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ORCHARD NETWORK

For Commercial Apple Producers

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Orchard Management

An Apple's Journey

Leslie Huffman, Apple Specialist, OMAF and MRA

Your apple started as a flower bud initiated a year ago in July, which hunkered down to survive our variable weather over winter and spring. This past May, the flower blossomed and was pollinated by visiting bees carrying pollen from another cultivar. This resulted in seed set, hopefully 8-10 seeds, which immediately began directing the growth of the apple. The developing embryo in the seed secreted hormones which prevented the fruit from dropping, both from natural drop in May and June, and in defiance of chemical thinners that were applied. This apple was determined to remain on the tree and produce seeds.

For 4-5 weeks in late May and June, the hormones from the seeds directed the developing fruitlet to produce cells through normal cell division. This was a critical time because the size potential of the apple was fully determined at this stage. Hopefully temperatures, moisture and sunlight were conducive to producing many cells through this period.

Ministry of Agriculture and Food

Ministry of Rural Affairs

Ontario

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This issue of the **Orchard Network Newsletter** was compiled by Carolyn Prieur, Client Service Representative, OMAF and MRA, Vineland Station

Soon these cells started to enlarge, because the seed hormones instructed the cells to fill with minerals like calcium, and sugars and acids produced by the trees, as well as air and water. Cells close to the skin also filled with red and blue pigments, which eventually produced the skin colours. Rapid cell enlargement occurs from 90-130 days after full bloom.

Closer to harvest time, the apple tissue begins to produce ethylene, a natural maturity hormone. Ethylene induces fruit ripening, but also causes an abscission layer to develop in the stem. Growers want to pick apples just as ethylene production begins, to capture the maximum flavour and quality, but before the flesh softens and the fruit drops. It's an annual challenge to judge the optimum time to harvest apples.

As you harvest the crisp, juicy fresh apple, think of its journey started last year, guided with the natural direction of plant processes, and the gentle assistance of growers and Mother Nature. It is a fascinating and amazing process that will soon result in a bountiful harvest across the province.

Dry August – Irrigation of Apple Trees in the Fall?

Rebecca Shortt, Engineer - Water Quality, OMAF and MRA

Last winter at the Ontario Fruit and Vegetable Convention, one of the California speakers reminded us that fall drought-stress impacts bud formation for the following year, leading particularly to malformed fruit. At the time, I was thinking "Not relevant to Ontario, we always get rain in the fall".

However, here we are at the end of a fairly dry August when the roots have been mining the deeper soil moisture. Consider a fall irrigation if you have not received August rains and if the fall continues to be dry. After harvest and before the leaves turn, the trees are still growing and forming buds for next year.

Fall irrigations can be tricky. Before harvest, an irrigation event can cause a dilution of the sugars in the fruit. Good drainage is important before overwintering.

How can I know if the trees need water in the fall? The simple answer is to dig a hole 12" and 24" deep and feel the soil – is it moist or dry? A soil moisture instrument can also be used to measure the amount of water available to the trees www.omafra.gov.on.ca/english/engineer/facts/11-037.htm.

Weather Innovations provides ET, or crop water use data based on weather (temperature, humidity, wind, sunshine). For southwestern Ontario, you can find these ET daily numbers and rainfall at www.onpotatoes.ca. Click on "Maps/Tools" and choose evapotranspiration (ET) from the drop down menu. By clicking on your nearest weather station, you can see daily records of the ET and the page will automatically calculate the ET for a user defined period. For example, in Leamington, there was 87 mm of crop water use (ET) in the last 3 weeks of August, and only 20 mm of rain! The ET values are relevant for a relatively large area (data from a nearby weather station can typically be used across a county). Rainfall should be measured daily at your orchard.

For optimal irrigation decisions, combine experience with soil moisture monitoring and ET data.

Planning for New Plantings

Leslie Huffman, Apple Specialist, OMAF and MRA

Harvest has started, but if you are planning a new planting next year, a few minutes now to prepare the field will help ensure your orchard investment will be successful.

September and October are an ideal time to control **perennial weed** problems. Scout to determine what weeds are present, and learn what the susceptible stages

are. Consult Publication 75, Guide to Weed Control for the most effective herbicides. If glyphosate is the product of choice, be sure to avoid drift into neighbouring trees.

If you like to **establish sod** before tree planting, early September is the best time to plant grass. We've had good experience with a mix of grass species – one example is 40% creeping red fescue, 40% turf-type tall fescue and 20% perennial ryegrass. It may be easier to plant the entire field and spray out the planting rows later this fall or next spring.

Fall soil sampling is important to determine the need for preplant **fertilizer**. Where soil tests show that phosphorus is needed, fall (or spring before planting) is an ideal time. This allows deep placement where the tree roots grow. Also, if soil pH needs adjusting, fall applications of **lime** allows enough time for activation to change pH.

Also, sampling for **nematodes** is most accurate in early fall, when soils are warm and moist. Check with your lab on when and how to deliver these, as populations need to be alive for accurate counts.

