



ORCHARD NETWORK

For Commercial Apple Producers

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ORCHARD MANAGEMENT

Orchard Network to Go Electronic

John Gardner, Apple Specialist, OMAF, London

In having a discussion with a group of growers earlier this year, none were surprised to learn that we have to go to an electronic format with web posting from now on. Printing this newsletter letter has become cost prohibitive.

Therefore, this will be the last hard copy mailed to you as a reader of the newsletter. To get started electronically, you will have to go to our website and "sign up" as a subscriber to the newsletter. Once a new issue is published, as a subscriber you will be notified by e-mail. The bulk of the newsletters done now by OMAF follow this format.

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**This Newsletter is brought to you by
the Ontario Apple Team:**

John Gardner, Chair, London
ONNL Editor
Apple Specialist
☎ (519) 873-4084

Dr. Jennifer DeEll, Simcoe
ONNL Associate Editor
Fresh Market Quality Program Lead
☎ (519) 426-1408

Dr. John Cline
University of Guelph, Simcoe
☎ (519) 426-7127, ext. 331

John Henderson, Brighton
Risk Management Specialist
☎ (613) 475-5175

Kathryn Carter, Simcoe
Pome Fruit IPM Specialist
☎ (519) 426-4322

Leslie Huffman, Harrow
Weed Management, Horticultural
Crops, Program Lead
☎ (519) 738-2251, ext. 499

Margaret Appleby, Brighton
IPM systems Specialist
☎ (613) 475-5850

Michael Celetti, Guelph
Plant Pathologist, Horticultural Crops
Program Lead
☎ (519) 824-4120 ext. 58910

For complete list of Crop Technology
Staff with OMAF, visit the OMAF
website at:
<http://www.gov.on.ca/OMAF/english/crops/resource/stafcrop.htm>

OMAF Contact Call Centre, Guelph
☎ 1-877-424-1300

This issue of the **Orchard Network
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Client Service Representatives,
Marian Desjardine, OMAF, London and
Leslie Parks, OMAF, Simcoe.

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I am also asking you to fill out a readership questionnaire that includes your e-mail/fax contact information as well as a mailing address. I do understand that not everybody will have e-mail capability. I do not want to loose anyone who depends on this letter for information.

Impressions from a Recent Trip to Europe

Rob VanDiepen, Grower, Nurseryman, Warwick, ON

Having had the opportunity to attend the IDFTA Conference in the mountainous region of South Tyrol, Italy, I was invited to share some impressions I had with readers of the Orchard Network. I traveled with my dad, John, for the entire trip.

First on our agenda was the Fruchtwelt Bodensee, a fruit grower oriented farm show. The Fruchtwelt is held every two years in Friedrichshafen and is the largest show geared to the fruit industry in Europe. Windfall harvesters, grading lines, hail and rain covers, apple varieties and nursery stock were some of the things on display. One of the types of displays that stood out was the large booths dedicated to one or two apple varieties. Some of the busiest booths were for nursery stock. This was a very informative show enjoyed by several thousand people.

A lot of information was shared at the IDFTA Conference. We had two days of speakers and two days of tours. Topics discussed included the ideal nursery tree, balance of growth and cropping, irrigation, fertilization, new varieties and variety performance reviews were some of the things discussed from local and international areas.

On the IDFTA tour of the Bodensee area, we were informed that one site was once a lake and therefore the soils were highly suited for fruit crops. The average orchard is 3-5 ha, all grown slender spindle. Ninety percent is grown on M9 rootstock (see figure 1). Golden, Gala, Braeburn, and Fuji are the most important varieties, with Red Delicious increasing in acreage. The average production for 2003 was 50T/ha. There are 8000 growers in the area, producing 900,000T, with 85% being marketed through 32 co-ops.

Some things we paid special attention to were the number of new varieties/strains being discussed at the trade show and conference. At the research station, we saw a piece of

equipment that measures pressure, brix, internal breakdown, etc., that could soon be integrated into grading lines.

Also, one display showed how long it takes to get a new variety to research testing. One of our lasting impressions was how well, and closely, all groups of the industry worked together to produce a high quality product for the consumer.



Figure 1 - Golden Delicious on M9 grown and trained as a tall spindle, Bodensee District, Italy. Photo by Rob VanDiepen.

Spiral Tree Guards – Watch Out!

J. Gardner, Apple Specialist, OMAF

Tree guards can be left in place too long. The task of removing spiral tree guards once trees are established could be well worth the effort.

Guards are normally installed when trees are planted to make sure they get off to a good start. Once in place, they form a protective barrier from various types of potential injury problems to the lower trunk. The most obvious is protection from rodents and rabbit feeding but also from various treatments that are applied to control vegetation around the base of the tree.

After 2 or 3 years, trees typically gain enough girth to make that once loose fitting guard pretty snug. Snug enough that the immediate microenvironment just under the bark is totally altered for the worst in some cases. Amongst other things, insect pests can hide under there, the bark can fail to mature on an annual basis because it's not exposed to the elements, and this is where the trouble starts.

Below is a picture taken in mid-May of the resulting failure to remove one of these guards after it has done its job in the first years of the trees' life. This tree is basically dead and on its way out. As a mature tree of a desirable cultivar we could well estimate the value of the tree as a capital asset in a bearing condition as several times more than the actual cost of a new tree. If you do have these types of tree guards make sure they are not going to create problems for you by leaving them on the trees longer than they should be left.



Figure 1 - Bark necrosis from a failure to remove the spiral guard after tree establishment.

Factors Contributing to the Need for Corrective Fertility/Orchard Management Practices

*Written by John Gardner, Apple Specialist,
Reviewed by Christoph Kessel, Horticulture
Nutrition Program Lead, OMAF*

On the following two pages, I have attempted to summarize the effects of some of the major factors and their contribution to the need for a management change when considering the feeding of bearing trees.

