

ORCHARD NETWORK

For Commercial Apple Producers

VOLUME #16, ISSUE #3 September, 2012

In this issue...

Orchard Management

One-Stop Apple Information

Leslie Huffman, Apple Specialist, Harrow

Is it a challenge to find information about apples on the OMAFRA website? Maybe you lost your bookmarks in a computer upgrade. Or maybe you just don't know where to start looking.

Fortunately, we've created a shortcut URL that is easy to remember. In your browser, just type in this shortcut:

ontario.ca/apples – or in French - **ontario.ca/pommes**

Your computer will do the rest, and take you directly to our main Apple page. At the top, you will find links to:

- Ontario AppleIPM module
- Planting New Apple Orchards in Ontario

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This issue of the **Orchard Network Newsletter** was compiled by Client Service Representative, Patti Arts,OMAFRA, Kemptville

- Publication 360, Guide to Fruit Production online (apples are chapter 4)
- Publication 310, Integrated Pest Management in Apples
- Orchard Network newsletter – and an index of all past articles
- Factsheets and articles
- Business information, links, statistics, etc.

Crop Protection

Consider Sanitation This Fall for Apple Scab Control

Kristy Grigg-McGuffin, Pome Fruit IPM, Simcoe

In some orchards this year, apple scab became quite a problem, likely in part to improper spray timing and/or a reduced fungicide program. Why not get a head start managing next year's disease pressure by reducing the number of over-wintering ascospores this fall.

Since apple scab resistance to sterol inhibitor and strobilurin fungicides has been confirmed in some Ontario orchards, cultural practices need to be implemented to help reduce disease pressure and risk of resistance development. It is possible to reduce the amount of over-wintering apple scab in your orchard using two practical and inexpensive methods:

1. applying urea fertilizer at leaf-fall or in spring, and
2. shredding fallen leaves with a flail mower.

Urea fertilizer at 45 kg/ha (mixed in 1,000 L of water/ha) may be applied at leaf-fall in the autumn or in the spring before bud break. This stimulates leaf breakdown by microbes and promotes faster removal by earthworms that feed on them. Urea also directly suppresses ascospore formation. Treat the entire orchard, including

the ground cover in the middle of rows. Apply urea spray using either an air blast sprayer with the upper nozzles turned off, or a boom sprayer set up to spray both under the trees and the middle of row.

Shredding over-wintering leaves in the fall or spring with a flail mower stimulates decomposition and disorientates leaf pieces so they eject ascospores toward the soil, instead of up into the tree canopy. Keep the flail mower set low enough to contact the fallen leaves, and rake or blow leaves from under trees into the middle of the row, or off-set the mower to reach them. Chop winter prunings at the same time. The low mower settings required to effectively shred leaves may denude the row middles, becoming muddy and slippery when early fungicide sprays are required. Apply lime at 5.6 tonnes/ha in early winter after leaves have fallen from trees to raise the pH of the fallen leaves and increase rate of microbial break-down.

Since the early 2000's, research has shown this practice to be effective in reducing over-wintering spores. Research from the University of New Hampshire showed a 97% reduction in ascospore productivity in leaves sprayed with 5% urea just before leaf-fall, 50% reduction when urea was applied to the leaf litter when approximately 95% of the leaves had fallen, and 70% reduction when urea was applied to the leaf litter in spring.[1] As well, the same researchers also reported that shredding the leaf litter in November or April will reduce the risk of scab by 80-90%. Similar findings have also been reported from Quebec.[2]

An orchard that had a scab problem this year will benefit from these sanitation practices by reducing disease pressure and making effective control with fungicides during primary scab season more likely. Again, lowering the disease pressure will also reduce the risk of developing resistance to fungicides, such as sterol inhibitors (Nova, Nustar, Inspire) and strobilurins (Flint, Sovran, Pristine).

[1] Sutton D.K. et al. (2000). Effects of shredding or treating apple leaf litter with urea on ascospore dose of Venturia inaequalis and disease buildup. Plant Disease 84: 1319-1326.

[2] Vincent C. et al. (2004). Apple leaf shredding as a non-chemical tool to manage apple scab and spotted tentiform leafminer. Agriculture, Ecosystems and Environment 104: 595-604.

Tipping The Scale: Why is Scale Injury Increasing in Apple Orchards?

Kristy Grigg McGuffin, Pome Fruit IPM, Simcoe

With the hot, dry weather we have experienced this year, a large increase in San Jose scale (SJS) injury to fruit (See Figure 1-p. 4) and limbs (See Figure 2-p. 4) has occurred in many apple regions across Ontario. Despite being native to Ontario, fruit damage by this pest was minimal in the past. The increase in populations in orchards over recent years is likely a result of changes in the products used in our IPM program (e.g. reduced use and loss of broad-spectrum OP insecticides). This year alone, the sudden and early spring caused many growers to miss the application window for dormant oil spray, which is the optimum time to manage SJS. As well, many growers opted to reduce their overall insecticide program due to crop loss from early season frosts. This could explain the large jump observed in late season SJS activity as typical summer sprays targeting other pests may have some activity on 2nd generation scale.

Post-bloom trials with Movento and Assail targeting 1st generation SJS were conducted this season in orchard blocks where damage has been extensive in past years. Movento is registered for SJS control, but has slow activity. It is important to use this product approximately 1-2 weeks before emergence of crawlers and follow up with another application 10-14 days later. Assail is not registered in Ontario for SJS, but is frequently used in the US. It is directed against crawlers as they emerge and often applied according to a degree-day (DDC) model.

