrepid), spinosyns (Delegate) and diamides (Altacor), Wise recommends the following re-application decisions for apples:

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

Rainfastness of Fungicides

There is no comparable research on rainfastness of fungicides and few labels provide this kind of information. A general rule of thumb often used is that 1 inch (2.5 cm) of rain removes approximately 50% of protectant fungicide residue and over 2 inches (5 cm) of rain will remove most of the residue. However, many newer formulations or with the addition of spreader-stickers, some products may be more resistant to wash-off. However, avoid putting on fungicides within several hours before a rainstorm as much can be lost to wash-off regardless of formulation. As well, there are exceptions to the general rule in regard to truly systemic fungicides such as Aliette and Phostrol.

The effectiveness of sticker-spreaders with fungicides is variable and product/crop specific. Penetrating agents don't help strobilurins; in fact, some fungicide/crop combinations have been associated with minor phytotoxicity due to excessive uptake. Captan, which is intended to stay on the surface, is notorious for causing injury when mixed with oils or some penetrating surfactants that cause them to penetrate the waxy cuticle. Consult labels for minimum drying times for individual products and recommendations for using surfactants.

Consider the following to improve fungicide efficacy during wet weather:

- During rainy periods, systemic fungicides tend to perform better than protectant (or contact) fungicides since they are less prone to wash-off.
- Applying a higher labelled rate can extend the residual period.
- Apply protectant fungicides such as **captan (Supra Captan, Maestro), mancozeb (Manzate, Dithane, Penncozeb) and folpet (Folpan)** during sunny, dry conditions to allow for quick drying on the leaves. These types of fungicides are better absorbed and become rainfast over several days after application.
- Similar to the above protectants, **fluazinam (Allegro)** is not systemic but does have good sticker properties during times of minor rainfall.
- Apply systemic fungicides such as **sterol inhibitors (Cevya, Nova, Fullback, Inspire), SDHI (Excalia, Fontelis, Sercadis, Kenja, Aprovia, Luna Tranquility) and strobilurins (Flint, Pristine, Merivon)** under humid, cloudy conditions. The leaf cuticle will be swollen, allowing quicker absorption. In dry, hot conditions, the cuticle can become flattened and less permeable, so product can breakdown in sunlight, heat or microbial activity or be washed off by rain.
- In general, most protectant **biological products such as Buran or Serenade** are prone to wash-off. Do not apply Buran if rainfall is imminent. However, this product can be used as a post-infection rescue treatment for apple scab.
- **SAR/ISR products such as Regalia or Lifegard** are rainfast after 1-3 hours but do not provide immediate protection. Maximum protection from these products is achieved in 3-5 days following application so timing these products in anticipation to infection events is critical.

For more information, see the article How to Get the Most Out of Your Fungicide Sprays by Annemiek Schilder, Michigan State University.

Spot it?

Snap, catch and report it

Spotted lanternfly (SLF) is present in the United States and getting closer to the Canadian border. It could be devastating for Canada's wine, fruit and forest industries.

WHAT TO LOOK FOR - LIFECYCLE

EGG LAYING
SEP-NOV

EGG MASS
OCT-JUN

EARLY STAGE NYMPH
MAY-JUL

LATE STAGE NYMPH
JUL-SEP

ADULTS
JUL-DEC

WHERE TO LOOK FOR IT

OVER 100 SPECIES OF TREES AND PLANTS

COMMERCIAL AND LEISURE VEHICLES

OUTDOOR ITEMS

If you think you have found the spotted lanternfly pest or egg masses in Canada, report it to the Canadian Food Inspection Agency.
Learn more at Canada.ca/spotted-lanternfly

Canadian Food Inspection Agency | Agence canadienne d'inspection des aliments

Canada

DANITOL® insecticide label expanded via Minor Use Program to help manage insects on numerous fruit crops in Canada

By Josh Mosiondz, Minor Use Coordinator, OMAFRA

Recently announced the approval of a minor use label expansion registration for DANITOL® insecticide for control of several insect pests in Canada including weevils and western raspberry fruitworm on caneberries (CG 13-07A); weevils on bushberries (13-07B); and Spotted Lanternfly on Pome and Stone Fruits (CG 11-09, and CG12-09).

