



# ORCHARD NETWORK

For Commercial Apple Producers

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## Orchard Management

### Apple Trees Get Ready for Winter Cold

*Leslie Huffman, Apple Specialist, OMAFRA, Harrow*

Apple harvest is finally drawing to a close, and orchard and equipment clean-up is in progress. Apple trees are losing their leaves, but a fascinating process is actively underway inside trees to prepare their tissues for the coming winter cold. This process is called **plant cold acclimation**, and the goal is to achieve adequate levels of cold hardiness to avoid winter injury.

Much research has been done on cold hardiness in the past century, and recent advances in understanding this mechanism continue to increase. We now know that there are 3 stages in the acclimation process. The first actually started when shoot growth stopped in early summer, and the tree began to store carbohydrates in branches, roots and fruit buds. So already by this time, trees can tolerate about -21°C (although fruit buds are much less hardy).

*(Continued on page 2)*

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

*(Continued from page 1)*

Although leafless trees appear dormant, the second stage of cold acclimation is now underway. Cells are actively exporting water through their cell walls into the intracellular space. Each cold event encourages more water export, which will reach its maximum level by mid-January.

If water remains in the cells, the crystals that form on freezing destroy important structures and cell walls, so contents can leak out and the cells will die. But for cells that have dehydrated themselves by exporting their water content, all the crystals form outside the cells and cause less or no damage.

After mid-January, cells will begin to rehydrate as temperatures warm, but if cold temperatures return, the process will reverse. So the third stage can actually be like a yo-yo effect within trees.

Although warm temperatures have been pleasant this November, if they continue, the trees will not increase in hardiness, and sudden drops in temperature that are common in December can cause severe damage. Also, cold during November and December will better prepare trees for the inevitable severe cold that often occurs in January.

So what's my weather wish? Gradually cooling temperatures throughout the fall, moderate uniform cold by Christmas, continuing until March, with a gentle snow fall to cover the ground evenly to protect roots with no thawing until spring. It's not likely to happen just like this, but at least as you bundle up for the coming cold, remember that it's helping fruit trees survive the winter ready to produce another good crop next year.

## **New Apple Cultivar Development - News from the Pacific Agri-Food Research Centre, Summerland**

*Dr. John Cline, University of Guelph, Simcoe;*

*Dr. Cheryl Hampson, Agriculture and Agri-Food Canada, Summerland, BC*

Global yearly production of major apple cultivars combined with consolidation of buyers and marketers, and stagnant per capita consumption has resulted in the weakening of apple prices. Currently, Canada is ranked approximately 25<sup>th</sup> among apple producing nations, similar to New Zealand and The Netherlands, accounting for less than 1% of the total 60 million MT annual global supply (FAO 2007). The United States, ranked 2<sup>nd</sup> next to China in world production, produces ten times Canada's volume. The U.S. accounts for over 50% of the Canadian market share. Fortunately, only 10% of world apple production enters international fresh apple trade and only a handful of countries engage in long-distance export (O'Rourke 2009). The leading fresh apple exporting countries are China, France, the United States, Chile, Italy, New Zealand and South Africa.

The apple industry is in a state of constant change as producers adjust to declining prices and increasing production costs. However, over the past decade, a cascade of new events has increased the complexity of the apple business profoundly. These include issues concerning food safety and traceability, organic versus conventional production, the "Buy Local Food", high fuel, electricity, fertilizer and pesticide costs, unprecedented labour cost increases, and climate change concerns.

Apple producers in many Western regions have been considering factors that might renew profitability. One solution often discussed is the creation of new cultivars. McIntosh, Delicious, Empire, Northern Spy, Golden Delicious, Gala and Spartan remain the most widely planted cultivars in Canada (Statistics Canada).

*(Continued on page 3)*

Recent statistics reveal a different trend in new orchards. The dynamics of new cultivar development and introductions is now also complicated by breeders restricting the testing, distribution, and production of new cultivars to control distribution and prevent overplanting. While there will always be demand for the local favourite apples, such as the chance seedling McIntosh, many of the new mainstay cultivars have been developed from breeding programs. New cultivars often command a premium price, but price declines as production increases. For example growers currently wonder if this will happen with Honeycrisp.