Preliminary results indicate that Movento provided effective, long-lasting control, averaging over the season 0.05 SJS / cm of shoot for a treatment of high rate (585 mL/ha) followed by low rate (365 mL/ha), and 0.003 SJS / cm of shoot for a treatment of two high rates (Figure 3). For both treatments, the first application was applied at petal fall, followed by the 2nd application 14 days later. This year, tree phenology, DDC timing and 1st generation crawler emergence did not mesh well for effective control using Assail alone. A rate of 120 g/ha was applied at 278 DDC, biofix March 1st, followed by a second application 14 days later. The number of SJS was approximately 0.2 SJS / cm of shoot, which was similar to the untreated check (See Figure 3-p. 4).

Generally, SJS starts in one or two trees and gradually spreads to surrounding areas in the orchard over a few years. Once scale has become established, it can be very difficult to eradicate. Examination of bark and twigs during pruning may help to detect scale infestations. Confirm SJS injury by cutting away bark to reveal a reddish discoloration. Pruning orchards to remove infested branches and suckers can help to open the canopy and allow for better spray penetration.

Successful scale control starts with prevention. With a limited number of insecticides used this season, there may be a need for a more aggressive management program next year. Use oil before the tree breaks dormancy when scales have only a thin wax covering. The most effective timing is from silver tip to ½ inch green, although limited control may be achieved with later oil applications for European red mite. However, as we saw this year, applying oil in the spring can be challenging due to concerns with frost and phytotoxicity (do not apply oil within 48 hours of frost or 14 days of captan).

Figure 1: Fruit injury caused by San Jose scale.

Figure 2: Heavy infestation of scale on tree limb.

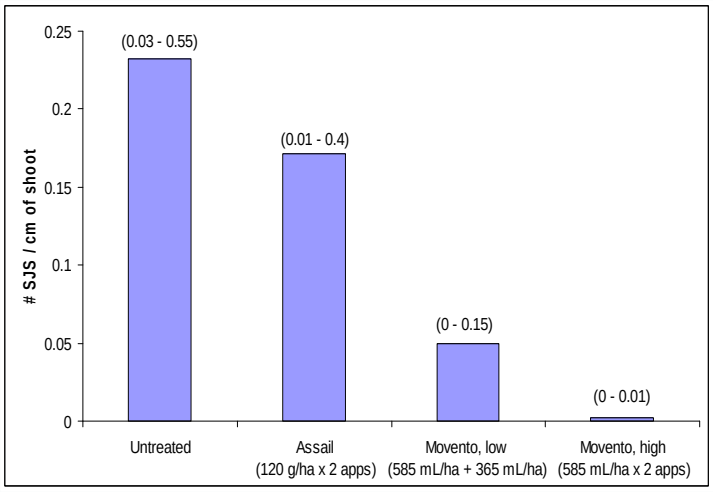

Figure 3: Average San Jose scale per centimetre of shoot from June - August 2012. Values above bars represent range of weekly counts over season.

For more information on the biology and management of scale, please visit the Ontario CropIPM online.

Brown Marmorated Stink Bug in Ontario: What Growers Need to Know!

Hannah Fraser, Entomology Program Lead Horticulture, Vineland

**adapted from Hort Matters Volume 12 Issue 25 and 27*

A well-established population of brown marmorated stink bug (BMSB) has been detected in Hamilton, Ontario. Dozens of nymphs and adults (Fig 1) were found in buckthorn located within a wildlife sanctuary and along parts of the Bruce Trail (Niagara escarpment). The large number of individuals collected through informal methods indicates the pest has likely been present in the area for several years. Field surveys conducted in Ontario (2011-2012) have not yet identified BMSB in crops, but growers should be on the look-out for the pest. It is quite likely there are other areas in Ontario with BMSB, but they may not have reached populations that are easy to detect.

BMSB has a very wide host range and it is likely present on other plants in the landscape, but most of the individuals we collected over the last two weeks were found in buckthorn (mostly because it was so easy to find them on these plants that we targeted our searches there). This insect obviously uses buckthorn as a reproductive host, so anyone interested in looking for it at this time of the year might consider using this as a sentinel plant.

Growers should also be looking for signs of stink bug damage and follow-up with scouting. In apples, late-season damage by stink bugs is easily confused with bitter pit; damage occurring very close to harvest may not be apparent when the fruit is put into storage (Figure 1).

Figure 1: BMSB dame in apples (photo credit: USDA-ARS)

At this point in the year, the most common life stages you are likely to observe are nymphs and adults. BMSB is a fairly large stink bug with several key distinguishing features:

Adults :

- 14-17 mm in length
- two obvious white bands on otherwise dark antennae
- inward-pointing white triangles between dark markings along the edge of the abdomen
- smooth edge along the pronotum or "shoulders"
- mottled brown-grey dorsally and a pale underside
- membranous portion of forewings have a reddish tinge
- brown legs with faint white banding

Figure 2: Brown marmorated stink bug adult (Photo credit: Jennifer Read, NRCan)

Late instar nymphs:

- pattern on edge of abdomen beginning to develop
- white bands on antennae
- obvious white bands on legs
- pronotum has toothed edge

Figure 3: Brown marmorated stink bug nymph. (Photo credit: David R. Lance, USDA APHIS PPQ, Bugwood.org)

How can you help?
Early detection is important to the long term success of management programs. We need to have a better understanding of where this pest is and how well it is established. There is a monitoring network for this pest; however, we have a better chance of finding pockets of small populations if more people are looking. Tracking the distribution and spread is essential. **If you think you have found BMSB, contact the Agriculture Information Contact Centre at 1-877-424-1300 or email** ag.info.omafra@ontario.ca. Place the insect in a leak proof container and add rubbing alcohol, or freeze to kill it.