Note: Spotted Lanternfly has not been detected in Canada at this time. This submission was submitted to and reviewed by PMRA in the event a pest population is detected in an agricultural field.

DANITOL® insecticide was already labeled for management of insects on a wide range of crops in Canada. These minor use proposals were submitted by the British Columbia Ministry of Agriculture and Food and Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec as a result of minor use priorities established by growers and extension personnel.

The following is provided as an abbreviated, general outline only. Users should be making insect management decisions within a robust integrated insect management program and should consult the complete label before using DANITOL® insecticide.

Crops(s)	Target	Rate (mL product / ha)	Application Information	PHI (days)
Caneberries (CG 13-07A)	Control of Weevils (including Black Vine Weevil, Obscure Root Weevil, Rough Strawberry Weevil, Strawberry Root Weevil) Control of Western Raspberry Fruitworm	779 - 1169	Apply with ground equipment in adequate water for uniform coverage (minimum of 200 L/ha by ground). Begin applications when first pest activity is noticed. A second application may be used with a minimum application interval of 14 days. Weevils: Monitor for pest presence and apply when adults are actively feeding on foliage. Do not exceed 2 applications per year with a minimum application interval of 14 days.	13 days (hand harvest), 3 days (mechanical harvest)
Bushberries (CG 13-07B)	Control of Weevils (including Black Vine Weevil, Obscure Root Weevil, Rough Strawberry Weevil, Strawberry Root Weevil)	779 - 1169	Apply with ground equipment in adequate water for uniform coverage (minimum of 200 L/ha by ground). Begin applications when first pest activity is noticed. A second application may be used with a minimum application interval of 14 days. Weevils: Monitor for pest presence and apply when adults are actively feeding on foliage. Do not exceed 2 applications per year with a minimum application interval of 14 days.	13 days (hand harvest), 3 days (mechanical harvest)
Pome Fruit (CG 11-09)	Control of Spotted Lanternfly	1169 - 1559	Make a foliar application as soon as the pest is detected. When possible, target smaller (first to third) instar nymphs for optimal efficacy. Do not exceed 1 application per year.	16 days (hand harvest)
Stone Fruit (CG 12-09)	Control of Spotted Lanternfly	1169 - 1559	Make a foliar application as soon as the pest is detected. When possible, target smaller (first to third) instar nymphs for optimal efficacy. Do not exceed 1 application per year.	16 days (hand harvest)

TOXIC to aquatic organisms and terrestrial plants. Observe buffer zones and vegetative filter strips specified under DIRECTIONS FOR USE. TOXIC to birds and small wild mammals. TOXIC to bees. Bees may be exposed through direct spray, spray drift, and residues on leaves, pollen and nectar in flowering crops and weeds. Minimize spray drift to reduce harmful effects on bees in habitats close to the application site. Avoid applications when bees are foraging in the treatment area in ground cover containing blooming weeds. To further minimize exposure to pollinators, refer to the complete guidance "Protecting Pollinators during Pesticide Spraying – Best Management Practices" on the Health Canada website (www.healthcanada.gc.ca/pollinators).