The development of new cultivars is a very lengthy process, often taking more than 15 years from initial cross to commercialization. Currently in North America there are apple breeding programs in British Columbia, New York, Ohio, Minnesota, and Washington State, with varying degrees of success. Many Ontario growers are aware that Canada has a nationally funded research program at AAFC-Summerland whose mandate is to develop high quality, adaptable, disease-resistant apple cultivars for Canada. This is achieved, in part, by taste panel evaluation to ensure selections are crisp, juicy, and firm and have good flavour. Some are tart and some are sweet. No specific type of appearance is targeted, but the fruit must be of reasonable size, attractive, not misshapen, etc. Storage length expected varies with picking date. Some crosses are devoted specifically to resistance to apple scab and all cultivars are expected to show some degree of resistance to powdery mildew and fire blight, but they are not rejected if they fail to show complete immunity to these diseases. The trees should be precocious, regular bearing, and high yielding, with a growth habit that is "grower friendly". The fruit must not be subject to bitter pit or storage disorders. Tree winter hardiness is also taken into consideration. Currently there are over 500 apple selections in advanced stages of testing. A rotating population of about 30,000 seedlings is in the ground at any given time

The Okanagan Plant Improvement Corporation (PICO), which recently has formed closer links with the Ontario Apple Growers and the Réseau d'essai de cultivars et de porte-greffes de pommiers du Québec, has partnered with AAFC to commercialize their new apple selections. PICO has a "Canada First" policy that provides Canadian growers with preferential access to new tree fruit cultivars developed at AAFC-Summerland. International licensing of these cultivars in the northern hemisphere is often delayed for several years to provide Canadian growers an edge in establishing domestic and international markets. Canadian growers generally pay one-time per-tree royalties, whereas international licensees of club varieties may be required to pay up-front license fees, planting and/or acreage fees, production based royalties on fruit sold, in addition to tree royalties. Another feature of the *Canada First* policy is that international licensees of club varieties in the northern hemisphere are prevented from selling their fruit in Canada for the life of their agreements.\*

New cultivars such as Honeycrisp, Ambrosia, and Pink Lady, by themselves, are not the solution to provide renewed profitability to the apple industry. While these provide niche market opportunities for some producers, some of these cultivars are more expensive to produce and are still being wholesaled at prices that do not provide the margins required to cover the high initial input and annual production costs. Scientific and grower evaluation of selections from breeding programs, most notably AAFC-Summerland, is a worthwhile endeavour for the Ontario industry to determine the suitability and performance in Ontario

growing and market conditions.

\*PICO organizes the on-farm testing and has certified virus-free bud wood as soon as it is available. PICO does not sell trees, but they license nurseries, who make and sell trees. Contact Ken Haddrell ([Ken.Haddrell@picocorp.com](mailto:Ken.Haddrell@picocorp.com), or 250-494-5164)



**Figure 1. 2009 Golden Delicious harvest from research plots, Summerland, BC Recent introductions such as Aurora Golden Gala Have Been gaining popularity in BC and Ontario**



**Figure 2. The Pacific Agri-Food Research Centre, Summerland has 4 ha dedicated to apple breeding. Currently there are over 30, 000 seedlings under evaluation and 500 advanced selections to draw up for the third and final stage of testing.**



**Figure 3. Pacific Agri-Food Research Centre, Summerland, BC**

John Cline is currently on sabbatical leave at the Pacific Agri-Food Research Centre, AAFC, Summerland where he is interacting with scientists on tree fruit research projects and learning about the BC tree fruit industry.

## Winter hardiness starts long before the snow flies

*Christoph Kessel, Horticulture Crop Nutrition, OMAFRA, Guelph*

For apple trees, winter hardiness is the ability to avoid cold injury in fall, winter and early spring. A tree develops its winter hardiness gradually during the shorter days and cooler temperatures of late summer and fall. Cold temperature damage can occur in late fall or early winter when hardening off is delayed. An apple tree's winter hardiness is built on many interconnected factors: its nutrition, orchard management, cultivar, rootstock and weather.

1. Maintain adequate supplies of essential crop nutrients.

Carbohydrates are a key component in winter hardiness. While not directly a nutrient, they are produced by photosynthesis using sunlight, carbon dioxide and water. This takes place in the leaf. Maintaining a healthy leaf canopy is crucial to producing adequate carbohydrates. Any cog missing or compromised in the photosynthetic wheel reduces carbohydrate production, affecting winter hardiness. These include insect, mite or disease damaged leaves, or nutrient deficient leaves. Nitrogen, potassium, magnesium, zinc, copper, manganese and boron have a direct or indirect role in photosynthesis and physiological processes. A deficiency in one of these nutrients can affect carbohydrate production and translocation, in turn reducing winter hardiness.

Manage and monitor the orchard's nutrient status by regularly using leaf and soil analysis. Keep a record of the analyses to track trends and use them to assist you in making future fertilizer management decisions.

If the leaf and soil analyses report nutrients within the sufficiency range, adequate for plant growth, supplying more will not improve winter hardiness. The greatest gains are made by adding the required deficient nutrients.