For more information visit the OMAFRA website at: www.ontario.ca/stinkbug

Control Options for Apple Leafcuring Midge

Kristy Grigg-McGuffin, Pome Fruit IPM, Simcoe

Monitoring traps for apple leafcurling midge (ALCM) were set out into orchards in Norfolk and Durham County again this year. Similar to 2011 pheromone trap data, 3 generations were observed in 2012 with a small generation pre-bloom, followed by 2 post-bloom (Figure 1). Based on the population numbers, it would appear pre-bloom or petal fall insecticide timing would be advantageous for season long control.

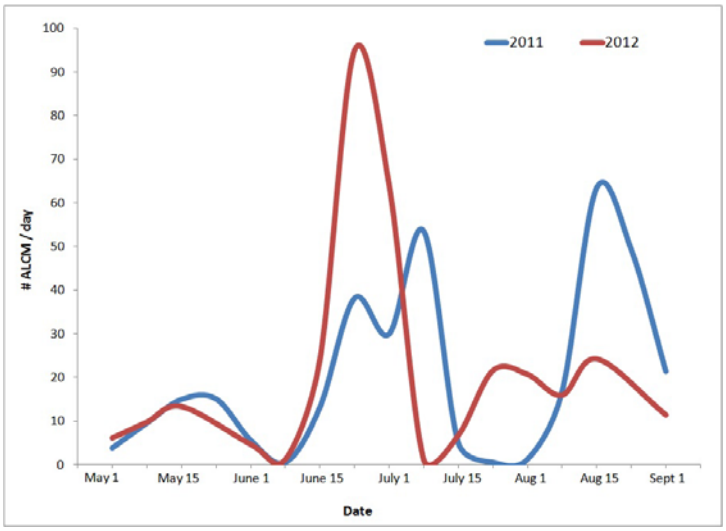

Figure 1. Average number per day of apple leafcurling midge adult males caught in pheromone traps, 2011 & 2012.

The ALCM overwinters as pre-pupae or pupae in silken cocoons in the soil, or in curled leaves. Following adult emergence in late May to early June, eggs are laid on apple leaves that are partially unfolded. After hatch,

emerging maggot-like larvae feed on the upper surface of leaves for 2-3 weeks before dropping to the ground to pupate. The margins of infested leaves are rolled in towards the mid-vein and the leaves become purple or red and brittle. (Figure 2).

Figure 2. Leaves infested with apple leafcurling midge become purple or red and brittle

Apples are the only host of the ALCM. Varieties with lush terminal growth may be preferred due to the availability of egg laying sites, though all cultivars are susceptible to infestation. As well, nursery or young blocks are very susceptible to this pest as injury will affect their growth.

Reports from New Zealand indicate that the ALCM can also affect flowers and fruit when high populations are present in early in spring. Larvae developing from eggs laid on flowers can affect the developing fruitlets, resulting in fruit whose skin is distorted by bumps. This has yet to be determined in Ontario orchards.

It is very difficult to manage this pest using insecticides since the midges are well protected inside the curled up leaves. Currently, cypermethrin (Ripcord 400EC or Up-Cyde 2.5 EC) is the only active ingredient registered to control this pest.

However, field trials using Movento have been quite successful. In 2011, low rate (365 mL/ha) pre-bloom spray was applied when 10 adult ALCM were caught in pheromone traps. A 2nd spray was applied 7-10 days later. Terminals were inspected weekly throughout the growing season and a significant reduction in the percent and severity of ALCM infestation was observed in the Movento blocks, compared to Assail and untreated treatments (Figure 3).

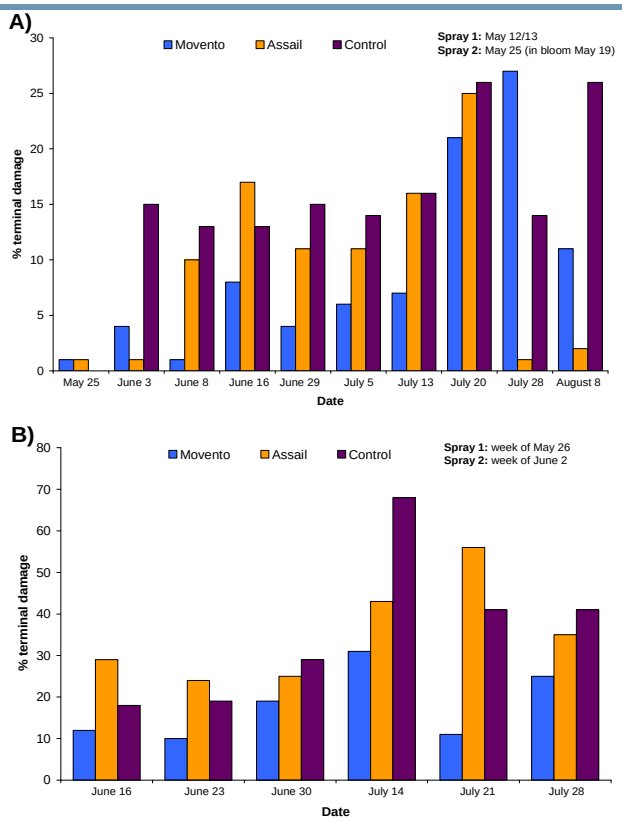

Figure 3. Apple leafcurling midge terminal damage after pre-bloom insecticide treatment in A) Norfolk County and B) Durham County, 2011