Assessing **replant issues** is important. Replant problems can result from nematodes, soil-borne diseases and/or fertility issues. If your site previously grew orchards, it is important to consider ways of avoiding the potential stunting problems of replant. Herbicide residues can also cause problems, especially where soil pH is above 7.5 or below 6.0. Learn what herbicides and rates were used in the past 5 years.

And finally, check on your **tree order** and work with your nurseryman to ensure purchase of the best quality trees available. Paying a little more for good quality trees will ensure your investment in new orchard pays off.

Fall is a busy time for harvest, but your new orchard will be better if you can squeeze in these important tasks soon.

Cost of Production Survey – Again!

Leslie Huffman, Apple Specialist, OMAF and MRA

I am frequently asked what it costs to grow a bushel of apples. And with the recent interest in new high density orchards, what it costs to plant a new orchard (and is it worth the investment?).

In 2010, the Ontario Apple Growers (Kelly Ciceran, Larissa Osborne and Sarah Marshall) and the OMAF and MRA Business and Apple Team (John Molenhuis and Leslie Huffman) joined forces to update the Ontario Apple Cost of Production (COP) and Establishment (COE). With the help of grower surveys, we were able to publish these two reports.

But it's already 2013! And these are out-of-date, and we are being asked for updated COP and COE's. But we need your help – several things have changed since 2010 – tree densities have increased, cost of inputs has risen, many growers have changed their cultivar mix, and more hand labour is required to produce higher quality apples. We have prepared a series of questions that will be sent to you by email from the Ontario Apple Growers. If you are able to answer any, most or all of these questions, it will help greatly.

We know it's a busy time of year, and we will be doing most of the work after harvest, but please gather data now – it will also help with your management decisions. Here is the link to the 2010 reports www.onapples.com/pdfs/2010EstablishmentandProductionCostsforApplesinOntario.pdf

Crop Protection

Did Your IPM Program Work?

Margaret Appleby, IPM Systems Specialist and Kristy Grigg-McGuffin, Pome Fruit IPM, OMAF and MRA

This fall, taking some time for harvest assessments will not only help you to assess this year's IPM program, but will also help to prepare you for next season. Before harvest, look at 200-400 apples, randomly picked from the top, sides and bottoms of trees, and evaluate for pest damage. Anything causing 2-5% damage is of concern.

Good pictures and descriptions of damage that you might encounter can be found online at www.ontario.ca/cropipm (or on your Ontario AppleIPM CD) and in your Pub. 310, Apple IPM manual. The "Often-Confused-With" pictures can help sort out what the damage might be. The Apple IPM manual has a harvest assessment page to copy for recording your results. Look for Appendix H on page 215.

Which block to do? To get the best idea of what's happening in your orchard, assess all blocks. However, giving yourself an hour or so per block, you can instead select representative areas of the orchard, if time is limited. If you assess the same block every year, you can compare your results and notice trends over time.

How to do it? Choose at least 10 (large trees) to 20 (dwarf trees) healthy trees randomly throughout the block. Select 200-400 apples, turning each to see all sides of the fruit without removing it. Choose fruit from different positions on the trees: upper, inner and outer. The key is to choose randomly, and write it down!

Also make notes of damage to leaves such as scab, tentiform leaf mines, powdery mildew, apple leaf curling midges and other feeding. This information will be important when planning your IPM program next year.

Early harvest assessments done already this year have indicated an overall successful year for pest management. There were some orchards that struggled with aphids, codling moth and OBLR, causing both foliar and fruit damage. In the east, damage from European Apple sawfly was relatively low. As well, some

blocks experienced higher pressures of leafcurling midge or mites, resulting in leaf curl or bronzing, respectively. Evidence of dogwood borer in graft unions of various M9 plantings have some growers considering DWB Isomate mating disruption next year. In a few orchards where fungicide programs failed or rains caused havoc on proper timing, powdery mildew and scab was observed, as well as flyspeck/blister spot, frog-eye leaf spot, black rot and bitter rot. If you do find some fruit with rots, set them aside and let us know. We would be interested in what pathogen caused the rot.

Avoid the Sting of Stink Bugs

Hannah Fraser, Entomology Program Lead, OMAF and MRA

The Brown Marmorated Stink Bug (BMSB) provincial survey 2013* has been underway since May. Overwintering adults were first detected at our hot spots in Hamilton beginning mid-June, and by early July, the first nymphs were found on buckthorn. Populations have been building ever since. We have been finding BMSB nymphs and adults (Figure 1) on a wide variety of common landscape trees and shrubs, as has been reported in the US. So far, we have only found breeding populations in localized areas in Hamilton.

BMSB numbers are at their peak by late August and early September. At this point in the season, most individuals will have completed their development and adults will be looking for any remaining food sources prior to overwintering. As a late-harvested crop, apples are at higher risk.