Increasing Likelihood/Need for Corrective Action	
Factor (unranked)	Rationale
Growing on coarse textured sandy soils low in O.M. (organic matter)	These soils don't hold much in reserve, their ability to store cations is diminished, available soil moisture is quickly depleted as demand increases in June - August.
Soils with low buffering capacity, (inability to resist changes in pH). Usage of ammonium based fertilizers on sandy soils with low O.M.	Soils should ideally be slightly acid and around 6.5 - 6.8 pH. pH > 7 reduces availability of Mn, Ca, Zn, and B. pH < 5.5 can reduce availability of Ca, Mg and increase Mn availability to a toxicity (measels).
Inadequate soil microbial activity	Poor breakdown of mulched material may be a sign of a carbon-starved ecosystem. A weak microbe population can result from less than ideal pH.
Excessive soil wetness, poor drainage part of the year - winter injury and frost damage, compaction	Foliar applied nutrients (e.g. urea) may help overcome poor or inadequate root performance or help a tree recover from a trauma event.
Renovation of acreage	pH adjustments and phosphorus reloading of soils best carried out while trees are gone. Adjustments to pH, potassium, phosphorus and other soil applied nutrients made according to soil test recommendations.
Excessive use of macronutrients, micronutrients	Excessive K interfering with uptake of Mg on Mg deficient soils, excessive P reducing uptake of Zn. Possible boron toxicity from excessive use.
Adding large amounts of organic materials with a high C/N ratio (e.g. wood chip mulch).	Soil microbes use a high % of available N to build up their numbers to take advantage of the carbon contained in the organic material
Drought and sustained moisture deficit during growing season and into fall	Repeated and sustained episodes of moisture deficit can inhibit root growth (spring, fall) and roots ability to absorb various nutrients
Poor sod growth	Sod health contributes significantly to overall nutrient cycling and soil health.
History of nutrient deficiencies	Some soil types are alkaline in nature with a high pH on coarse sandy soil with a low O.M. or areas with natural shortages of micronutrients like boron or zinc.
Change in cultivar mix and tree density	Some of the newer cultivars (hard varieties) require higher N status as determined by leaf analysis.
Higher yields	Crop removal of N, P and K is directly related to crop size. This does not necessarily imply an increase in the use of N.
Fruit quality problems	Too much N can be as bad as too little. Too much N can degrade postharvest life. Lack of K can inhibit the fruit size, colour and tree hardiness.
Dramatic reduction in crop load (off year or frost has taken out bloom), or heavy pruning	Adjustments have to be made to compensate for lack of nutrient removal. 25 bins will remove approximately 14 kg N, 22 kg K, 3.5 kg P. Adjust N stands for nitrogen in this case, for degree of pruning.
Cultivars with a high probability of exhibiting calcium related disorders	Management changes to improve absorption pickup and delivery of adequate calcium to the crop, e.g. may involve changing thinning or irrigation practices.
Excessive vigour, pruning and training costs are too high	Excessive growth and luxury consumption of nutrients can come at the expense of crop quality.
Unusually high disease expression	Lush growth can enable fireblight to be more destructive.

Decreasing Likelihood/Need For Corrective Action	
Factor (unranked)	Rationale
Trees established on fine textured deep silts, loams and clay loams. Soils having high O.M.	Every percentage point of O.M. results in approximately 20 lb/ac plant available N, greater ability to store and provide the essential nutrients, and higher cation exchange capacity.
Soil high in buffering capacity, stable pH	Soils not easily subject to changes in pH don't readily change their ability to release nutrients. Soil microbes continue to function at capacity.
Adequate microbial activity as evidenced by rapid breakdown of mulched materials, prunings	Microbes work for free, indicator of healthy orchard ecosystem.
Good site, deep friable soil, no drainage problems	Roots function well year round.
Adequate available soil moisture, irrigation scheduling	Superior production of new roots - better absorption of nutrients and less water cycling out of crop to leaves when trees are irrigated.
Tissue, soil analysis on regular basis - adjusting to a standard based on calibration work	Less likelihood of getting completely off track with nitrogen, potassium and micronutrients.
No dramatic changes in use of large volumes of O.M. (therefore C/N ratios) (e.g. mulching with wood chips, straw)	Added nitrogen not required to compensate for large changes in carbon available in orchard ecosystem.
Sod growth good	Balanced feeding of sod helps nutrient cycling and O.M. production.
Monitoring and adjusting supply (N,P,K) to fulfill yield/growth expectations (adequate soil reserves of phosphorus)	Positive correlation between yield and removal of N, P, K
Growing cultivars that don't generally express calcium related physiological disorders	Diminished need to adjust cultural practices to compensate for inability to pick up and distribute adequate amounts of calcium to crop.
Maintenance application of foliar grade fertilizers (N,P,K + micros) in combination with soil/tissue testing	Can overcome short-term needs.
Stress control on trees e.g. irrigation, thinning, summer pruning, cropload management, mulching soils - no serious trauma events - winter injury, frost etc.	Absorption and distribution of essential nutrients is done by the tree with greater efficiency when trees are relieved of cyclical stress factors
Adequate shoot growth. 20 - 30 cm/yr., moderate pruning needs, consistent cropping	Shows balance between fruiting habit and new growth. Grower is able to control pruning costs.
Good fruit set and need for thinning	Adequate fruit set can be a good sign of balanced feeding. Need for N is highest early in the growing season. Tree reserves of N essential for first 3 weeks.
Fruit quality, fruit size, and storage potential meeting expectations	Good indicators of balanced program including crop nutrition and orchard management in general.

Building a Crop of Apples

J. Gardner, Apple Specialist, OMAF, London

This spring season is not unlike the previous one in terms of the challenges from a scab management perspective. It just doesn't seem like that long ago we were right where we are now with rain, frost damage to buds and trees, wind and yes some hail in the pre-bloom period. Temperatures this year on average are warmer than last year through the bloom period.

I can remember talking about it being too cold last year for fireblight infection during bloom however, the volume and frequency of rainfall appeared to override the lack of warmth and fireblight infections did show up at bloom for some growers. This year, it has been warm enough on average for infections from fireblight bacteria during bloom.

The largest crop of apples Ontario has ever grown came from a near perfect bloom in 1999. Back then, we had two weeks of warm dry temperatures through the bloom period. Conditions that in my opinion meant the movement of pollen in the orchard like we had never seen before.

We now know that apples grown as a result of multiple siring or bloom being pollinated from more than one variety will have the potential to grow larger than those pollinated with pollen coming from only one variety. I was asked recently about different strains of apple being okay for pollinators of other strains of the same cultivar. There is some evidence that different strains of McIntosh will indeed pollinate other strains.