2. Adjust nitrogen fertilizers according to orchard management practices.

Not enough or excessive nitrogen can affect winter hardiness. Nitrogen deficient trees will stop growing sooner and harden off earlier than adequately supplied trees. But, they are also more susceptible to the mid-winter cold damage. Trees grown with excessive nitrogen harden off late in the fall. This makes them vulnerable to cold injury.

While there is little that can be done at this time of the year, plan to adjust next year's nitrogen applications to accommodate orchard management practices. Fertilizer nitrogen rates should be reduced to account for nitrogen from organic soil amendments applied to the orchard or if the orchard is heavily pruned in the spring.

## Putting New Life into Old Orchard Soils!

*Anne Verhallen, Soil Management Specialist (Hort), OMAFRA, Ridgetown*

Orchard removal offers a real opportunity for soil improvement, whether the land is going directly back to trees or will be used in the production of other crops.

Long term crops like orchards already have a couple of points in their favour where good soil health is concerned. Soils that are undisturbed by annual tillage generally build organic matter levels near the soil surface, particularly if they are mulched. Soil structure becomes more stable, and earthworm populations often increase. These factors help to increase air and water drainage within the soil.

On the flip side though, orchard soils do have some challenges maintaining soil health. Traffic patterns for spraying, mowing and harvesting are fixed, leading to ruts and areas of tightly compacted soils. Fortunately, these are outside the drip line of the trees, and seldom cause problems in producing orchards. However, a new planting density may land a tree row directly onto a compacted zone. Soil pH can also shift over the time in orchard production, especially as permanent sod does not lend itself to lime application.

As you plan for new production, it is important to take the opportunity to create the best soil environment for the roots of the new planting. Root systems are the basis for the overall productivity of your crop. A healthy soil is a critical part.

What exactly is "soil health?" Basically soil health, refers to how well the soil performs all the functions we expect of it – storing and providing water to the crop, providing drainage, keeping roots well aerated, cycling of nutrients and maintaining a structure that allows the crop roots to fully take advantage of the whole soil profile for water, nutrients and crop support.

Soil testing is a good place to start to assess overall soil health. Take a look at nutrient levels like phosphorus and potassium. Notice if soil pH needs adjusting, because lime applications usually require at least one full year to raise the soil pH to adequate levels. Request that soil organic matter level be tested. Organic matter directly influences soil structure – how well the soil drains, holds water and allows root expansion. On a degraded sandy loam, increasing soil organic matter by half a percent can increase the nutrient-holding ability by 15% and the water-holding ability by 12%. This is particularly important on irrigated soils.

You can build organic matter by adding compost or manure, however be aware of the nutrients that you are applying at the same time. Here are some targets for soil

organic matter levels based on AAFC research:

| Soil Type           | Average Clay Content | Optimum Organic Matter* |
|---------------------|----------------------|-------------------------|
| Sands & sandy soils | 10%                  | 3%                      |
| Loamy soils         | 20%                  | 4%                      |
| Clay loam soils     | 40%                  | 7%                      |
| Clay soils          | 50%                  | 9%                      |

\* Optimum Organic Matter for maximum stability

If your soil test shows organic matter levels lower than these optimums, add more residues by growing cover crops, rotating out to forages or grain crops for a few years. Organic materials like straw can also be added to increase residues and ultimately build organic matter. These efforts will be reflected in your soil's health and ultimately in the health of your future crops.

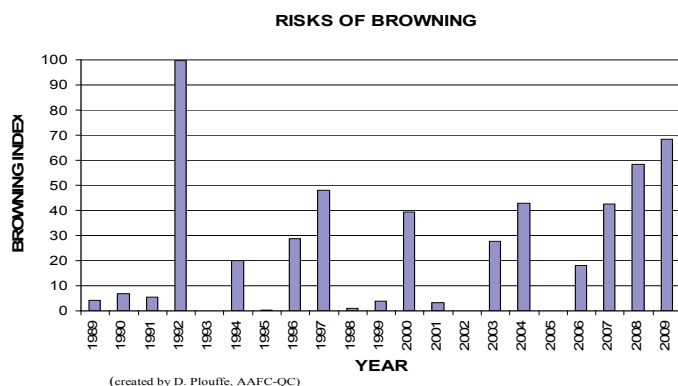
## Postharvest

### High Risk of Chilling Disorders for 2009-10 Storage Season

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

CIPRA is a computer-based program (developed by the research team of Dr. Bourgeois, AAFC-QC) that can use weather data to predict the risk susceptibility of apples to certain storage disorders (Bourgeois, DeEll, and Plouffe). According to CIPRA (utilizing weather data in July and August from Norfolk County), the risk for low-temperature or chilling-related disorders in apples during the 2009-10 storage season is extremely high.