Older signs of stink bug damage appear as sunken spots, with corky brown tissue beneath the skin. Early symptoms of injury, particularly in apples, can be difficult to detect (Figure 2). Sometimes white sugar crystal residues and / or a small hole can be seen in the centre of discoloured feeding sites. Fruit that appears unblemished at harvest can come out of storage with brown spots and damage similar to that caused by bitter pit (Figure 3).

The following link has some excellent photos of stink bug damage in apple: hudsonvf.cce.cornell.edu/scouting%20reports/BMSB%20Project/BMSB%20Alert%209-26-12.pdf.

Here are some of the pre-harvest tips being recommended to growers in other production areas:

- ***Scout orchard perimeters***. Injury is often greatest along wooded edges, especially those where preferred hosts are abundant (Tree of Heaven, Catalpa, buckthorn**, etc.). Consider in-season

Figure 1. Brown marmorated stink bug nymph (left) and adult (right).

Figure 2. Early feeding injury is often difficult to detect, but may appear discolored spots. (Peter J. Jentsch, Cornell University Hudson Valley Lab)

Figure 3. Fruit can come out of storage with brown spots and damage similar to that caused by bitter pit. (Peter J. Jentsch, Cornell University Hudson Valley Lab)

monitoring of these hosts on your farm next year, as an early warning that BMSB is established nearby.

- ***Look up***. BMSB tend to prefer the upper canopy, so use a ladder to increase your ability to detect this pest when numbers are low.
- ***Monitor often***. BMSB are strong flyers and can move from landscape hosts into crops very quickly.
- ***There are no thresholds in tree fruit.*** BMSB can be difficult to detect, and it doesn't take many stink bugs to cause significant economic loss in apples.

Remember that there are other stink bugs capable of causing damage to apples. If you think you have found BMSB, please contact us immediately via the Agriculture Information Contact Centre 1-877-4524-1300 or email ag.info.omafra@ontario.ca. There are several products registered for management of BMSB (see the summary table below). For more information on BMSB, visit www.ontario.ca/stinkbug and www.stopbmsb.org.

* Funding for the project "Assessment of the Distribution and Natural Enemies of the Brown Marmorated Stink Bug in Southern Ontario" was obtained through the OMAF and MRA / University of Guelph Partnership program Emergency Management Theme, with the financial support of the Grain Farmers of Ontario, the Grape Growers of Ontario, the Niagara Peninsula Fruit and Vegetable Growers' Association, Ontario Apple Growers, and the Tender Fruit Producers' Marketing Board. The BMSB Research Team includes Dr. Cynthia Scott-Dupree (University of Guelph), Dr. Tara Gariepy (Agriculture and Agri-Food Canada), Hannah Fraser and Tracey Baute (Ontario Ministry of Agriculture and Food and Ministry of Rural Affairs), with the support of several other OMAF and MRA Agriculture Development Branch staff.

** Surveys in Ontario indicate buckthorn is a suitable and highly preferred season-long host of BMSB, supporting both nymphs and adults.

BMSB Registrations for Apples

Product	Crops	Rate	Preharvest interval	Re-entry period	Max # applications/yr	Re-treatment interval
Actara 25 WG thiamethoxam 25% group 4 Reg. # 28408 (**suppression**)	Apple, crabapple, pear, oriental pear	385 g/ha	60 days	12 hours	2 NOTE: Post-bloom application only	10 days
Clutch 50 WDG clothianidin 50% Group 4 Reg. # 29382 (**suppression**)	Pome fruit*	210-420 g/ha	7 days	12 hours	2 NOTE: Post-bloom only. If making 2 applications do not exceed a total of 420 g/ha per season	10-14 days
Lannate Toss-N-Go methomyl 90% Group 1A Reg. # 10868 (**control**)	Apples**	2.1 kg/ha	8 days	5 days thinning 12 hours other activities	1	NA
Malathion 85E malathion 85% Group 1B Reg. #8372 (**suppression**)	Apples, pears	1.22 L/ha	3 days	12 hours	2	As required

Notes:
* Pome fruit includes apple, pear, crabapple, oriental pear, loquat, mayhaw and quince.
** Do not apply to Early McIntosh, Wealthy or SummerGlo apple varieties.

For more information or to do a label search, visit the Pest Management Regulatory Agency website at:
pr-rp.hc-sc.gc.ca/ls-re/index-eng.php

Powdery Mildew Fungicide Resistance Project Update

Kristy Grigg-McGuffin, Pome Fruit IPM Specialist, OMAF and MRA

Collections continued this year for the National Powdery Mildew Fungicide Resistance Survey, which is part of a project administered by the Ontario Apple Growers (OAG). For 2013, 16 new Ontario sites were selected from the five growing districts. As well, all 16 sites from 2012 were also re-sampled due to poor spore viability with last year's powdery mildew collections. In total, 90 growers across Canada agreed to participate in this project, including 34 in British Columbia, 32 in Ontario, 12 in Quebec and 12 in Nova Scotia/New Brunswick.