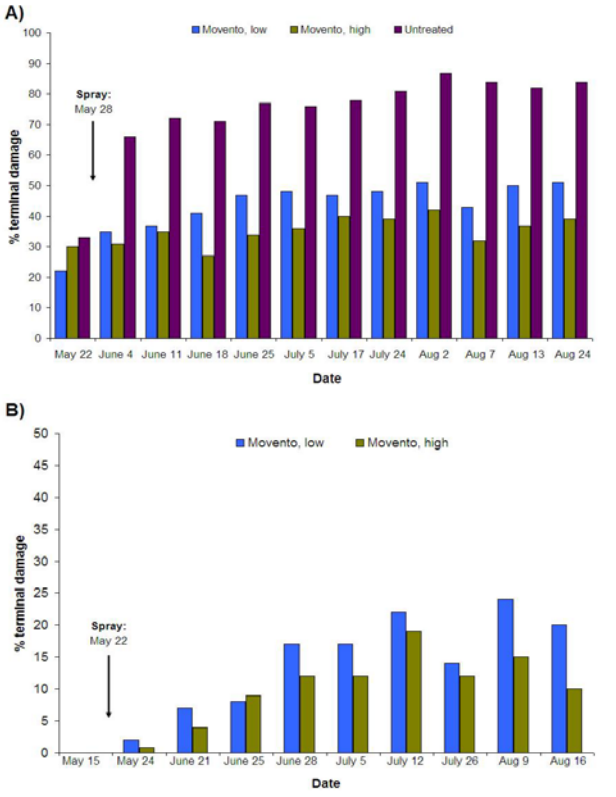

Figure 4. Apple leafcurling midge terminal damage after petal fall insecticide treatment in A) Norfolk County and B) Durham County, 2012.

Due to the early season, pre-bloom Movento applications could not be repeated this year. Instead, single petal fall applications were compared at the suggested low and high rates (365 and 585 mL/ha, respectively). Preliminary results suggest that though a reduction in percent and severity of ALCM infestation was observed with a high rate of Movento, a single petal fall application of this product provided approximately 60-80% control (Figure 4). Pre- and post-bloom treatments will be tested again next year.

For more information on the biology and management of ALCM, please visit the Ontario CropIPM online

Aggressive Fire Blight Management

Michael Celetti, Plant Pathologist Horticulture Crops, Guelph

This past year has been very difficult for many apple growers. To make matters worse, several orchards have been hit with fire blight, including many that never had fire blight before. Fire blight is a very devastating disease of pear and apple, caused by the bacteria pathogen *Erwiniaamylovora*. It is not clearly understood why fire blight shows up in orchards with no history of this disease. The bacteria may have been introduced unknowingly, or built up on a wild host nearby and moved by pollinating insects. Regardless, growers with infected orchards should consider aggressive management approach, with intensive orchard sanitation and the timely applications of antibiotics (eg. streptomycin).

Intensive Orchard Sanitation: Studies have shown that removing infected limbs, branches, spurs and shoots as soon as symptoms appear results in less secondary infection. Pruning fire blight out of trees with a few strikes can result in complete control. It is best to remove the inoculum source as soon as possible in orchards that are not growing vigorously. However, aggressive pruning early in the season on vigorous trees with fire blight can result in a worse situation by stimulating succulent shoots susceptible to infection. Pruning out fire blight strikes in vigorously growing trees may be delayed until terminal bud set. Remember that delayed removal of inoculum risks more infection, so there is higher potential for trauma blight in the event of severe wind, rain or hail. IN all cases, avoid pruning out fire blight strikes in wet or hot weather to minimize spreading this pathogen.

Pruning cuts should be made at least 30 cm (12 inches) beyond the canker or visible infected tissue into 2nd year wood at a healthy branch union. Pruning tools should be sterilized between each cut in a 70% solution of alcohol or a solution of 1 part bleach to 5 parts water. Beware that bleach is corrosive to pruning tools. Alternatively, the cut can be made into 2nd year wood leaving a 10-12 cm 'ugly' stub, which can be removed during dormant pruning. Painting the stubs with a bright colour will ensure they are easily found.

Scout the orchard for fire blight cankers. Pruning out infected limbs with cankers and, if necessary, entire trees during the dormant season is imperative for a successful fire blight management program. Not all fire blight cankers harbour active bacteria over the winter. Late-forming cankers often harbour bacteria and become active the following spring. Unfortunately small cankers sometimes are missed, and it may take a few years to get all overwintering cankers.