Here's something interesting about fruit size and temperature. Dr. Ian Warrington of New Zealand has reported getting a larger Gala by prolonging cool temperatures in the post bloom period longer than 25-30 days past full bloom. We often think that warmer temperatures are better. However, for temperate climate tree fruit like apple, just maybe there is a best temperature range for various processes like cell division just as there is for photosynthesis, colouring etc.

This may help explain why last year we observed better growth rates early in the season in several cultivars (including Royal Gala) treated with the particle film Surround® WP

Crop Protectant. In summary, Dr. Warrington says that best potential fruit size for Gala apple is achieved by a moderately cool season after bloom and a moderately warm season for the rest of the growing season.

A few words on thinning this year's apple crop in view of the fact that there is some frost damage out there. Something we have learned about frost damage and thinning rates is that unless the damage is judged to be very serious, thinning treatments should go on as usual. The odd king that has been taken out with frost should not trigger a dramatic change in what you would normally do for a certain cultivar or age of tree.

Frost events that have taken out a good percentage of lower canopy fruit buds may require some adjustment to the program. Normally, the top half of a tree will still have a decent set unless the frost is really serious. Those clusters in the top half of the tree will also benefit from thinning if fruit size is what you're after.

Under average conditions, thinning treatments add several times more value to a crop than any yield reduction due to loss in crop volume. Both thinned and unthinned crops will be comprised of apples of various sizes that follow a normal distribution pattern with some larger fruit, some smaller fruit, and most of the fruit somewhere in the middle for size. The most noticeable change in the look of a thinned crop compared to an unthinned crop is the shift in distribution of fruit sizes resulting in a larger average fruit size.

A word of caution: Fireblight that is active in the orchard can be spread by hand thinning and/or bud pinching early in the season.

This of course is not the whole story for developing adequate fruit size in a crop. We have to talk about water, leaf function, ethylene management and so on but that's enough for now.

Temporary Storage of Solid Manure on Your Farm

Donna Speranzini, Nutrient Management Planning Specialist, OMAF, Vineland

Are you a horticultural producer or cash cropper, looking for guidelines on how to safely store solid manure, temporarily on your farm? The Ontario Ministry of Agriculture and Food has recently released a new factsheet on this issue called Temporary Field Storage of Solid Manure or Prescribed Materials (Order number 03-105, Agdex 743/538).

The use of manure can have many benefits on your farm. Over time, tillage and erosion can result in the loss of organic matter from soil. Manure, particularly solid manure with bedding, can replace some lost organic matter and increase soil structure, porosity, and water holding ability. Manure is also a good source of nutrients for crops; both nitrogen and phosphorus are available in the first year but are also present, tied up in organic matter, for release in the second and third years.

Using manure on your farm does not come without its challenges. Nitrogen in manure is present in both ammonium and organic forms. Ammonium nitrogen in liquid run off can be harmful to fish in nearby streams. Ammonium is eventually converted to nitrate by bacteria and may be available for loss due to leaching. The ability to temporarily store solid manure on your farm, creates great flexibility, but must be done properly to reduce the potential for surface or groundwater contamination.

The new factsheet outlines 10 individual management factors that will help you make good choices for when, where and how long you should store solid manure in a temporary pile on your farm. The longer you want to store a temporary pile on your farm the more positive management factors you should take into account.

Be careful when choosing which type of manure you take on your farm. The most desirable type is higher in dry matter of the manure. It can soak up more rainfall resulting in less potential run-off and more days of storage. Manures that are properly composted have lower nutrient contents, friendlier microbes and

as such pose less environmental risk and can be stored longer.

Select the site for your pile wisely. Manure piles placed more than a 150 meter flow path away from field drainage lines and surface water sources will reduce potential environmental impact. Piles that are located on heavy textured soils are less likely to impact groundwater. Temporary piles should not be located on the same site more than one year in three.

Manage the look of your pile. Most of the environmental damage caused by temporary piles is the result of rainfall run-off. **Piles that are flat on top have less run-off from the sides. The smaller the perimeter of your pile, at the ground surface, the better.** Probably the best environmental management feature for your temporary manure pile is a rain proof cover. All of these management features are described in more detail in the factsheet, with a scoring system to allow you to calculate how long a temporary pile should be stored on your farm.

The factsheet can be obtained from the Ag Information Contact Centre at 1-877-424-1300 or [online at http://www.gov.on.ca/OMAFRA/english/engineer/facts/03-105.htm](http://www.gov.on.ca/OMAFRA/english/engineer/facts/03-105.htm).

CROP PROTECTION

Managing OFM in 2004

Kathryn Carter, Pome Fruit IPM Specialist, Simcoe & Hannah Fraser, Entomology Program Lead, Horticultural Crops

Ontario apple growers saw very little damage in their orchards from oriental fruit moth (OFM) at harvest in 2003. Lowered levels of infestation were probably a result of monitoring, improved management, the availability of registered pest control products, as well as weather conditions unfavourable for development.

Don't assume that with the lowered pest pressure of 2003 that OFM has gone away – this is a pest that will continue to require your attention. Control measures should still be applied to manage OFM, especially in orchards with a history of damage.

Several trial spray programs (funded through CanAdapt) and **mating disruption (MD)** programs were tested by OMAF last year and were very effective in managing OFM. This year, growers also have two new mating disruption products (Isomate Rosso, and 3M sprayable pheromone) available for them to use against OFM; these tools will provide additional flexibility and choice in developing a sound management program. Consult the latest edition of Publication 360, 2004-2005, for information on registered products.

Development of OFM broods varies as a function of the host plant (peach versus apple). Use pheromone traps in apple orchards to monitor OFM flights. For programs incorporating insecticides: keep in mind that these first sprays should be applied 6-10 days after the upswing in trap counts for managing 1st generation larvae, and 3-6 days after the upswing for subsequent generations. **In blocks where MD dispensers were applied last year,**

pheromone traps will not provide reliable data for the flight of the overwintering generation. Although degree day models have been developed for OFM in apples, they require additional validation under Ontario conditions.

Growers who used MD programs successfully last year are encouraged to continue their programs this year. Also growers who had very little damage, and low pest pressure last year may be interested in trying mating disruption to manage OFM. Pheromone mating disruption products are not insecticides and will not control other pests that may be present in the orchard. Initial OFM populations must be low, and orchard blocks must be square or rectangular blocks at least 4 ha in size. Pheromone dispensers or sprays must always be applied before insect flight begins. For more information on using MD see OMAF Factsheet Mating disruption for management of Insect Pests, Order No. 03-079.