In the spring, overwintering mildew infected white shoots were collected from orchards prior to any fungicide sprays. If further collections were required, cooperating growers agreed to leave 6-8 trees unsprayed for disease. Samples were collected and sent to the Okanagan Tree Fruit Cooperative (OTFC), north of Kelowna, BC for resistance testing to Group 3 (Nova 40W, Nustar, Funginex DC & Inspire), Group 7 (Fontelis, Luna Tranquility [Group 7+9]), and Group 11 (Sovran, Flint 50 WG and Pristine WG) fungicides.

We hope to have results by December 2013. Look for this information in the next Orchard Network newsletter or at the Ontario Fruit & Vegetable Convention in February 2014.

This is a large and challenging project, with the Ontario Apple Team providing leadership. We are hopeful that this project will provide growers with information needed to make fungicide choices, as well as develop the ability in our laboratories to do resistance testing in the future.

Funding for this project is provided by Agriculture and Agri-Food Canada through the Canadian Agricultural Adaptation Program (CAAP) and the Pest Management Centre, Risk Reduction Program, as well as Dow AgroSciences Canada, Syngenta Crop Protection E.I. DuPont Canada, BASF Canada Inc and Bayer CropScience Inc.. This work was in partnership with Ontario Apple Growers, Apple Growers of New Brunswick, Nova Scotia Fruit Growers' Association, Fédération des producteurs de pommes du Québec, British Columbia Fruit Growers' Association and the Apple Working Group of the Canadian Horticulture Council. We gratefully acknowledge Danielle Hirkala at the Okanagan Tree Fruit Cooperative.

Rots the Problem? Dealing with Pre-harvest and Storage Disease

Kristy Grigg-McGuffin, Pome Fruit IPM Specialist, OMAF and MRA

With the frequent rains since petal fall, fungal pathogens, such as black rot and bitter rot infections have been observed in many orchards across the province this year. As harvest quickly approaches, take the time to consider management of these diseases and prepare for other storage issues that may arise. Since many storage issues are actually initiated in the orchard, careful thought should go into control at this level. Often pre-harvest symptoms are not obvious and infection can come as quite a surprise when fruit is later brought out of storage.

Black rot (*Botryosphaeria obtuse*) overwinters in cankers on twigs, branches and trunk, as well as on mummified fruit. This often makes apple cultivars which retain mummified fruit, such as Gala, Honeycrisp, Cortland and Northern Spy more susceptible to infection, as well as trees damaged by winter injury or fire blight.

Late season black rot infection often appears just before harvest as black spots on the fruit associated with mummified fruit left from chemical thinners (Figure 1). Eventually, the lesions enlarge into a brown rot with concentric dark and light rings (Figure 2), which late in the season or in storage, may develop tiny pimple-like black pycnidia (Figure 3). The flesh of fruit infected with black rot remains firm, in contrast to several other apple rots and may increase storage decays after harvest, frustrating growers and packers alike.

Figure 1. Late season black rot infection appears as black spots on fruit associated with mummified fruit left from chemical thinners.

Figure 2. Black rot lesions enlarge with concentric dark and light rings.

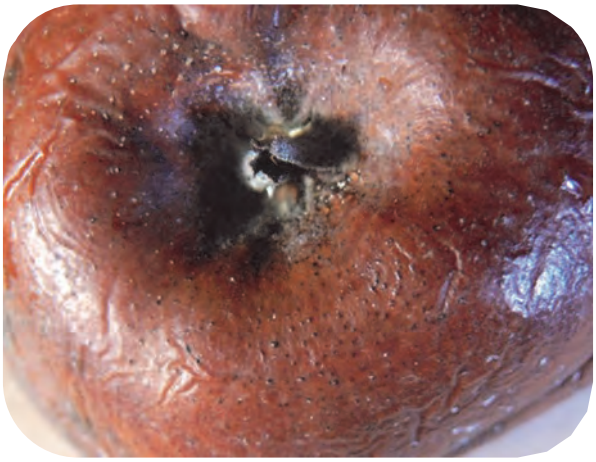

Figure 3. In storage, black rot infected fruit remain firm and may produce tiny pimple-like black pycnidia.

Bitter rot, caused by the fungus *Colletrotrichum gloeosporiodes* and *C. acutatum*, overwinters in mummified fruit, crevices in the bark, and cankers. Typically, symptoms appear late summer to harvest. This year, spots on maturing apples have been observed across the province, particularly on Golden Delicious, Gala, Honeycrisp, Gingergold and Spy.

Early infections on fruit appear as tiny, grey or brown spots that enlarge to sunken, dark brown lesions, often surrounded by a red halo (Figure 4). Especially during wet or humid conditions, masses of salmon-coloured spores are produced on the surface of the expanding fruit lesions. A diagnostic V-shaped rot can also be observed progressing towards the core when infected fruit are cut open (Figure 5).

Figure 4. Bitter rot appears as sunken spots, surrounded by a red halo. Masses of salmon-coloured spores are produced on the surface of the enlarged lesion.