Use of Management Products:
Growers who experienced fire blight this past season should also consider applying copper next spring. Copper residue left on the surfaces of trunks, branches and limbs will kill bacteria that ooze out of cankers. Copper sprays can be applied from dormant to green tip, but green tip is the preferred timing. Applying copper too early may result in the copper washing off and the effectiveness of copper sprays will be reduced or non-effective, particularly with heavy rainfall before half-inch green. Delaying copper after the half-inch green stage can result in phytotoxicity and severe fruit russetting.

Open blossoms are very susceptible to fire blight infection and tend to be the primary avenue for tree infection. Once the bacteria are in a blossom, and under the right temperatures, the bacteria multiply rapidly on the tips of the stigma. When the bacteria population reaches a critical size, water from rain, dew or irrigation washes the bacteria into the nectar thodes (the primary infection site). Closed blossoms or blossoms that begin to lose their petals are not susceptible to infection.

Protecting blossoms with timely applications of Streptomycin 17 is critical for fire blight control. Streptomycin is not systemic and is quickly degraded in sunlight. Applications should be made when conditions are predicted to be conducive for bacteria build-up in the orchard either using CougarBlight or Maryblyt models. For best results, streptomycin should be applied just prior to a wetting event such as dew or rain. Since streptomycin has a little kick back action, applying streptomycin up to 24 hours after a rain or dew will still reduce blossom infections significantly but will not be as effective as applying just before the wetting event. Secondary blossoms (referred to as "rattail" bloom or "tag" bloom) often open when environmental conditions for infection are high or extreme. Since they open much later than the majority of blossoms, they are often unprotected and therefore extremely vulnerable to fire blight infection. Secondary blossoms should be removed immediately since they rarely produce marketable fruit and are more of a liability.

The fire blight bacteria can also get into rootstocks which almost always results in tree death. The most susceptible rootstocks to fire blight are M.9 and M.26. The fire blight

bacteria can enter the rootstock either by moving though the vascular tissue of the scion (eg blossoms or shoot) or through a root sucker from the rootstock. Rootstocks that become infected from the scion often die a year later, whereas rootstock infections through a sucker often die the same year. Rootstock suckers particularly growing from M.9 and M.26 are very susceptible to fire blight infections and should be removed immediately.

Figure 1. M9 Rootstock infection with fire blight pathogen cause tree's leaves to turn colour prematurely.

Figure 2. Fire blight infection in a M.9 root sucker.

Figure 3. Rootstock infected with the fire blight almost always results in tree death

A New Leaf Spot Disease - Is This What We are Seeing?

Kristy Grigg-McGuffin, Pome Fruit IPM, Simcoe

A recent report from Dave Rosenberger at Cornell University described yellowing and defoliating symptoms on Golden Delicious similar to what some growers have been experiencing in Ontario this year. After further inspection, it was determined this may not be the suspected necrotic leaf blotch, but a fungal disease, Glomerella leaf spot. This is the same pathogen that causes bitter rot (see Hort Matters Volume 11 Issue 28 for Bitter Rot in Apples by Michael Celetti). Although it tends to be more common in warmer climates, such as the southern US, with the very warm summer, it appears to be causing leaf spots in more northerly states, such as West Virginia and New York. Diagnostic symptoms include leaf spots with concentric rings, commonly on Gala and Golden Delicious. The lesions start as purple spots, but turn brown with time (Figure 1). This can occur on both old and young leaves, eventually yellowing and dropping prematurely (Figure 2).

For more information and pictures of this disease, visit:

Dave Rosenberger's article in Cornell Fruit News and Events:
blogs.cornell.edu/fruit/2012/08/31/glomerella-leaf-spot-a-new-disease-affecting-golden-delicious-apples-in-ny/

Keith Yoder's article in Virginia Tech Agricultural Research and Extension Center Tree Fruit Disease Update:
treefruitdisease.blogspot.ca/

Figure 1. Early lesions of Glomerella leaf spot are small purple spots which enlarge with concentric growth rings that may coalesce.

Figure 2. Leaf yellowing and defoliation caused by Glomerella leaf spot.

Why So Many Weeds?

Kristen Callow, Weed Management Horticulture, Harrow

Scientists guesstimate that there are approximately 100,000,000 weed seeds per hectare of agriculture land. Yes, it is true scientists around the world dug up soil and counted the number of weed seeds. Glad that wasn't my graduate project! The numbers varied from different countries, but 100,000,000 is a good estimate. Of those 100,000,000 weed seeds approximately 1,000,000 emerge every year. This is why it is very unlikely that anyone can deplete the weed seed bank (weed seed that is dormant in the soil) to zero.

Seed enter the soil from several sources, but most commonly from weeds that are allowed to mature on an already occupied site. In general, the amount of seed produced by agricultural weeds is astonishingly high (Table 1), but it can also vary markedly due to the high growth plasticity of most weed species. Thus, the actual amount of seed produced per individual plant can vary from nothing to millions, depending on its growing conditions.

Weeds vary considerably with respect to the longevity of their seed (Table 1), depending upon species, depth of seed burial, soil type, and level of disturbance. Many weed species are noted for the especially long-lived nature of their seed.