Table 1. Spray programs for controlling OFM in apple in 2004

	Program 2	Program 3	Program 4	Program 5
1st generation	Decis®	Assail®	Decis®, or Assail ®	Decis® or Assail® and Mating disruption
2nd generation	Assail®	Assail ®	Mating disruption	Mating disruption
3rd generation	Assail®	Decis®	Mating disruption	Mating disruption
4th generation	(Decis®*)	(Decis®*)	(Decis®*)	(mating disruption)

*-only where monitoring indicates necessary

Do not use > 4 applications of Assail per year

Do not use >3 applications of Decis per year

- Pesticides should be applied 6-10 days after upswing in trap counts for 1st generation, and 3-6 days after upswing in pheromone trap counts for subsequent generations.
- Refer to your local agri-bulletin for information on spray timings.
- Although degree day models have been developed for OFM, they have not been validated under Ontario conditions.

There are several different strategies for incorporating MD into an apple IPM program. Apples generally have a longer growing season than tender fruit, and this may affect the products used and the timing of MD applications. No single product provides true “season-long” management in apples, given the activity of the pest and the length of time the crop remains in the orchard. Be aware of label recommendations for re-application.

Where OFM pressure is high, and/or organophosphate resistance to OFM is confirmed, MD programs should include the use of a supplemental insecticide directed at emerging first generation larvae (i.e. apply an insecticide in addition to the MD product – first generation only). In areas where population pressure is low, where season-long area-wide mating disruption programs are being adopted, and where few alternative hosts are present, it may be possible to eventually discontinue

insecticide applications for first generation OFM. **Effective strategies verified in Ontario to date have included the use of insecticides, with or without MD, to manage first generation OFM larvae.**

A partial fourth generation may develop in some years, with adult activity into October. Even if an insecticide was used to manage the first generation larvae, followed by a longer-lived MD product for summer generations, re-application of a MD product or supplemental insecticide near harvest may be required to maintain protection in some years for late-season cultivars.

Apple Registration Update 2004

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

The 2004-2005 Fruit Production Recommendations are hot off the press and available at the local OMAF offices. There haven't been a lot of new additions to the apple spray guide, but there are a few new products that growers should be made aware of.

Fungicides/Antibiotics

Flint® (trifloxystrobin) is a new strobilurin fungicide that is registered for managing apple scab, powdery mildew, cedar apple rust, flyspeck and sooty blotch. The recommended rate is 140 g/ha, however, higher rates may be necessary if disease pressure is high. To avoid the development of fungicide resistance, Flint® should be applied solely as a protectant, not as an erradicant. However, this product does have a 72-96 hour kickback activity. **Do not use tree row volume when applying Flint®.**

The registration for streptomycin has been renewed again for this year. Streptomycin can be applied up to 3 times per year, and cannot be applied after petal fall. Entry into treated fields is prohibited for 24 hours following application. The following protective equipment must be worn when entering treated areas within 7 days of application to perform activities that involve contact with treated plants, soil or water: chemical-resistant coveralls over long-sleeved shirt and long pants, chemical-resistant gloves, chemical-resistant headgear for overhead exposure, socks and chemical-resistant footwear.

Mating disruption products

There are two new mating disruption products available for managing oriental fruit moth (OFM). **Isomate Rosso, a new pheromone twist tie**, will manage OFM for approximately 120 days. Another new MD product is the **3M sprayable pheromone**. The pheromone can be added to a spray tank and applied to the orchard accordingly. Sprays must be repeated during the growing season according to label instructions.

Insecticides and Other Insect Management Tools

The pest management regulatory agency (PMRA) has recently conducted a review of the registration of azinphos-methyl (Guthion® and Sniper®). As a result of this decision these products will no longer be registered for use on apples after December 31, 2006. The review has also resulted in some significant changes to the label. Only border sprays must be used to manage plum curculio.

The re-entry interval for post application is now 14 days for agricultural workers. Early entry into treated area is allowed provided the following protective equipment is used:

- Chemical-resistant coveralls over long-sleeved shirt and long pants
- Chemical-resistant gloves
- Chemical-resistant footwear plus socks
- Protective eyewear
- Chemical-resistant headgear for overhead exposure

In orchards where Guthion has been applied, for the remainder of the growing season, workers must wear clean, long-sleeved shirts and protective gloves each time they perform activities that involve foliar contact. Workers must be notified of the pesticide application verbally, and by posting warning signs at entrances to treated areas. Wash stations must be available in the field for all re-entry workers.

Members of the general public (U pick operations) are not allowed to enter treated orchards for 30 days after application. The new pre-harvest interval ranges from 14 days to 21 days depending upon the amount of product used.

Surround® WP Crop Protectant (kaolin clay) has also received registration for managing tarnished plant bug, leafrollers, leafhoppers, apple maggot and plum curculio in apple, pear, crabapple and quince. Surround can be applied up to the day of harvest, and there is no re-entry interval. Surround should be applied at a rate of 25 to 50 kg per 1000 L. Use sufficient spray volume to obtain thorough **near drip** coverage.

Two or more applications are desirable for a base film. For optimal performance applications must coat all portions of plant that are to be protected, including both sides of the leaves. Dwarf, semi-dwarf, and otherwise well-pruned trees will be easier to cover than large trees. Optimum efficacy may be more difficult to achieve in large trees due to increased difficulty achieving thorough coverage.

Applications to tree crops can be made with commercial air blast or high-pressure sprayers that provide enough air turbulence to coat both sides of the leaves, bark, and fruit. The advantage with using this material is that coverage is entirely visible after application. The objective would be to maintain a uniform particle film over the entire surface of the canopy and the developing crop. Avoid application methods that lead to “caking” of Surround on the surface of leaves and fruit.

Blister Spot on Crispin (Mutsu) Apples

Michael Celetti, Plant Pathologist - Horticulture Crops Program Lead, OMAF

Most apple growers who grow the variety Crispin (or Mutsu) are concerned with the disease Blister Spot. The disease is caused by a bacterium *Pseudomonas syringae* pv. *papulans* and is probably present in most orchards. Research has shown that many cultivars including Golden Delicious, Red Delicious, Jonagold and Cortland are susceptible to this disease but Mutsu is highly susceptible and the variety impacted the most. The other susceptible cultivars usually become diseased in the rows planted beside a block of the highly susceptible Mutsu cultivar.