The figure below shows the results from 1988 to 2009 using weather data from Norfolk County in Ontario. The model indicates that there is a **69% risk of chilling-related disorders developing during storage this year** (i.e. flesh browning, low temperature breakdown, soft scald). This is the second highest risk index during the 21 years noted and it is primarily due to colder than normal temperatures and higher than average rainfall during the summer.



As such, it would be wise to watch your apples closely this year. Take samples from storage whenever possible and check for chilling-related disorders. In addition, be sure to use the recommended storage temperatures for all cultivars. 'Empire', 'McIntosh', and 'Honeycrisp' will be especially susceptible.

### Soft Scald in Relation to Preharvest Precipitation and Soluble Solids Content in "Honeycrisp"

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

*The following summary is adapted from the recently published scientific paper – Moran, R.E., J.R. DeEll, and W. Halteman. 2009. Effects of preharvest precipitation, air temperature, and humidity on the occurrence of soft scald in 'Honeycrisp' apples. HortScience 44:1645-1647.*

The overall objective of this study was to evaluate the influence of preharvest environmental variation in temperature and precipitation on the occurrence of soft scald in 'Honeycrisp' apples. The relationship of soft scald incidence with precipitation, temperature, and fruit maturity indicators in 'Honeycrisp' apples was examined using 6 years of data in Ontario and 7 years of data in Maine.

Soft scald incidence was highly variable from year to year, ranging from 0% to 76% in Ontario and from 1% to 85% in Maine.

Stepwise regression analyses of the Ontario data identified two variables that explained a significant portion of the variability in soft scald incidence. Soluble solids concentration ( $^{\circ}$ Brix) at harvest (partial  $r^2 = 0.50$ ;  $P = 0.0041$ ) and precipitation during 90 to 120 days from bloom (partial  $r^2 = 0.28$ ;  $P = 0.0344$ ) were negatively related to soft scald incidence in Ontario-grown 'Honeycrisp'.

Analyses of the Maine data also identified two variables that explained a significant portion of variability in soft scald incidence. Precipitation during 90 to 120 days from bloom (partial  $r^2 = 0.53$ ;  $P = 0.0001$ ) and maximum air temperature during 60 to 90 days from bloom (partial  $r^2 = 0.21$ ;  $P = 0.0001$ ) were negatively related to soft scald incidence in 'Honeycrisp' from Maine.

In conclusion, higher precipitation during 90 to 120 days from bloom was associated with lower soft scald incidence in both Ontario and Maine. Higher soluble solids contents at harvest and higher maximum air temperature during 60 to 90 days from bloom were also associated with lower soft scald incidence in Ontario and Maine, respectively.

## Crop Protection

### Apple Scab in Ontario Orchards 2009

*Kathryn Carter, Pome Fruit IPM Specialist,  
OMAFRA, Simcoe*

In June 2009, problems with apple scab on fruit in Ontario orchards were reported by growers, scouts and consultants. OMAFRA began a grower survey focusing on orchards with scab problems. Over 63 orchards across the province were visited to assess occurrence and severity of apple scab infections. Assessments were conducted from the end of July through late September.

In each orchard, 500 fruit (25 fruit from 20 trees) were assessed, and 10 terminals (base, middle, or tip of terminal) on 10 trees were inspected for the presence of scab. The survey revealed that the level of scab between orchards was quite variable, with neighbouring orchards showing very high, or very little scab (see Fig. 1).

Scab was an issue in each of the 5 apple growing districts, however the Haldimand/Norfolk, and Essex/Kent areas reported the greatest amount of damage. In general, scab was present in more orchards than we have ever seen before, and in many cases at greater severity than we have ever seen before, despite the repeated applications of fungicides.

#### Fruit scab

Some varieties were reported to have more scab than others (Red Delicious, McIntosh, Gala, Empire, Cortland). Some growers felt trees hit hardest by frost had the worst scab damage.

The preliminary results of the survey showed that over half of the orchards studied had greater than 11% fruit scab in the blocks surveyed.