Table 1. Seed Production and Length of Seed Survival in Soil

Weed Species	Average No. of Seed / Plant (Stevens 1954, 1957)	Length of Seed Survival in Undisturbed Soil (years)	
		(Toole and Brown, 1946)	(Kivilaan and Bandurski, 1981)
Canada thistle *Cirsiumarvense* (L.) Scop.	680/stem	21	
Common lamb's-quarters *Chenopodium album* L.	72,450	39	
Common purslane *Portulacaoleracea* L.	52,300	30	40
Common ragweed *Ambrosia artemisiifolia* L.	3,380	39	40
Curly dock *Rumexcrispus* L.	29,500	39	80
Dandelion *Taraxacumofficinale* Weber	15,000	6	
Green foxtail *Setariaviridis* (L.) Beauv.	34,000	39	
Redroot pigweed *Amaranthusretroflexus* L.	117,400	10	40
Shepherd's-purse *Capsella bursa-pastoris* (L.) Medic	38,500	16	35
Wild oats Avenafatua L.	250	1	
Yellow foxtail *Setariaglauca* (L.) Beauv.	6,420	30	30

Source: Wilson, 1988

With this information it is easy to see why the battle against weeds is everlasting. The old saying of one year seeding means seven years weeding is very true. Management of weeds on an on-going basis is an essential requirement of orchard management. Please, please, please do not let your weeds produce seed. Otherwise, in most weed species cases you will be controlling their progeny for the rest of your life!!

This is even more important now with the development of glyphosate tolerant giant ragweed and Canada fleabane. Glyphosate resistant Canada fleabane, the more common orchard weed of the two has now been found in Chatham-Kent, Elgin, Essex and Lambton counties in Ontario and its spread will continue. Glyphosate resistant Canada fleabane has been found in 14 different countries around the world to date and will be coming to a field near you in the future.

Glyphosate resistant Canada fleabane in glyphosate tolerant soybean field, Essex county. ©Kristen Callow, 2012.

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The Twenty Questions of Crop Diagnosis

Elaine Roddy, Vegetable Crop Specialist, OMAFRA

*Adapted from Hort Matters Volume 12 Issue 26

Diagnostics is one of the most interesting and challenging aspects of crop production. Damage arises from any number of sources, and the symptoms are often remarkably similar. Technologies such as digital cameras, text messages, twitter and email all help to make finding the problem (and a solution) quicker and easier. However, with these technologies, the background information about a crop is not always readily available. This information is often a crucial step in making accurate decisions about management.

Crop symptoms are the obvious place to start. The more information you can gather the better. Try to catch the symptoms early. Look at both the leaves and fruit in several different locations throughout the orchard.

When collecting samples for disease diagnosis, include as much plant material as you can. If a fertility problem is suspected, take soil and tissue samples from both the problem and unaffected areas of the orchard. Unless otherwise specified, keep samples in the fridge or a cool location until they can be delivered to an agronomist or a laboratory.

Use the following list to help narrow down problem areas in your crop. When talking to an consultant, be sure to provide him/her with as much of this information as possible.

Symptoms:

1. What are the symptoms (yellowing, necrosis, spots, insects, reduced vigor)?
2. When did they first appear?
3. Where do they occur on the tree (upper canopy, lower scaffolds, leaves, trunk)?
4. Where do they occur in the orchard? Is there a pattern to the damage, or is it randomly scattered? Is it wide spread, or in an isolated section?

Chemicals:

5. What has been applied to the orchard and when? This includes historical spray data for the previous 2-3 years.
6. Were tank-mixes or other tank additives used and are they compatible?
7. What were the weather conditions at the time of application?
8. What fertilizer products have been used and what was the rate and placement?

Sprayer:

9. When was the sprayer last calibrated and nozzles replaced?
10. When was the last thorough cleaning? What chemicals have been used since then?

Cultivar:

11. Was the nursery stock from a reliable, certified source?
12. What is the cultivar/variety? Are there any specific varietal susceptibilities or tolerances?
13. Was the nursery stock treated? With what?

Planting:

14. What were the weather conditions at the time of planting?
15. What was the planting depth?

Soil:

16. What are the soil and tissue test levels (including macro and micro nutrients)?
17. What is the soil pH? Is this level compatible with any chemicals applied?
18. What is the soil texture and organic matter level? Are these compatible with chemicals applied?
19. Does the soil structure or moisture differ in the affected areas? Is there a hard pan limiting root growth, water movement and aeration?

Environmental:

20. Any unfavorable weather conditions? (excessive heat, cold, dryness, wetness, winds, ozone/air pollution?)

Postharvest

Effects of Preconditioning Temperature and Duration on the Quality of 'Honeycrisp' after Storage

Dr. Jennifer DeEll, Fresh Market Quality Program Lead, Simcoe

As more 'Honeycrisp' trees come into production and more fruit become available, there is a need to store this cultivar longer term. However, there are inherent quality issues with 'Honeycrisp'. For example, it is very prone to chilling injury, soggy breakdown and soft scald development. To control these storage disorders it is common to precondition the fruit prior to cold storage with delayed cooling. Postharvest application of 1-methylcyclopropene (1-MCP, SmartFresh), an inhibitor of ethylene action, has also been shown to reduce certain storage disorders in apples. Therefore, the effects of delayed cooling and SmartFresh on the physical and sensory quality of 'Honeycrisp' after storage were investigated.