The bacteria overwinter in apple buds, leaf scars and diseased fruit from the previous season that are left on the orchard floor. Although infected apple buds may appear healthy, the bacteria multiply during the spring and are rain splashed to

leaves and other plant surfaces throughout the orchard. The bacteria can survive and multiply on leaf surfaces including weeds in the orchard without causing any disease symptoms. During late spring or early summer, a brief shower is all that is required to distribute the bacteria onto the fruit where they infect through the pores or lenticels.



Figure 1 - Blister spot symptoms on a Crispin (Mutsu) apple.

Young fruit are most susceptible beginning 2 weeks after petal fall, lasting for about 6 weeks. Often symptoms do not appear until mid to late July or up to 2-3 months after petal fall, at which time the bacteria can no longer infect the fruit. Initially the infection appears as small water soaked raised blisters associated with the lenticels on the fruit surface. The first spots are often detected near the calyx end of fruit that are produced towards the outside of the tree facing the sun. The lesion eventually becomes a purplish black lesion expanding no more than 4-5 mm in diameter on the fruit surface and rarely penetrates the flesh (Figure 1). The lesions do not develop into a fruit decay, however, several to over 100 blister spots can occur on a single fruit reducing the fresh market quality significantly.

There are two products registered for control of blister spot in Ontario, Aliette WDG and Copper 53W. Aliette WDG is applied at petal fall followed by two more applications at 7-day intervals. No more than three applications of Aliette are allowed per season. Results from a study conducted in New York and Ohio with Aliette during the mid

1990's indicate that this product will suppress the severity of Blister spot infections during years of heavy disease pressure but the economics of three applications for suppression may not be justified. It is possible that the timing of applications in the Ohio and New York studies was not early enough. Growers who choose to use Aliette for managing Blister spot in Mutsu apples are encouraged to apply the product at petal fall. Copper 53W is also registered for Blister spot control and should be applied not earlier than 10 days after petal fall to avoid causing injury. Hydrated lime should also be mixed with the copper as a safener. Do not mix Aliette with copper. For more information consult OMAF Fruit Production Recommendations 2004-2005, Publication 360.

Surround Crop Protectant Achieves Pest Control Product Status

J. Chaput, Minor Use Coordinator, OMAF, Guelph

The Pest Management Regulatory Agency (PMRA), Engelhard Corporation and Engage Agro recently announced that Surround WP Crop Protectant has finally received registration as a pest control product, under the pest control products act in Canada, for use on pome fruits, to decrease damage from a number of key insect pests.

This new minor use registration is an important milestone for both conventional and organic crop producers who can now take advantage of this novel pest management tool. It has taken several years of hard work between Engelhard Corporation, OMAF, Engage Agro and PMRA to secure this registration.

Surround WP Crop Protectant forms a mineral-based particle film intended for protection of pome fruits from a number of key pests including pear psylla, tarnished plant bug, oblique-banded leafroller, leafhoppers, apple maggot, plum curculio, 1st generation codling moth and oriental fruit moth. Surround WP Crop Protectant was already available as a sunburn/heat stress suppression product.

Surround WP Crop Protectant is a novel pest management tool; as such, it may require the use of supplemental control materials and should be used within a sound IPM program.

Follow all other precautions on the Surround WP Crop Protectant label.

For pear psylla, it is recommended to use 50 kg/ha of Surround WP applied up to 3 times during the pre-bloom period every 7-10 days but not later than green, cluster bud and applied up to 3 times every 7-14 days starting at first petal fall.

For tarnished plant bug, apply 25-50 kg/ha before infestation begins and continue at 7-14 day intervals.

For OBLR apply first 2 sprays 7 days apart starting just prior to green tip stage or at initial emergence of leafroller larvae. For subsequent generations apply at 7-14 day intervals as larvae emerge.

For leafhoppers apply first spray within 3 days of first petal fall or at initial infestation and continue every 7-14 days during infestation period.

For apple maggot apply 2 sprays 7 days apart before expected oviposition or a first detection. Continue applications every 7-14 days to keep fruit covered during egg-laying period.

For plum curculio, 1st generation codling moth and oriental fruit moth, apply Surround WP at first detection and continue applications every 7 days to keep fruit covered during egg-laying period.

Consult the complete Surround WP Crop Protectant label for comprehensive use directions and consult Engage Agro for guidance on using this product correctly on pome fruits.

Surround WP Crop Protectant should be used in an IPM program and in rotation with other management strategies. Surround WP Crop Protectant is a novel pest management tool and can be used by both conventional and organic pome fruit growers in Canada.

We wish to thank Hannah Fraser, Kathryn Carter and John Gardner, OMAF as well as Kevin Ker, Ker Crop Management Services, Ken Wilson, Horticultural consultant and Bernt Solymar, Earthtramper Consulting Inc. for assisting with research studies in Ontario in the past several years.

We also wish to thank the personnel of Engelhard Corporation, Iselin, New Jersey for their patience and support of this registration and the personnel of the Pest Management Regulatory Agency for evaluating and approving this important reduced risk, pest management tool.

For copies of the new supplemental label contact Jim Chaput, OMAF, Guelph (519) 826-3539 or Dave Wright, Engage Agro (519) 826-7878.

Frequently Asked Questions About Flint

Kathryn Carter, Pome Fruit IPM Specialist, OMAF and Dr. Wendy McFadden-Smith, McSmith Agricultural Research Services

Over the past few weeks there have been a lot of questions about Flint® (trifloxystrobin), a new strobilurin fungicide from Bayer Crop Sciences that just received registration in apples for scab, powdery mildew, fly speck, sooty blotch and cedar apple rust. Flint is in the same chemical family as Sovran and should be used in rotation with other chemistries such as EBDC's (Ferbam, Zineb, Dithane, Manzate, Polyram, Penncozeb), sterol inhibitors or demethylation Inhibitors (Nova and Nustar), and phthalimides (Supra Captan and Maestro).

Like Sovran, Flint is absorbed and retained in the waxy cuticle of leaves and fruit. These products redistribute well within a leaf or fruit; however, they do not move systemically through the leaf or the plant via the sap stream. There is some redistribution of Flint on the leaf surface following an application; however as the leaf grows, the leaf surface that is not covered by Flint will not be protected from diseases. Also, leaf tissue that expands after Flint has been applied will not be protected either.