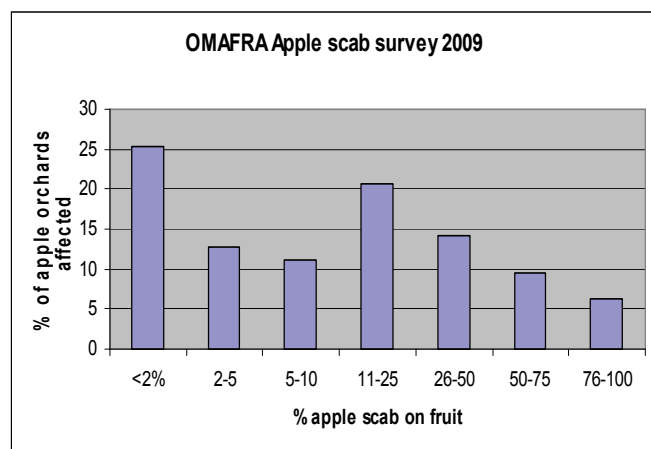


Figure 1 Results of OMAFRA Apple Scab Survey 2009(n=63 orchards)

#### Leaf scab

Many fruit cluster leaves were infected with apple scab, as well as the leaves at the base of the new growth. This indicates that the infections likely occurred early in the season. Generally there was less scab on terminal leaves, which suggests that as the season progressed growers were better able to manage the scab in their orchards.

#### Grower survey

OMAFRA is conducting a grower survey to attempt to get a better understanding of the potential causes of the high levels of scab. We would like all growers to fill out a survey (see attached form) and fax/email it into OMAFRA at 519-428-1142 or [kathryn.carter@ontario.ca](mailto:kathryn.carter@ontario.ca). Please send in your surveys by December 15, 2009 and include your spray records if possible. All information will remain confidential.

*More information on the survey results, and tips on managing scab will be presented at the Apple Scab Workshop at the OFVC at Brock University on February 24, 2010. For more information see <http://www.ofvc.ca/>.*

# Ontario Grower Survey: Apple Scab 2009

**Grower Name (optional):**

**Location:**

(This information will be kept confidential and not be shared outside OMAFRA)

1. Did you have apple scab in your orchard in: 2007? \_\_\_\_\_  
2008? \_\_\_\_\_  
2009? \_\_\_\_\_
2. How many acres of apples do you have in total? \_\_\_\_\_
3. How many acres of apples are affected by scab: on fruit \_\_\_\_\_  
on leaves \_\_\_\_\_

| Variety    | Tree age | scab present |          | % fruit affected |
|------------|----------|--------------|----------|------------------|
|            |          | on leaves    | on fruit |                  |
| Empire     |          |              |          |                  |
| McIntosh   |          |              |          |                  |
| Gala       |          |              |          |                  |
| Gingergold |          |              |          |                  |
| Ambrosia   |          |              |          |                  |
| Red Del.   |          |              |          |                  |
| Other:     |          |              |          |                  |
| Other:     |          |              |          |                  |

4. How many fungicides were applied in your orchard : in 2007 \_\_\_\_\_ 2008 \_\_\_\_\_ 2009 \_\_\_\_\_
5. Did you hand thin scabbed fruit in your orchard ?
6. What water volume did you use in your orchard:
  - a. early in the season \_\_\_\_\_
  - b. Later in the season \_\_\_\_\_
  - c. Do you spray every row \_\_\_\_\_ or alternate row \_\_\_\_\_?
7. Where alternate row spraying is used:
  - How many weeks do you perform alternate row spraying? \_\_\_\_\_
  - Do you return to apply on alternate alleyways afterwards? \_\_\_\_\_
  - Do you apply the full rate or a 50% rate? \_\_\_\_\_
8. When did you apply the last fungicide in 2008 and what fungicide was used in that last spray? \_\_\_\_\_
9. When did you apply the first fungicide in 2009? \_\_\_\_\_
10. What is your driving speed during spraying in km/hr?? \_\_\_\_\_
11. When was the last time you replaced your nozzles? \_\_\_\_\_
12. Would you be willing to provide your spray records to the OMAFRA apple team (all records will remain confidential) to determine why scab was such a problem this year? \_\_\_\_\_

If yes, please email spray records to [kathryn.carter@ontario.ca](mailto:kathryn.carter@ontario.ca) or fax to Kathryn Carter at 519-428-1142.  
Electronic copy of this survey are available by contacting Kathryn (see above) or call her at 519-426-4322.

Thanks for taking the time to help with this—it is greatly appreciated!

## Dealing with Apple Scab in 2010

Kathryn Carter, Pome Fruit IPM Specialist, OMAFRA, Simcoe

Fruit damage from apple scab was high in many Ontario orchards in 2009, and many growers are looking at improving their scab management programs in 2010. Economic losses to apple scab generally occur when the following three factors occur:

- high levels of inoculum in leaf litter
- weather conditions favourable for scab development between green tip and bloom
- inadequate fungicide protection during this time.