'Honeycrisp' apples were harvested in Norfolk County, Ontario on September 16th, 2011. Fruit maturity was measured as: 19.5 ppm internal ethylene, 16.0 lb firmness, 13.1% soluble solids, 771 mg malic acid (per 100 ml of juice), and 6.4 starch index. Apples were transported to the *Apple Research Storage Lab* in Simcoe within 1 hour of harvest and cooled to ~10°C. Half of the apples were then treated with SmartFresh (1 ppm, 1-MCP) overnight for 24 hours. Three bushel boxes of each treated and non-treated fruit were subsequently held for 0, 5, 10, or 20 days at 10°C, 5 or 10 days at 20°C. After the appropriate time, all apples were then held in either air storage at 3°C for 4 and 8 months.

After 4 months of air storage, 'Honeycrisp' treated with SmartFresh had reduced internal ethylene concentration and peel greasiness. All preconditioning treatments, regardless of temperature or duration, substantially reduced the incidence of soft scald (Table 1). However, preconditioning at 20°C was less effective than at 10°C in apples not treated with SmartFresh.

Some bitter pit was observed after 4 months in air storage. Severe sunken dark lesions were also present, but only in apples that were preconditioned and/or treated with SmartFresh (Plate 1). It has been previously suggested that SmartFresh can aggravate the development of bitter pit, resulting in dark brown, large sunken lesions.

The highest amount of storage rots was found with preconditioning at 20°C for 10 days and the incidence was reduced with SmartFresh treatment.

Complementary sensory evaluations were performed at the *Vineland Research and Innovation Centre* (Bowen and Lesschaeve). Following removal from cold storage, the apples used for tasting were held at room temperature for 5 days prior to the sensory evaluations. SmartFresh-treated fruit preconditioned at 20°C for 5 days had higher mean ratings of "crisp texture" than those not treated with SmartFresh and held at 20°C for 10 days or 10°C for 20 days before air storage at 3°C. In addition, apples with no preconditioning (immediate storage at 3°C) and no SmartFresh treatment had higher mean ratings for "chewy texture" than those not treated with SmartFresh and held at 20°C for 5 days.

After 8 months of air storage, 'Honeycrisp' from all treatments had severe peel greasiness and there were little or inconsistent effects of preconditioning and/or SmartFresh on other physical quality attributes (i.e. firmness, soluble solids, acidity).

All preconditioning treatments, regardless of temperature or duration, continued to reduce the incidence of soft scald.

Some bitter pit was observed in fruit from all treatments, with the highest incidence found in non-SmartFresh treated fruit preconditioned for 20 days at 10°C. Severe sunken dark lesions (exacerbated bitter pit) were also observed and SmartFresh tended to increase the incidence.

High amounts of storage rots (up to 17%) were observed, but the incidence was often reduced by SmartFresh.

At this time, sensory evaluations revealed that panellists could detect a difference due to SmartFresh in 'Honeycrisp' apples preconditioned at 20°C for 5 days or 10°C for 10 or 20 days. In further analyses, apples not treated with SmartFresh were described by more intense "oxidized red apple", "earthy", and "honey" flavors and were found generally less intense for "juicy, crisp" textures. Conversely, SmartFresh-treated fruit were rated higher for "fresh green apple" flavour and "acid" taste.

Plate 1: Severe sunken dark lesions (exacerbated bitter pit) in 'Honeycrisp'.

Table 1: Disorders and rots of 'Honeycrisp' apples treated with or without SmartFresh and held at 10°C for 0, 5, 10, or 20 days or at 20°C for 5 or 10 days, followed by 4 months in air storage at 3°C, plus 8 days at ~18°C.

	Soft scald (%)	Soggy breakdown (%)	Bitter pit (%)	Severe bitter pit (%)	Storage rots (%)
No Delay					
No SmFr	53 ^{A}	3 $^{A-C}$	1 ^{BC}	0 ^{C}	3 ^{BC}
+ SmFr	24 ^{B}	1 ^{BC}	1 ^{BC}	4 $^{A-C}$	1 ^{C}
Delay 5 days at 10°C					
No SmFr	5 ^{E}	3 ^{AB}	5 ^{A}	4 $^{A-C}$	6 ^{AB}
+ SmFr	10 $^{C-E}$	4 ^{A}	1 ^{BC}	8 ^{AB}	3 ^{BC}
Delay 10 days at 10°C					
No SmFr	4 ^{E}	0 ^{C}	4 ^{AB}	8 ^{AB}	4 $^{A-C}$
+ SmFr	3 ^{E}	3 $^{A-C}$	1 ^{BC}	9 ^{A}	1 ^{C}
Delay 20 days at 10°C					
No SmFr	4 ^{E}	0 ^{C}	2 $^{A-C}$	6 $^{A-C}$	3 ^{BC}
+ SmFr	5 ^{E}	2 $^{A-C}$	2 $^{A-C}$	7 $^{A-C}$	1 ^{C}
Delay 5 days at 20°C					
No SmFr	17 ^{BC}	0 ^{C}	3 $^{A-C}$	8 ^{AB}	4 ^{BC}
+ SmFr	7 ^{DE}	0 ^{C}	1 ^{BC}	1 ^{BC}	2 ^{BC}
Delay 10 days at 20°C					
No SmFr	14 ^{CD}	0 ^{C}	0 ^{C}	2 ^{BC}	8 ^{A}
+ SmFr	9 ^{DE}	0 ^{C}	0 ^{C}	9 ^{A}	3 ^{BC}
Significance[1]	****	***	*	**	**

[1] Means within the same column with the same letter are not significantly different at P <0.05
*, **, ***, **** = significant at P <0.05, P <0.01, P <0.001 or P <0.0001, respectively.