Follow crop specific directions for application timing. For applications on crops that are with high pollinator exposure (bushberry and caneberry, stone fruit, pome fruit and tree nuts) or when using managed bees for pollination services: DO NOT apply during the crop blooming period. If applications must be made during the crop blooming period, restrict applications to evening when most bees are not foraging. Toxic to certain beneficial arthropods (which may include predatory and parasitic insects, spiders, and mites). Minimize spray drift to reduce harmful effects on beneficial arthropods in habitats next to the application site such as hedgerows and woodland. Fenpropathrin may impact predatory and parasitic arthropod species used in IPM programs within the treatment area. Unsprayed refugia for beneficial species of at least 1 metre from treatment area will help maintain beneficial arthropod populations. This product contains aromatic petroleum distillates that are toxic to aquatic organisms. To reduce runoff from treated areas into aquatic habitats, avoid application to areas with a moderate to steep slope, compacted soil, or clay. Avoid application when heavy rain is forecast. As this product is not registered for the control of pests in aquatic systems, DO NOT use to control aquatic pests. DO NOT contaminate irrigation or drinking water supplies or aquatic habitats by cleaning of equipment or disposal of wastes. To reduce risk to aquatic organisms from run-off, a vegetative filter strip of at least 10 metres wide between the field edge and adjacent, downhill aquatic habitats must be observed, as specified under DIRECTIONS FOR USE. Follow all other precautions, restrictions, and directions for use on the for DANITOL® insecticide label carefully.

For a copy of the new minor use label contact:

- Erica Pate, Berry Crop Specialist OMAFRA (CG 13-07), Simcoe (519) 410-0624
- Kristy Grigg-McGuffin, Horticulture IPM Specialist (Apples) OMAFRA, Simcoe (519) 420-9422
- Wendy McFadden-Smith, Horticulture IPM Specialist (Pears, Grapes) OMAFRA, Vineland (905) 932-8965
- your regional supply outlet, or
- visit the PMRA label site http://www.hc-sc.gc.ca/cps-spc/pest/registrant-titulaire/tools-outils/label-etiq-eng.php

Note: This article is not intended to be an endorsement or recommendation for this particular product, but rather a notice of registration activity

KOPA® insecticidal soap expanded via Minor Use Program to help manage insects on numerous fruit crops in Canada

By Josh Mosiondz, Minor Use Coordinator, OMAFRA

The Pest Management Regulatory Agency (PMRA) recently announced the approval of a minor use label expansion registration for KOPA® insecticidal soap for suppression of spotted lanternfly nymphs on fruit trees and grapes in Canada.

Note: Spotted Lanternfly has not been detected in Canada at this time. This submission was reviewed submitted to, and review by PMRA in the event a pest population is detected in an agricultural field.

KOPA® insecticidal soap was already labeled for management of insects on a wide range of crops in Canada. These minor use proposals were submitted by the Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec as a result of minor use priorities established by growers and extension personnel.

The following is provided as an abbreviated, general outline only. Users should be making insect management decisions within a robust integrated insect management program and should consult the complete label before using KOPA® insecticidal soap.

Crop(s)	Target	Rate (L product / 400 L water)	Application Information	PHI (days)
Fruit Trees (apples, apricots, cherries, nectarines, peaches, pears, plums, and prunes) Grapes	Suppression of Spotted Lanternfly nymphs	4 - 8	Mix 8 L of product with 400 L of water. Add sufficient water to the mixing tank to allow proper agitation by pump or paddles. Continue stirring while adding first the Kopa Insecticidal Soap then the remaining water. Hard water in excess of 300 ppm should be conditioned to reduce its hardness prior to mixing with Kopa Insecticidal Soap. For field applications, apply the diluted solution at a rate of 700 to 1900 L/ha using ground spray equipment. For best results, commence treatment when infestation is first noticed. Thoroughly spray insect pests on plants with diluted product to wetting. Minimize run-off to reduce plant injury on sensitive plants. Kopa Insecticidal Soap is a contact spray and is effective in its liquid state. Pests need to be contacted with spray solution to be effective. Efforts should be made to thoroughly reach all plant parts including undersides of leaves. Repeat treatment every one to two weeks as needed. Apply to a maximum of three consecutive applications to ensure plant injury does not occur. Additional applications may be possible if previous experience with repeat applications of the product under the same conditions have not produced plant injury. May be used on edible crops up to and including day of harvest.	0