### Inoculum

Growers have little control over weather conditions, but they can reduce inoculum, and ensure adequate fungicide protection. Research has shown that reducing ascospores in orchards by 90% will reduce the number of apple scab lesions by 90%. The need for a good fungicide program remains, but reducing inoculum allows fungicides to work more effectively as well as reduce the rate of resistance development. There are several methods to reduce inoculum in orchards:

- Applying urea to the orchard floor:** Apply 45 kg of agricultural urea per 1000 L of water/ha to the orchard floor after 95% leaf drop (November) or in the spring (April) before bud break to reduce the number of ascospores. The urea works in two ways: it directly inhibits the development of ascospores, and it stimulates the growth of naturally occurring organisms that are antagonistic against *V. inaequalis*. In most years, the spring treatment is more effective and results in fewer leaf and fruit infections. If snow cover remains until bud break, it will reduce the time for the urea to work, which reduces the effectiveness. Keep this application of urea in mind when calculating your N budget. In orchards requiring effectiveness of the treatment, lower rates of urea, a fall application may be preferred, to reduce the impact of the N. Previous research by McSmith Agricultural Research Services (W. McFadden-Smith) determined that the fall application of urea does not have a negative impact on winter hardiness or on fruitfulness for subsequent years.
- Shredding overwintering leaves:** Rake or blow leaves from under trees and shred them using a flail mower to encourage leaf decay. Spring mowing may also re-orient the leaves to prevent the fungus from effectively discharging spores.

### Weather conditions

Growers can't do much to improve weather conditions to prevent scab infections, but accurate monitoring and recording of weather can help growers predict infection periods and time fungicide sprays effectively. Weather records are an important step in your scab management program. Note the

weather conditions during each spray application, including temperature, wind speed and direction, and drying conditions to help assess spray coverage and effectiveness.

### Calculating infection periods

For scabby orchards in 2009, count the hours of leaf wetness regardless of the time of day when the wetting period started. In low inoculum (scab-free) orchards, do not count hours of leaf wetness if the rain begins after sunset. For secondary infections (when scab is present) count the periods of leaf wetness regardless of the time that rain begins.

### Timing of fungicides

Always apply fungicides preventatively, where possible: do not wait until after an infection has occurred to spray. Do not apply fungicides as eradicants. Once scab is present in the orchard, it is better to keep the crop protected from further infections using protectant sprays, rather than trying to burn out lesions (which may promote fungicide resistance). Follow the fungicide resistance management strategy, found in the new Publication 360, Fruit Production Recommendations (available in March 2010).

### Ensuring adequate coverage

Ensuring timely and adequate fungicide applications is another important component of managing apple scab. With the high scab pressure from 2009 lingering in overwintering leaves in orchards, fungicides should be applied before the first infection period occurs after green tip.

It is safest to avoid alternate row spraying, regardless of the time of year. Alternate row spraying generally results in sub-lethal fungicide doses and increases the chance of developing resistance to some fungicides. There will be more information on the risks associated with alternate row spraying, at the Apple Session on February 25, 2010 at the OFVC at Brock University.

For the best coverage, calibrate sprayers at the beginning and again in mid-season. This includes making changes due to increased tree size and leaf density. Plan for enough sprayers to adequately cover your orchards; as a rule of thumb one sprayer should cover 20 hectares. Drive between 4 and 6 kph and avoid spraying in still, windy, or changeable weather conditions.

### Choosing fungicides

Researchers in New York recommend using tank mixes of captan and mancozeb since this combination redistributes well, regardless of the type of rain event (heavy rain or mist).

**For more information:** An Apple Scab Workshop is planned at the Ontario Fruit and Vegetable Convention on Wednesday, February 24, 2010 at Brock University. Information on the workshop can be found at <http://www.ofvc.ca/>.

# Monitoring Codling Moth for Insecticide Resistance in South-western Ontario Apple Orchards

Kristy Grigg, University of Guelph

Codling moth, *Cydia pomonella* L. (CM) is a major pest of apples throughout the world<sup>1</sup>. In recent years, CM damage has been increasing in Ontario apple orchards<sup>2</sup>. With higher than normal levels of CM damage not attributable to timing or coverage of insecticide sprays, Ontario growers are concerned that CM populations are developing resistance to organophosphorus (OP) insecticides. Decreased efficacy of these insecticides has been documented in the primary apple producing regions of Europe, South Africa, South America and the United States<sup>1</sup>. Of increasing concern is research indicating cross resistance between OP insecticides and alternative registered products (i.e., insect growth regulators and neonicotinoid insecticides), leaving growers with limited options for resistance management<sup>1,2</sup>. It is critical to determine if OP resistance is present in Ontario. Growers need to be aware of the status of resistance and, if resistance is identified, alternative strategies must be developed for managing this pest.