Unlike black rot, the bitter rot fungus does not require fruit wounding to establish an infection and can directly penetrate the fruit skin. Because of this, it's critical if the pathogen is in your orchard to protect the maturing fruit before harvest.

Figure 5. Bitter rot has a diagnostic V-shape rot progressing towards the core.

Blue and **gray molds** (*Penicillium expansum* and *Botrytis cinerea*, respectively) are two important diseases of stored apples. Both pathogens require a wound to cause disease, which most frequently occurs during picking and handling operations. Spores can survive long periods of unfavourable conditions, as well as from season to season on picking boxes, contaminated bins, storage walls and packing equipment. The pathogens may also invade fruit that are over mature at harvest or fruit held in storage too long.

The symptoms of blue mold begin as soft watery light brown areas around injuries or lenticels on the fruit surface. Fruit affected by gray mold is spongy, light to dark brown, and diseased tissue is not separable from the healthy tissue. Blue mold initially has tufts of snow-white spores that turn to blue-green (Figure 6) and has a musty odour, while gray mold has fluffy white or grey mycelium and dark grey spores masses (Figure 7) with a “cedar-like” smell only in advanced stages.

Figure 6. Blue mold initially has tufts of white spores that turn blue-green.

Pre-harvest chemical controls are available that will help reduce both pre-harvest and storage diseases. If possible, include one of these chemicals during your last

cover spray. Captan, Pristine or Granuflo may provide some protection against rots. Scala is registered as a pre-harvest treatment for grey mold, but post-harvest treatments for blue and gray mold are also registered, including Mertect, Scholar or Bio-Save. For more information on pre- and post-harvest fungicides, consult the Apple Calendar in Publication 360, Guide to Fruit Production.

Figure 7. Gray mold has fluffy white or grey mycelium and dark grey spore masses.

As you're getting your orchards ready for harvest, the following are some general management techniques to keep in mind to reduce postharvest fruit rots:

This season

- **Handle fruit carefully during harvest** – bruised or wounded fruit are susceptible to storage diseases.
- **Harvest fruit at proper maturity** – the more mature, the more susceptible a fruit is to storage diseases.
- **Minimize inoculum sources** – use clean bins, limit the amount of soil and plant debris brought in and sanitize storage equipment.
- **Keep fruit cool after harvest** – warm temperatures encourage pathogens to grow.

Next season

- **Practice orchard sanitation to remove inoculum sources** – prune out cankers or dead branches, and remove rotten or mummified fruit.
- **Apply calcium sprays** to improve fruit quality.
- **Prune** to increase air flow, promote faster drying time and ensure better spray penetration.

Monitoring for San Jose Scale

Megan Leedham, OMAF and MRA summer student; Kristy Grigg-McGuffin, Pome Fruit IPM Specialist, OMAF and MRA

San Jose scale (SJS) is a difficult pest to control within apple orchards due to their biology. Females remain immobile under a scale, which acts as a protective covering from predators, desiccation and pesticides. Males, however, are small flying insects which allow males and females to mate. Their young emerge as crawlers which move along the bark or onto fruit in search of sap to feed on (Figure 1). Within a few days after the crawler has found its feeding area, it builds the protective scale covering. This creates a very small window when the crawlers are unprotected which is ideal for timing an insecticide spray.

Figure 1. San Jose scale feeding injury on developing fruit.

There are a few spray timing options, but most require knowledge of when the crawlers have emerged and are most vulnerable. Dormant oil applications (Superior Oil, Purespray Green Spray Oil) can be very effective by targeting the overwintering SJS before the immature scales develop a protective waxy layer. However, good coverage and timing are essential with the use of oils since they smother the crawler but have no impact on adults. Delaying dormant oil sprays to target European red mites have limited control for SJS at this timing. Post-bloom sprays are also an option, though determining the appropriate timing is more difficult. Petal fall sprays targeting the early generation are also more useful over later sprays (mid-July) when fruit injury may have already occurred and spray penetration can be difficult to achieve good coverage. New products have been registered recently targeting the summer generations of SJS, but label recommendations state correct spray timing to be "when crawlers are active" and growers are struggling to predict when this timing would be.

Because very little is known about how to monitor this pest in Ontario, OMAF and MRA tested a number of different techniques this season. Two U.S. models using degree-days (DD) to predict crawler emergence were tested:

1. Cornell DD model

- Biofix: March 1st
- Base temperature: 10^0C
- 1st generation crawler emergence: 278 DD, or approx. 29 ± 12.5 days from McIntosh petal fall
- 2nd generation crawler emergence: 806 DD, or approx. mid-July

2. Washington DD model

- Biofix: first adult male catch
- Base temperature: 10.5^{0}C
- 1st generation crawler emergence: 222-249 DD, or approx. 1st generation codling moth (CM) biofix
- 2nd generation crawler emergence: n/a

Monitoring began at pink in a Simcoe orchard with a historically high pressure of SJS on Empire and McIntosh. Pheromone traps (Figure 2) were installed at king bloom in trees with high overwintering SJS populations and checked weekly until the first adult male SJS was caught (Figure 3). Beginning at petal fall, scouting for crawler emergence was also conducted on a weekly basis by monitoring infested branches and developing fruitlets for the presence of the small, yellow insect. Table 1 summarizes the findings using both DD models. Overall, both models were very accurate in predicting 1st generation SJS crawler emergence, estimating between June 20-26 with the actual visual confirmation of crawler activity on June 22. The 2nd generation crawler emergence predicted by the Cornell DD model also corresponded to what was observed in the Simcoe orchard.