This product is toxic to aquatic organisms. Do not allow wastewater, effluent or runoff containing this product to enter lakes, streams, ponds or other waters. Avoid direct application to ponds, streams and lakes. If this pest control product is to be used on a commodity that may be exported to the U.S. and you require information on acceptable residue levels in the U.S., visit CropLife Canada's web site at www.croplife.ca

Follow all other precautions, restrictions, and directions for use on the KOPA® insecticidal soap label carefully.
For a copy of the new minor use label contact:

- Erica Pate, Berry Crop Specialist OMAFRA (CG 13-07), Simcoe (519) 410-0624
- Kristy Grigg-McGuffin, Horticulture IPM Specialist (Apples) OMAFRA, Simcoe (519) 420-9422
- Wendy McFadden-Smith, Horticulture IPM Specialist (Pears, Grapes) OMAFRA, Vineland (905) 932-8965
- your regional supply outlet, or
- visit the PMRA label site http://www.hc-sc.gc.ca/cps-spc/pest/registrant-titulaire/tools-outils/label-etiq-eng.php

Note: This article is not intended to be an endorsement or recommendation for this particular product, but rather a notice of registration activity

Factors Affecting Internal Browning in Apples During Storage

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

Advancements in controlled atmosphere (CA) storage technology and the advent of postharvest treatments with 1-methylcyclopropene (1-MCP) have enabled apples to be stored longer than ever before. Unfortunately keeping apples longer has also allowed for certain storage disorders to become more prevalent. Internal browning is one such problem for many apples.

Radial flesh browning near the stem-end (shoulder) of the apple is usually the first sign of internal browning in 'Gala' apples (Figure 1). This can progress towards the calyx end of the fruit, becoming the more common internal browning that can found be when cutting the apple horizontally across the equator. Full internal browning develops more quickly in other apples, such as 'Ambrosia' (Figure 2).

Figure 1: Internal stem-end (shoulder) browning in 'Gala' apple

Figure 2. Internal browning in 'Ambrosia' apple

High incidence of internal browning is typically found when apples are harvested late, or at advanced maturity stages. Fruit maturity at harvest time is a major factor affecting this disorder and it is something that can be easily corrected. Our research has shown a main effect of harvest time, across several years, with much higher incidence of internal browning in fruit from later harvests (4+ on Cornell starch chart). For example, 'Ambrosia' apples from two orchards were harvested twice, 6 days apart. Apples were cooled overnight to 0.5°C and treated with 1-MCP (SmartFresh™) the following day. CA storage was established 4 days after harvest, as 1.7% O_2 + 1.2% CO_2 at 0.5°C. Apples were evaluated for quality after 8 months of storage, plus during 14 days at room temperature. 'Ambrosia' from the first harvest had significantly less internal browning, compared to those from the later harvest (31 vs 63%, respectively). This is very important to note, as harvesting only 6 days later resulted in over double the amount of browning. Similarly, 'Ambrosia' apples were stored in ambient air storage at 0.5°C for 4 months and fruit from the first harvest had significantly less browning than those from the later harvest (8 vs 37%, respectively). Preharvest 1-MCP (Harvista™ orchard spray) can be very effective at reducing internal browning, as it delays advanced maturity (ripening) at harvest time. Rate and timing of application are critical for its efficacy. In contrast, postharvest 1-MCP treatment does not have consistent effects on internal browning and has been shown to decrease, increase, or have no effect on browning.

Ultra-low oxygen storage or dynamic CA with less than 1% oxygen reduces the development of internal browning. 'Gala' held in oxygen as low as 0.4% using SafePod technology to monitor fruit respiration (Storage Control Systems Inc., Michigan) had zero internal or stem-end browning, compared to 17% incidence of browning in 2.5% O2 + 2% CO2 and 6% incidence in 1.5% O2 + 1.1% CO2. Similarly, 'Ambrosia' held in oxygen as low as 0.7% using SafePod technology had <1% internal browning, compared to 20% incidence in 2.5% O2 + 2% CO2 and 8% incidence in 1.7% O2 + 1.2% CO2.