During the 2009 season, surveys were conducted to determine the efficacy of the present integrated pest management strategies for CM in Ontario apple orchards. The objectives of this research were to determine if Ontario CM remain susceptible to OP (Guthion) and neonicotinoid (Calypso) insecticides.

Adult male CM were collected daily from orchards in Essex and Norfolk Counties during June and August 2009 flight periods using pheromone-baited delta traps. Moths collected from an abandoned orchard and minimal-spray orchard in Essex and Norfolk, respectively, were used as insecticide-susceptible control strains. The active ingredients (technical grade >95% purity) of Guthion and Calypso were applied in direct contact bioassays with baseline discriminatory doses predetermined by that which caused 95% mortality in an insecticide-susceptible laboratory strain. Both products caused less mortality in most orchard strains compared to the field insecticide-susceptible strains (Fig. 1 & 2); however, Guthion was generally more toxic than Calypso. Moth mortality was also generally less in June versus August flight periods with both products.

Further studies are being conducted at the University of Guelph and Agriculture & Agri-Food Canada with CM larvae to confirm above results, as well as test for susceptibility to newly registered products, including insect growth regulators (Intrepid and Rimon), rynaxypyr (Altacor) and spinetoram (Delegate).

Funding and technical assistance for this project is provided by Ontario Apple Growers, NSERC, Agriculture & Agri-Food Canada and OMAFRA. The researchers gratefully acknowledge the apple growers in Essex and Norfolk Counties for allowing the use of their orchards.

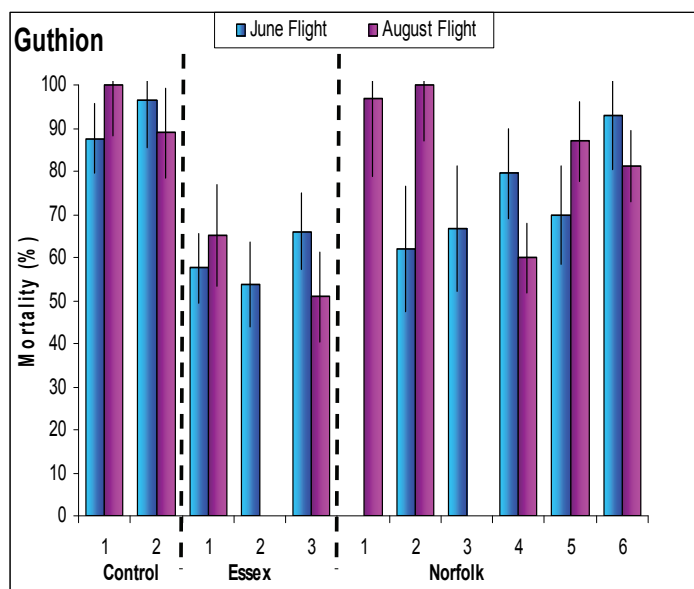


Fig. 1. Percent mortality at 48 h after Guthion treatment (250 ppm, a.i. azinphosmethyl) for male codling moth during June and August 2009 flight periods, Essex and Norfolk County.

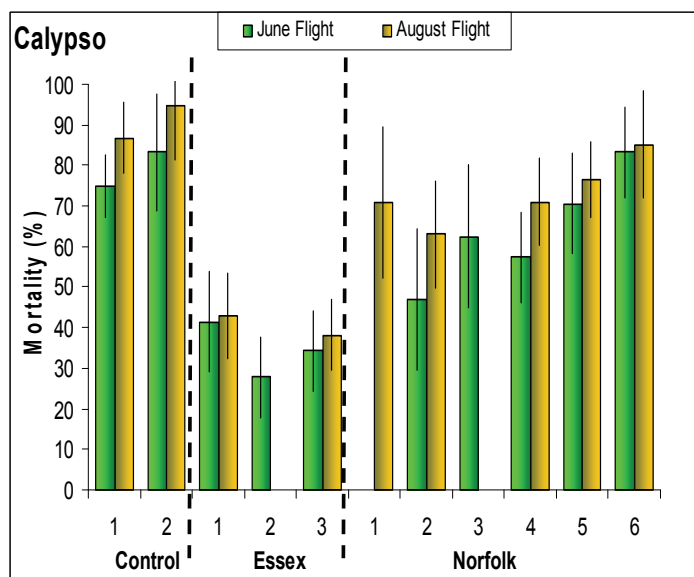


Fig. 2. Percent mortality at 48 h after Calypso treatment (250 ppm, a.i. thiacloprid) for male codling moth during June and August 2009 flight periods, Essex and Norfolk County.