Figure 2. San Jose scale pheromone trap.

While both models were successful this year, relying on a set calendar day, such as March 1st as a biofix may not necessary reflect the actual development of the scale in an individual orchard from year to year, whereas monitoring adult flight using pheromone traps would. Keep in mind, however, due to the small size of the adult scale (Figure 4), this insect can be difficult to see on the pheromone trap without a hand lens and/or dissecting microscope.

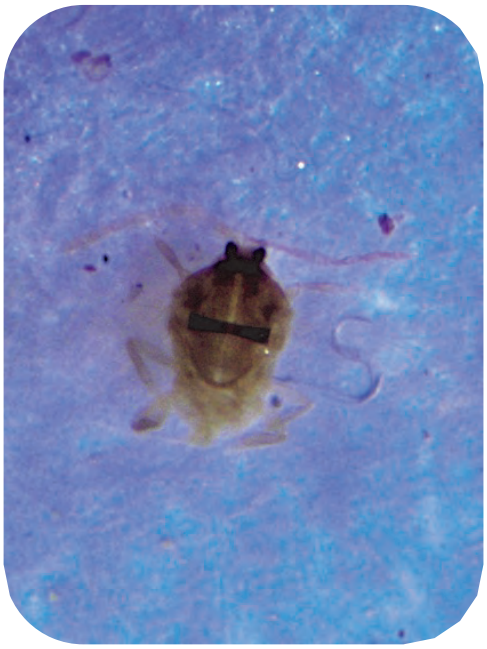

Figure 3. Adult male San Jose scale caught on pheromone trap. Note the distinct dark band across abdomen.

Figure 4. The small relative size of adult male San Jose scale on pheromone trap requires a highly trained eye, hand lens and/or dissecting microscope to detect.

Another monitoring technique used this year to detect crawler activity was the use of sticky traps on limbs. Electrical tape (sticky side out) was wrapped around limbs of infested trees at petal fall to trap crawlers moving to another section of the branch. Unfortunately, the tape needed to be replaced every 2-3 days due to excess debris, spray and/or insects, and only one crawler was caught out of 5 traps. To extend the amount of time the trap stayed sticky, additional sticky traps were installed and sprayed with Tanglefoot™, while others were covered with a plastic tube around the branch to shield it

from dust, sprays and other insects. Even with the Tanglefoot™ and plastic covering, only one crawler was caught in 1 of 5 covered traps, and both types needed at least weekly replacement. Overall, this method was not only ineffective based on the labour required to install and maintain, but also required a highly trained eye using a hand lens or dissecting microscope.

Trials testing various summer treatment options were also conducted this season in three orchards with historically high SJS pressure. Treatments included:

- Dormant oil: Applied prior to bud break at 2% solution (20 L/1,000 L water)
- Movento: Applied at petal fall at 585 mL/ha and re-applied 14 days later.
- Purespray Green Spray Oil: Applied at crawler emergence at 1% solution (10 L/1,000 L water).
- Closer: Applied at crawler emergence at 400 mL/ha and re-applied 14 days later.

Harvest assessments for this trial are currently being conducted. Stay tuned for results in the next Orchard Network or at the Ontario Fruit and Vegetable Convention.

Table 1. Comparison of the predicted San Jose scale (SJS) crawler emergence based on two US degree day (DD) models with the actual observed crawler activity in a Simcoe, ON orchard.

Model	McIntosh petal fall (+29 days)	1st gen. CM biofix	Biofix	1st gen. SJS crawler emergence		2nd gen. SJS crawler emergence	
				DD timing	Observed	DD timing	Observed
Cornell	May 21 (June 19)	May 17-21	March 1	June 20	June 22	August 4	August 8
Washington			May 22*	June 22-26		n/a	

*date of trap collection, catch occurred sometime between May 16-22

Adjusting Airblast Sprayers for High-Density Apple Orchards

Dr. Jason S.T. Deveau, Application Technology Specialist, OMAF and MRA

As Ontario continues to plant high-density apple orchards, spray operators are faced with the challenge of adjusting their spray practices to match the size, shape, area-density and stage of growth of the trees. The same issue was encountered in the seventies when growers moved from standard apple trees to semi-dwarf varieties.

Back then, growers used a pro-rata formula called Tree-Row Volume to reduce their output from ~3,750 L/ha (400 US gal/ac) to approximately 1,000 L/ha (~110 US gal/ac). The method worked, and todays' agrichemical products developed for use in apple orchards are generally tested in 1,000 liters of spray volume per hectare (with the exception of products intended to drench the target).