Incidence of internal browning increases with longer storage durations. For example, 'Gala' stored in air at 0.5°C had no internal browning after 2 months, 12% after 4 months, and 18% after 6 months. Similarly, 'Gala' held in CA of 2.5% O_2 + 2.0% CO_2 at ~1°C had little internal browning through 5 months of storage, but then the disorder increased significantly with storage time thereafter (up to 59% after 9 months). Furthermore, internal browning increased with subsequent holding at room temperature.

Slow cooling tends to reduce the development of internal browning. Rapid cooling to 3°C within 24 hours after harvest resulted in more internal browning in 'Gala' apples, compared to slow cooling over 7 days (DeEll, *The Grower, May 2017*). 'Gala' cooled rapidly and stored in CA for 8 months at 1°C had up to 59% browning incidence, compared to zero to 11% in fruit cooled slowly. In another study, 'Ambrosia' apples were held at 10°C for 1 week after harvest or cooled immediately to 0.5°C. After 7 months of CA storage, internal browning was significantly less in apples held at 10°C initially, with 1.5% incidence compared to 12.6% in those cooled immediately to 0.5°C. There were no significant differences in fruit firmness.

Overall, it is important to remember that there are many factors that influence the development of internal browning in apples. These can range from orchard management, fruit maturity at harvest time, postharvest treatments, to storage conditions and duration.

Acknowledgements:
Thanks to the Ontario Apple Growers, Norfolk Fruit Growers' Association, Apple Marketers' Association of Ontario, AgroFresh Inc., Pommes Philip Cassidy Inc., GRB Ag. Technologies Inc., and Storage Control Systems Inc., for their continuous support; as well as Sky Lesage and Younes Mostofi for their technical assistance.

Announcements

Ontario Pest Management Conference

Tuesday, November 7, 2023

The 20th Annual Ontario Pest Management Conference (OPMC) will be held in **Guelph, ON** on **November 7, 2023**. The OPMC features research on all aspects of pest management associated with plant, animal and human health.

This year's theme is 'Invasion: Facing the Plague of New Pests' and features the following plenary speakers:

- **Dr Julie Urban, Pennsylvania State University** – *Spotted Lanternfly Past, Present and Future: Impacts and Management of this Invasive Pest*
- **Dr Jonathan Griffiths, Agriculture & Agri-Food Canada** – *A Plague On All Our Houses: Plant Viruses*
- **Dr. Lynn Sosnoskie, Cornell AgriTech** – *Palmer Amaranth: Biology, Ecology, Management and Lessons Learned from Georgia, California and New York*

Stay tuned to the conference website **www.ontariopmc.ca** for more details. Registration opens September 1st.

For the 2023 conference, OPMC will be soliciting abstracts for

1. **Student Competition - Graduate Oral Presentation** (sponsored by CropLife Ontario Council) – 6 spots total, one $500 award and plaque for the winning entry
2. **Student Competition - Graduate Poster Presentation** (sponsored by CropLife Ontario Council) – 6 spots total, one $500 award and plaque for the winning entry
3. **Student Competition - Undergraduate Poster Presentation** (sponsored by OPMC) – 4 spots total, one $250 award and plaque for the winning undergraduate (or diploma) student
4. **General Posters –** non-competitive

Refer to the Call for Posters/Oral Presentations section on the OPMC website for details and instructions on submissions (https://www.ontariopmc.ca/submission). **The submission period ends on Friday September 22nd.** For questions on the submissions, please email ontariopmc@gmail.com

OFVC 2024: Save the Date

Wednesday & Thursday, February 22 & 23, 2024

The Ontario Fruit and Vegetable Convention (OFVC), Canada's premier horticultural event, is returning to the Niagara Falls Convention Centre, Ontario on **February 21-22, 2024**.

The Apple Program will have a round table half-day session, taking place Wednesday afternoon, along with session speakers and panels throughout Thursday morning & Thursday afternoon.

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