Flint is rainfast after just 2 hours. No pH adjustment is necessary if the spray is applied immediately. However, if the product is left in the tank for a few hours, the spray mixture should be buffered to pH 7. The buffering must be done at the time the spray mixture is prepared.

Unlike the SI fungicides (Nova and Nustar), the strobilurin fungicides are excellent inhibitors of spore germination and therefore they are excellent protectant fungicides. Flint has good kick-back activity on apple scab, but no kick-back activity on the other diseases on the label. For apples, the labeled 175 g/ha rate allows for up to 72 hours kick-back under moderate to heavy disease pressure and up to 96 hours kick-back under light disease pressure. For curative applications, a disease forecasting system should be used, and a second application is required within 7 to 10 days. The kick-back activity period starts at the **beginning of the infection period**.

FLINT works best preventively; however, if curative applications are necessary, they should be made soon after an infection period when the leaves are mostly dry.

Researchers in the US have shown that in orchards where DMI (Nova, Nustar) resistant scab is present, strobilurin fungicides lose their kick-back activity on apple scab. Although loss of control of apple scab due to increased DMI resistance has not been documented in Ontario, growers should be following resistance management strategies to avoid the development of DMI resistant scab. These strategies include rotating chemistries, preventative application of fungicides, use of full label rates and excellent coverage of leaves and fruit.

OMAF Pub. 360 recommends that Flint should be applied preventatively at 140 g/ha at 7-10 day intervals, depending on the weather and disease pressure. The label rate ranges from 140 to 210 g/ha, depending on the pest. Under high disease pressure or for kick-back activity (scab) the higher label rate should be used. Reports from New England researchers suggest that both Flint and Sovran are rated as only "fair" in terms of efficacy against cedar apple rust. If you have susceptible cultivars, moderate to high inoculum pressure, and conditions favorable for cedar apple rust and quince rust infection, you should not rely on the strobilurin fungicides for rust control. If you do use Flint for cedar apple rust (or powdery mildew), the label states that you should alternate it (every other application) with a sterol inhibitor fungicide. (from **Disease Management Update to 2000-2001 New England Apple Pest Management Guide** L. P.

Berkett and T. Bradshaw University of Vermont
<http://orchard.uvm.edu/aim/2001NEAPMGUpdate.htm>)

Flint should not be applied using tree-row-volume. Remember that alternating between Flint and Sovran is not rotating at all. To prevent resistance, strobilurin fungicides (Flint or Sovran) should not be used more than 4 times per season and no more than 2 applications in a row.

Unlike other strobilurins, Flint is not phytotoxic to cherries.

Strategies for Scab Control in 2004

Introductory Comments by Kathryn Carter with Quotes and strategies from New York Pathologists, Dave Rosenberger, Bill Turechek, and Wolfram Koeller

Controlling apple scab in 2004 may be more difficult than in previous years since most orchards have significant carry-over inoculum due to less-than-perfect scab control during the summer of 2003. Also wet weather in August and September 2003 removed fungicide residues and created favourable conditions for late-season infections to occur in any orchard that had visible scab lesions prior to the start of the rains without additional fungicide protection. Late-season infections may remain invisible or may be only faintly visible on the under side of the leaves, so the severity of late-season infections may be underestimated.

According to David Rosenberger: Tree Fruit Pathologist, N.Y. State, **"high inoculum contributes to more scab control failures than is generally recognized.** In high-inoculum orchards, the first infections often occur earlier than in low inoculum orchards, and the slightest gap in prebloom fungicide protection can result in economically significant scab infections. Orchards with visible scab on leaves at the end of last season are automatically considered high-inoculum orchards. However, there is increasing evidence that some symptomless leaves may also harbor over-wintering inoculum. This may occur if infections were only suppressed by use of SI fungicides applied on a post-infection timing or if infections occur in autumn. The latter is of special concern for spring of 2004."

"High inoculum alone increases the potential for severe scab infections at green tip, but the risk for infection skyrockets if high inoculum is combined with early ascospore maturity. Ascospore maturity is often advanced compared to tree phenology in years where continuous snow cover and cold wet spring weather combine to allow rapid advances in spore maturity. **Pseudothecia that develop under cool temperatures produce more ascospores than those that develop under warm temperatures.** So the cool wet spring we have been having is optimal for scab infections." (Rosenberger et al., 2004)

Fungicide resistance to DMI's has been identified in New York; however, there have been no documented cases of resistance in Ontario orchards. Researchers in the US have shown that in orchards where DMI (Nova, Nustar) resistant scab is present, strobilurin fungicides lose their kick-back activity on apple scab. As a result, growers in the US have had to drastically change their scab management strategies.

Good scab management guidelines for Ontario during the 2004 season include:

1. Not using alternate row spray applications.
2. Not delaying the first scab spray. Sprays should have been applied when green tissue was first present in the orchard.
3. Applying fungicides preventatively. Attempting to stop scab epidemics after lesions have become visible will speed the development of pesticide resistance.
4. If it is absolutely necessary to apply curative sprays, applications should not be made when the leaves are still wet.
5. Extending the intervals between scab sprays is considerably more risky.
6. Finally be aware of the benefits and limitations of the products you are working with.

Benefits and Limitations of Fungicides

Strobilurin fungicides (Sovran, Flint) are excellent protectants with only limited post-infection activity. The strobilurin fungicides do NOT have pre-symptom activity (activity from 72 hours after infection until scab lesions appear). It was this pre-symptomatic activity of dodine, Benlate, and DMI's (SI) fungicides that made

them very effective for eliminating the “misses” that occurred as we cut back on pre-bloom scab control. Using Sovran or Flint to arrest epidemics after scab lesions become visible in spring will only speed development of complete resistance to this class of fungicides according to Rosenberger in New York.