A new model is required that will allow the applicator to maintain (or improve) insecticide and fungicide efficacy while minimizing waste. The Crop-Adapted Spraying (CAS) model currently being tested by OMAF and MRA is based on the premise that pesticides sprayed onto crops like tree fruit should not have rates that reflect the area of the planting. Instead, they should reflect the tree area-density, which means the amount of crop in the orchard, not the area of the orchard planting.

The ultimate goal of CAS is to adapt the amount of active ingredient per unit ground area such that the amount of active ingredient per unit target area (usually the leaf area) remains constant for canopies of varying shape and density. When this is achieved with sufficient accuracy, the pesticide efficacy is maintained.

Here are the steps to follow if you are spraying a young and/or high-density orchard with an airblast sprayer:

1. Sprayer should receive all seasonal maintenance prior to first use and undergo a visual inspection before each spray day.
2. Park sprayer in an alley between rows of trees and tie 10 cm lengths of ribbon to the ends of the deflectors (if present) and the nozzle bodies. Turn on the air and extrapolate where the nozzles and deflectors are aimed. Adjust deflectors and turn off nozzles that will spray over or under the tree canopy.
3. Confirm ground speed with a half-full sprayer in the orchard using GPS or a calibration formula.
4. Affix 25 cm ribbons to far side of three trees. Tie them at the top and at the widest portions of the canopies. Drive past in the spraying gear at the ideal RPMs with the air on, and ensure the ribbons waft outwards. This will determine if more/less air is required from the airblast sprayer, and if operator should speed up or slow down during spraying. This is also an opportunity to perform Gear-Up-Throttle-Down if sprayer is using a positive displacement pump.
5. Place water-sensitive paper at the top, centre and bottom of the tree canopy and spray water (see Figure 1 on pg 11). If coverage exceeds 15% surface-area and 85 discrete droplets per square centimetre, reduce output in those positions by replacing nozzles with lower outputs. If less than ideal coverage is achieved, increase the nozzle rates in those positions. Excessive coverage may be unavoidable in the outer edge of the canopy, given that spray must pass through to get to the centre.
6. When the canopy grows and fills in sufficiently, usually after petal fall, repeat steps 4 and 5. If you are suspicious that the spray is being stretched too thin or

you are unsatisfied with the coverage, you may have to increase the output. This is more of an issue with larger trees. Early in the season, wind travels unimpeded in a high-density orchard and will blow the spray off course, reducing coverage and requiring higher water volumes or possibly more air to compensate. As the trees fill in, the average wind speed is reduced and more spray can impact on the target. Therefore, increasing spray volume after petal fall may not be required.

Figure 1 – Ideal fungicide/insecticide coverage on water-sensitive paper affixed to the top of a 3 m (10 foot) high, high-density apple tree

When the correct sprayer settings and volumes have been determined, the operator will mix their spray tank as they would for their typical application to a semi-dwarf orchard. However, they may be spraying as little as 300 L/ha in a high-density orchard, and will therefore go further on a tank. The leaves will receive the same absolute amount of active ingredient as in a larger, denser orchard; the difference will be that the spray is not wasted through over-spraying.

This method of application is really no more sophisticated than turning off nozzles that are aiming at the ground or above that target. It will take time for operators to get comfortable with the new volumes (and reduced dosage per hectare) and regular scouting is highly encouraged to confirm they are achieving control.

Postharvest

Links to Important Postharvest Articles on Apples

Jennifer R. DeEll, Fresh Market Quality Program Lead - Hort Crops, OMAF and MRA

As harvest begins, it is a good time to recall previous articles that contain helpful hints on postharvest handling and storage of apples.

A chart of the recommended starch-iodine test values at harvest for long-term storage of apples can be found here www.omafra.gov.on.ca/english/crops/hort/news/orchnews/2010/on-0810a11.htm

Information on the maturity and storage of 'Ambrosia' apples can be found at www.omafra.gov.on.ca/english/crops/hort/news/orchnews/2009/on-0809a8.htm

Remember that harvesting 'Empire' late (advanced harvest maturity) increases the incidence of flesh browning in storage. More information on this relationship can be found here www.omafra.gov.on.ca/english/crops/hort/news/orchnews/2009/on-0809a7.htm

The SmartFresh™ label in Canada was expanded in 2011 to allow up to four applications (1 ppm 1-MCP) within 240 days of harvest. As a result, many storage operations are treating rooms with SmartFresh more than once during filling. A summary of trial results can be found at www.omafra.gov.on.ca/english/crops/hort/news/orchnews/2013/on-0113a8.htm

The current CA recommendations for Ontario apples can be found here www.omafra.gov.on.ca/english/crops/hort/news/orchnews/2012/on-0912a12.htm