Food Safety Snippets

On Farm Food Safety: Your Business Advantage
Training Workers on Proper Hand Washing

Hand washing is critical to food safety. This is especially true for horticultural producers who produce food which will be eaten fresh or uncooked. Workers could contaminate food either directly or indirectly if their hands are contaminated. To minimize food safety risks associated with contaminated hands, workers must be trained and practice proper hand washing. Here are the steps for proper hand washing:

- Wet hands with potable water
- Apply soap
- Scrub all hand surfaces, between fingers, under nails and wrists for 20 seconds
- Rinse hands thoroughly with potable water
- Dry hands with a clean paper towel
- Turn off the tap with the paper towel

Ministry of Agriculture, Food and Rural Affairs website at www.ontario.ca/goodagpractices or call us at 1-877-424-1300.

CA Storage Recommendations for Apples - 2012

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In general, the current standard CA recommendations range between 2.5%-3% O_2 and 2.5%-4.5% CO_2 at 0°C-3°C. Due to recent research using new storage technologies and strategies, CA recommendations have been reviewed.

Table 1 below lists CA storage recommendations for commercial apple cultivars in 2012, including storage atmospheres, temperature, and approximate storage-life. Note that not all low oxygen regimes have been tested in combination with SmartFresh treatment.

TABLE 1. Storage Atmospheres, Temperature, and ~ Storage-Life for Commercial Apple Cultivars

Cultivar	Regime	O_2 (%)	CO_2 (%)	Temp (°C)	Storage Life (mo)
Ambrosia	Standard CA	2.5	2.0	0	6-7
	Low Oxygen	1.7	1.0	0-1	6-8
Cortland	Standard CA	2.5	2.5	0	4-6
	Standard CA + SmartFresh[1]	2.5	2.0	2-3	6-8
	Low Oxygen	1.5	1.5	0-3	6-7
Crispin (Mutsu)	Standard CA	2.5	2.5	0	6-8
Delicious	Standard CA	2.5	2.5	0	7-9
	Low Oxygen	0.7-1.5	1.0-1.5	0	8-10
Empire	Standard CA	2.5	2.0	2	5-7
	Standard CA + SmartFresh[1]	2.5	< 0.5 (first 6 weeks) 2.0 (afterward)	2	7
	Standard CA + SmartFresh[1] + DPA[2]	2.5	2.0	2	7
	Low Oxygen	1.5	1.0-1.5	2	6-8
Fuji	Standard CA	2.5	1.0-2.0	0-1	8-10
Gala	Standard CA	2.0-2.5	2.0-2.5	0	5-7
	Standard CA + SmartFresh[1]	2.5	2.0	1-2	6-8
	Low Oxygen	1.5	1.5	0	6-8
Golden Delicious	Standard CA	2.5	2.5	0	5-7
	Low Oxygen	1.5	1.5	0	6-8
Honeycrisp	CA – Not recommended Air Storage	-	-	3–5[3]	2-4
Idared	Standard CA	2.5	2.5	0	7-8
	Low Oxygen	1.5	1.5	0	8-9
Jonagold	Standard CA	2.5	2.0	0	5-7
	Low Oxygen	1.5	1.5	0-1	6-8

(cont. from page 13)

Cultivar	Regime	O_2 (%)	CO_2 (%)	Temp (°C)	Storage Life (mo)
McIntosh	Standard CA	2.5	2.5 (first 6 weeks)	3	5-6
	Standard CA + SmartFresh[1]	2.5	0.5 (first 6 weeks) 4.5 (afterward, gradually)	3	6-8
	Standard CA + SmartFresh[1] + DPA[2]	2.5	2.5 (first 6 weeks) 4.5 (afterward, gradually)	3	6-8
	Low Oxygen	Strain Dependent[4]			
Northern Spy	Standard CA	2.5	2.5	0	7-9
	Standard CA + SmartFresh[1]	2.5	2.0	0	10-11
	Low Oxygen	1.5	1.5	0	9-11
Spartan	Standard CA	2.5	2.5	0	6-7
	Standard CA + SmartFresh[1]	2.5	2.5	0-1	6-8

[1] SmartFresh = 1-methylcyclopropene (1-MCP), an ethylene inhibitor
[2] DPA = diphenylamine
[3] Hold at 10°C for 7 days prior to storage
[4] Some strains (i.e. Marshall) are very susceptible to low oxygen injury

Announcements

Calendar of Events for Apple Growers 2012-13

November 20-21	Essex County Associated Growers Convention, Leamington www.bountyofthecounty.ca OAG District 1 Annual Meeting
December 4-6	Great Lakes Fruit, Vegetable and Farm Market Expo www.glexpo.com
January 6-9	Ontario Fruit and Vegetables Growers Annual Meeting, Niagara Falls www.ofvga.org
January 8	Ontario Apple Growers Annual Meeting, Niagara Falls http://onapples.com/
February 20-21	Ontario Fruit and Vegetable Convention, Niagara Falls www.ofvc.ca Feb 20: Cider Workshop and Competition Feb 21: Apple Day
February 23-28	International Fruit Tree Association, Boston www.ifruittree.org