Vanguard, an anilinopyrimidine fungicide, is of questionable value for scab programs under New York, and Ontario conditions. Protection provided by Vanguard is never better than that provided by 3 lb/ac of mancozeb, and the 48-hr post-infection activity of Vanguard is most reliable at low temperatures (<45 °F). (Rosenberger, 2004)

A conservative scab program that has been developed for New York in 2004 (Rosenberger et al, 2004) includes the following:

1. Application of a urea spray (40 lb/ac) to the leaf litter (to help it break down) before green-tip in orchards that were clobbered with scab last year. A spring application of urea can significantly reduce inoculum production in the leaf litter, thereby reducing pressure on fungicides.
2. Using a fungicide at green tip or at least before the first scab infection period. A copper spray applied at green-tip to suppress fire blight will also control scab and will suppress the superficial bark cankers caused by *Botryosphaeria* species.
3. Follow up sprays at no more than 5-7 day intervals (or before rains) with captan, mancozeb, or Polyram.
4. Application of either a strobilurin fungicide or an SI+contact fungicide starting at pink or bloom to initiate mildew control and to enhance scab control during the period of peak risk for development of fruit scab. (The SI will help with scab control only where scab is still sensitive to SI fungicides).
5. After the first strobilurin or SI+contact spray, continuing with additional strobilurin or SI+contact sprays through second cover. Alternating strobilurin with SI+contact sprays may be more effective than using two applications of one group followed by two applications of the other. Using the high label rates of strobilurin fungicides will slow development of resistance to these fungicides. Use the strobilurin and SI+contact fungicides with shorter spray

intervals (i.e., 7-9 days rather than 8-12 days) if the season is highly favorable for apple scab, and maintain this short spray interval through second cover if scab lesions are visible on leaves at petal fall.

Furthermore, Rosenberger says that "by using shorter spray intervals and depending primarily on contact fungicides, growers should be able to completely control prebloom scab infections even in orchards with high inoculum. Effective scab control from green-tip to petal fall virtually eliminates risks of significant fruit infection, and more extended fungicide spray intervals can be employed after the supply of scab ascospores is depleted (usually around petal fall) so long as no scab lesions are evident on cluster leaves."

Watching for Weevils: Trapping Plum Curculio Part 2

Neil Carter, Tender Fruit and Grape IPM Specialist, OMAF, Vineland

Most monitoring for plum curculio (PC) involves looking for damage on developing fruit, but traps can be used to monitor for this pest as well. Beating trays are often recommended for finding the adult weevils on trees but I have had little success finding PC with beating trays even in problem areas for the weevil. Traps can be most useful when there are known problem areas where PC cause damage every year and especially where PC populations are high. Traps are good tools to indicate when the first PC start moving into an orchard; knowing when these weevils are active helps in accurately timing the first insecticide application for PC, rather than waiting until damage is found. Although trapping PC indicates *when* PC are active, the number of PC caught in traps is not a good predictor of the amount of eventual fruit damage. Any type of PC trap should be used in conjunction with fruit damage monitoring, not as a replacement for monitoring.

A couple of years ago, I wrote about “Circle traps” for PC designed by Kansas pecan grower, Edmund Circle. Another type of PC trap is available and has been used for several years in the U.S. Their PC problems are often more consistent and severe than ours, and they use various PC traps in different crops. The trap pictured here is sometimes called a “Teddars

trap” (in 1994, W.L. Tedders and B.W. Wood published their results of using these traps to monitor pecan weevil). However, these traps are more commonly referred to as “pyramid traps” or “pyramid trunk traps”. Work in 2002 by Andrea Coombs, Mark Whalon, and Larry Gut showed that pyramid traps generally caught more PC than other styles of traps in Michigan (although the differences were not always statistically significant).

In Niagara orchards, PC is a localized, sporadic pest, so monitoring for it in stone and pome fruit orchards each year is a good strategy. When PC is present in an orchard, it is often a problem only on one or more borders so a border spray may be sufficient for control. Plum curculio is a small (4-6 mm), warty, grey – brown weevil (a type of beetle) with a long snout. Female weevils lay their eggs under the skin of fruit beside a characteristic crescent-shaped scar – that crescent-shaped scar is what you look for on fruit when you are monitoring for PC. Plum curculio overwinter in brush or wooded areas near to orchards and become active after a period of warmth (3 or 4 days over 15°C) and rain in the spring.

The pyramid traps look like tree trunks to the weevils and the weevils climb up them into the trap at the top. This is true for many weevils, so you will likely have other similar insects in the trap (along with spiders, wasps, click beetles, etc.). Plum curculio will walk into orchards when the temperature is mild but some will fly when temperatures reach 20°C and higher. Hence, any traps, such as these, are less effective in warmer weather because some weevils may fly over them and into the trees.

The best placement for pyramid traps is adjacent to tree trunks at the border of the orchard near to likely overwintering sites for PC. If the traps are being used only for early season monitoring, the pyramid traps can be removed before mowing. Pyramid traps and Circle traps can be used unbaited or baited with “plum essence”, which is usually available from wherever you buy your traps. Some lures may include components of the aggregation pheromone for PC (such as “grandisoic acid” and “benzaldehyde”). A list of pest monitoring equipment suppliers can be found on page 238 of OMAF Publication 360 – Fruit Production Recommendations 2004-2005. There is very

little difference in the price of the two styles of trap (Circle versus pyramid) in the Great Lakes IPM catalogue, so groundcover management might be your only concern with the pyramid traps.



Figure 1 – Weevils prefer to climb the dark plastic pyramid trap instead of the tree when light coloured trunk guards are used.

POSTHARVEST

Postharvest Notes on ‘Honeycrisp’ from South of the Border

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

‘Honeycrisp’ has outstanding flavor and texture characteristics, but it also has problems with high incidences of bitterpit, soft scald, and soggy breakdown. A recent paper by Watkins et al. (2004) reports on research from New York, Massachusetts, and Michigan states. The following conclusions are made –

1. Soft scald and soggy breakdown incidence were consistently the highest in storage temperatures of 0 and 0.5°C, and reduced or

eliminated by temperatures of 2.2, 2.8, or 3°C.

2. DPA treatment sometimes reduced, but did not eliminate soft scald.
3. Soft scald and soggy breakdown were both reduced by holding fruit at 10 or 20°C for 1 week or 1 to 4 days, respectively.
4. Bitter pit incidence was sometimes increased by storage delays and storage at the higher temperatures.
5. Little effect of any treatment on fruit firmness, soluble solids content, internal ethylene concentration, background color, and titratable acidity was detected.

It is also interesting to note that these disorders are relatively less common in Massachusetts and Michigan, compared to New York. Both soft scald and soggy breakdown are often observed in New York in late harvested 'Honeycrisp', within the harvest period used by industry. Local observations have indicated that the behavior of 'Honeycrisp' in Ontario is most similar to that in New York. Therefore, there needs to be a compromise in postharvest treatments that reduce soft scald and soggy breakdown but increase bitter pit.