Finally, a recent article in *Good Fruit Grower* summarizes my tops five ways to ensure apples store well. Here is the link to that article www.goodfruit.com/Good-Fruit-Grower/August-2013/The-top-5-ways-to-ensure-apples-store-well/?utm_source=Good+Fruit+Grower+eFlash&utm_campaign=52396976c9-Good_Fruit_Grower_newsletter_072913&utm_medium=email&utm_term=0_f67a0b0e5e-52396976c9-10276393

Maturity and Storage of 'Honeycrisp' Apples

Jennifer R. DeEll, Fresh Market Quality Program Lead - Hort Crops, OMAF and MRA

Determining the optimum harvest maturity for 'Honeycrisp' is difficult. Standard maturity indices, such as internal ethylene concentration, starch index, soluble solids concentration and fruit firmness are not always consistent. Current recommendations suggest that **harvest should occur when the ground color beings to change from green to yellow and the starch index is above 6** (Cornell chart). The best eating quality has been associated with 13.5 lb minimum firmness and at least 13% soluble solids (Watkins et al., 2004). There has been no consistent relationship of internal ethylene to harvest date and differences in maturity do not always exist among apples with varying levels of red color. For example, brilliant red fruit can exhibit very similar internal ethylene concentrations, starch content, and firmness values as those with only slight red coloration (DeEll and Murr, unpublished data).

Immature 'Honeycrisp' may never mature and thus remain of poor eating quality. Fruit harvested too early do not develop varietal flavor and are almost tasteless. If harvested too late, 'Honeycrisp' can develop fermentation products, such as ethanol and acetaldehyde, which cause undesirable flavors. The onset of such off-flavors is difficult to predict, as there are no associated visual symptoms. Harvesting at optimum maturity is the best way to achieve the characteristic flavor of 'Honeycrisp'.

'Honeycrisp' is **extremely susceptible to bitter pit**. Lesions may appear prior to harvest or during storage, and usually develop in the calyx end of the fruit. The cause for bitter pit is a mineral imbalance in the apple flesh, associated with low levels of calcium. 'Honeycrisp' fruit are also **prone to developing soft scald during storage**. Soft scald is a low-temperature disorder of apples that is characterized by sharply defined, irregularly shaped, smooth, brown lesions of the skin (Figure 1). Peel tissue is initially affected and then hypodermal tissue is damaged as the disorder continues to develop. Skin lesions are often then invaded by secondary pathogens, such as *Alternaria* or *Cladosporium*. 'Honeycrisp' is also **susceptible to soggy breakdown**, which likewise develops during storage. Soggy breakdown is distinguished by soft, brown, spongy tissue within the fruit cortex (Figure 2).

Prior to cold storage, **conditioning at 10°C for 1 week is recommended** to reduce the incidence of soft scald and soggy breakdown. Conditioning at warmer temperatures has been shown to substantially reduce titratable acidity, which has also been noted within sensory evaluations. Bitter pit can develop more rapidly at warmer temperatures, so conditioning at 10°C is a compromise between bitter pit and soft scald development.

After conditioning at 10°C for 1 week, 'Honeycrisp' is best **stored in ambient air at 3°C**. Controlled atmosphere (CA) storage of 'Honeycrisp' is not currently recommended in Ontario. However, limited success has been observed using 3% O_2 and 1.5% CO_2 at 3°C (DeEll, unpublished data; Watkins et al., 2013). Severe internal browning can develop when 'Honeycrisp' is held in many of the standard or typical CA regimes used for other apple cultivars. 'Honeycrisp' tends to be very sensitive to CO_2, so CO_2-related disorders can develop easily.

Ethylene production, respiration, and **greasiness can be reduced by SmartFresh™** (1-MCP) on 'Honeycrisp'. SmartFresh tends to be slightly more effective when applied at the onset of the conditioning period at 10°C, compared to after that 1 week period. However, always be aware of any CO_2 accumulation during the SmartFresh treatment, as this has potential to cause CO_2 injury. There is little loss of firmness in 'Honeycrisp' during storage, so any improved firmness retention caused by SmartFresh treatment is difficult to discern.

Figure 1: Soft scald in 'Honeycrisp'.

Figure 2: Soggy breakdown in 'Honeycrisp'.

Calendar of Events for Apple Growers

- **South West Hort Expo**, Leamington, Nov. 19-20, 2013. An expanded convention by the Essex County Associated Growers, including Fruit Day (Nov. 20), workshops on Social Media and Agriculture, Irrigation Scheduling, Soils and Cover Crops, Organic Growing, Nozzle Adjustments and much more. 519-326-4481
- **Great Lakes Expo**, Grand Rapids, Mich, Dec. 10-12, 2013. www.glexpo.com
- **Ontario Fruit and Vegetable Convention**, Niagara Falls, Feb. 19-20, 2014. Includes Apple Day (Feb. 20), Cider Workshop and Cider Competitions (Feb. 19). www.ofvc.ca
- **International Fruit Tree Association**, Kelowna, B.C. February 22-26, 2014 www.ifruittree.org

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