For more information, please contact Kristy Grigg, University of Guelph ([kgrigg@uoguelph.ca](mailto:kgrigg@uoguelph.ca)) or Ian Scott, Agriculture & Agri-Food Canada ([ian.scott@agr.gc.ca](mailto:ian.scott@agr.gc.ca)).

<sup>1</sup> Mota-Sanchez, D., Wise, J.C., Vander Poppen, R., Gut, L.J. & Hollingworth, R.M. 2008. Pest Manag. Sci. 64: 881-890.

<sup>2</sup> Carter, K. & Fraser, H. 2006. Ontario Ministry of Agriculture, Food and Rural Affairs, Toronto. [www.omafr.gov.on.ca/english/crops/hort/news/hortmatt/2006/02hrt06.pdf](http://www.omafr.gov.on.ca/english/crops/hort/news/hortmatt/2006/02hrt06.pdf)

## Blossom End Rot of Apples

Margaret Appleby, IPM Specialist, OMAFRA, Brighton

Although apple scab was the major concern on apple fruit this year, harvest assessments also showed problems with blossom end rot, or calyx end rot. In the past, this damage has been reported occasionally, but recently has become a key factor in fruit out-of-grade for McIntosh and Empire in some orchards.

Blossom end rot, or calyx end rot, can be caused by three different fungi:

*Sclerotinia sclerotiorum* (the cause of white mold on beans)

*Botrytis cinerea* (the gray mold fungus)

*Botryosphaeria obtusa* (the black rot fungus).

Taking samples for lab diagnosis is the best way to determine the causal fungus, but characteristic symptoms are also helpful to determine the offending fungi.

When blossom end rot is caused by *B. obtusa*, symptoms usually develop only as fruit ripens in autumn, although sepal infections occurred earlier. Symptoms of blossom end rot caused by the other pathogens appear earlier during summer.

Blossom end rot, caused by *B. cinerea*, is sometimes called "dry eye rot" and is not common. The disease develops when *B. cinerea* colonizes dying petals, moves into sepals and eventually into fruit. *Botrytis* infections in sepals may remain quiescent until storage and then develop into fruit decays.

More commonly is calyx end rot caused by *S. sclerotiorum*. Calyx end rot lesions often grow to 1/4 to 1/2" diameter before dying out. Infected fruit appear normal at harvest, except for the dry lesion on the calyx. Sometimes, however, apples with calyx end rot color prematurely and drop from the tree before harvest.

Not much research has been done on the biology and management of *S. sclerotiorum* on apples, but we know about managing this fungus in other crops. The fungus survives in sclerotia (black pebble-like resting structures) in a wide range of broad-leaved plants. In spring, the sclerotia germinate and produce wind-dispersed ascospores that germinate and grow on senescing flower petals and then invade the plant tissues.

Reducing the presence of broad-leaved plants in the orchard ground cover with 2,4-D applications may help to reduce the inoculum. Leaving the orchard cover long in the early part of the season may also capture wind-dispersed spores before

they reach the blossoms and newly formed fruit. Little is known about how fungicide programs may affect calyx end rot, so the OMAFRA apple team will be investigating management strategies to try to reduce the increasing grade-out problem from blossom end rots.

Adapted from an article by Dr. David Rosenberger, Scaffolds, May 9, 2005.

## Announcements

### Dates to Remember for Apple Growers

**Great Lakes Fruit, Vegetable and Farm Market Expo** [www.glexpo.com](http://www.glexpo.com)

Grand Rapids, MI (Roger Brook, 517-281-9370

[brookr@glexpo.com](mailto:brookr@glexpo.com))

**Dec. 8-10, 2009**

**Ontario Fruit & Vegetable Growers Association Convention** [www.ofvga.org](http://www.ofvga.org)

Niagara Falls (Deanna Hutton 519-763-6160-ext 116)

**Jan. 11-13, 2010**

**Empire State Fruit & Vegetable Expo**

[www.nysaes.cornell.edu/hort/expo/](http://www.nysaes.cornell.edu/hort/expo/)

Syracuse, N.Y. (Lindy Kubecka 315-687-5734)

**Jan. 27-29, 2010**

**Ontario Fruit & Vegetable Convention**

[www.ofvc.ca](http://www.ofvc.ca)

St. Catharines, ON (Glenna Carnie 905-688-0990)

**Feb. 24-25, 2010**

**Apple Scab Workshop,  
Apple Program,**

**Wed. Feb. 24  
Thurs. Feb. 25**

**International Fruit Tree Association**

<http://ifruittree.org/>

Grand Rapids, Michigan

**Feb. 28-Mar. 3, 2010**



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**Northern Ontario Regional Office: 1-800-461-6132**

**[www.ontario.ca/omafr](http://www.ontario.ca/omafr)**