Influence of ReTain, DPA, 1-MCP, and CO₂ on 'Empire' Quality

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

Dr. Dennis Murr, Professor, University of Guelph, Guelph

The objectives of this study were: 1) to determine the effects and interactions of 1-MCP, ReTain, and DPA on the quality of 'Empire' apples during storage, and 2) to investigate the effects of CO₂ in the CA regime for 'Empire' apples treated with 1-MCP. 'Empire' apples that had been treated with and without ReTain (200 ppm, ~ 4 weeks prior to harvest) were harvested, treated with or without DPA (~1000 ppm) and 1-MCP (1 ppm, 24 hours at 0°C), and subsequently stored in CA of 2.5% O₂ with either 2% or 0% CO₂ for 120 and 240 days at 2°C.

There was no significant effect of ReTain on fruit firmness, CO₂ production, and total volatiles after storage, although there was slightly less

ethylene production in ReTain-treated fruit compared to those not treated. DPA treatment had no significant effect on CO₂ production, ethylene, and total volatiles, but when fruit were treated with 1-MCP then DPA resulted in firmer fruit (+ 0.7 lb) than when no DPA was applied. 'Empire' treated with 1-MCP had similar firmness after 1 or 7 days at ~23°C following 120 days of CA storage with or without CO₂.

However, of the fruit not treated with 1-MCP, only those in the CA regime without CO₂ exhibited reduced firmness retention (– 1.8 lb) during the 7 days at ~23°C. After 240 days of storage, apples that were treated with 1-MCP also had reduced firmness retention (– 0.4 lb) without CO₂ in the CA regime, while the effect of 0% CO₂ was even stronger on the fruit not treated with 1-MCP.

These results clearly show the importance of CO₂ in the CA regime regardless of 1-MCP treatment, for maintaining fruit firmness, especially after long-term storage. However, due to increased sensitivity to CO₂ in 1-MCP treated apples, DPA should always be used to control any possible CO₂ injury.

ReTain May Influence Storage Disorders

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

ReTain is a very useful orchard management tool in terms of delaying fruit maturity and reducing fruit drop. However, there are some reports to be aware of that indicate increased susceptibility to various storage disorders when apples were treated with ReTain.

Bramlage et al. (1980) found that apples treated with ReTain had higher incidences of core browning. Treated 'McIntosh' had an incidence of 56% after storage in air at 0°C for 4 months, compared to 29% in non-treated fruit. Similarly, treated 'Spartan' had an incidence of 43% versus 6% in non-treated fruit. This phenomenon is thought to be related to delayed fruit maturity due to ReTain, since core browning is worse in immature than in mature apples.

Johnson and Colgan (2002) found that ReTain treated 'Cox's Orange Pippin' developed core flush (30-60%) and internal breakdown (10-

55%). Furthermore, both disorders were more severe with ReTain applications closer to harvest (2 or 4 weeks prior), and increasing the concentration of ReTain increased the incidence of internal breakdown.

In short, anything that suppresses ethylene production can cause or aggravate the development of various physiological disorders in apples. Although the exact mechanism behind this effect is not known, it appears that the ability of apples to withstand stresses from high CO₂, low oxygen, and low temperature are reduced where a low rate of ethylene production is maintained during storage. Also in support of this theory, the use of 1-MCP increases fruit susceptibility to CO₂ injury and ethylene removal from storages has been reported to promote core browning, low temperature breakdown, and CO₂ injury in various apple cultivars.

Effect of 1-MCP and NatureSeal on Fresh-Cut Apple Slices

*H.P.V. Rupasinghe, NSAC, Nova Scotia,
D.P. Murr, University of Guelph,
J.R. DeEll, OMAF, Simcoe,
& J. Odumeru, Lab Services, Guelph*

Wounding during processing triggers certain physiological reactions, which lead to reduced shelf-life of fresh-cut apples. Exposure to 1-MCP (1 ppm, 24 hours at 0°C) immediately following harvest, in regards to the quality of fresh-cut apple slices, was evaluated in combination with a post-cut dipping treatment, known as NatureSeal.

Efficacy of 1-MCP treatment on fresh-cut physiology and quality depended on cultivar and storage duration of apples that were utilized in processing. Ethylene production and respiration rate of fresh-cut apples were inhibited by 1-MCP, but not by NatureSeal. Total volatiles content produced by fresh-cut apples was not influenced by either 1-MCP or NatureSeal. 1-MCP did not influence the quality attributes of fresh-cut apples when slices were prepared using apples stored for 1 month. However, the effects were distinct using apples that were stored either 4 months in cold storage or 6 months in standard controlled atmosphere. Browning and softening of the cut-surface, and changes in initial total soluble solids content (sugars) were partially suppressed by 1-MCP

treatment in 'Empire' apples. In 'Empire' apples, the total microbial growth was also suppressed by the 1-MCP treatment. Overall, the influence of 1-MCP on quality attributes in 'Crispin' apples was marginal. NatureSeal consistently maintained the firmness and reduced browning of fresh-cut apples stored at 4°C for up to 21 days.

In conclusion, the additive effect of 1-MCP in the maintenance of fresh-cut apple quality is an advantage for the processing and marketing of fresh-cut apple slices.

Quiz on Food Safety & Micro Biology

Sandra Jones, On-Farm Food Safety Program Lead, OMAF, Guelph

Just for fun, here is some trivia around food safety and microbiology. Go through the questions and test your knowledge by answering true or false. Good luck with your guesses.

1. Your chances of getting food poisoning when living in Canada are one in twenty chances a year.
2. People who are most likely to become sick from food-related illness are infants and young children, senior citizens and people with weakened immune systems. Symptoms of food poisoning will appear within 4 to 48 hours after consuming food contaminated with bacteria, parasites or viruses.
3. You can get 'hamburger disease' or barbecue syndrome from eating salad.
4. Bacteria can grow quickly at room temperature. Under ideal conditions, one bacterium can multiply into 33 million within 12 hours.
5. *Escherichia coli* (*E. coli*) are a group of bacteria that inhabit the intestines of all humans and most animals. There are about 100 different types of *E. coli* and most do not cause disease. In fact, we depend upon *E. coli* for our source of Vitamin K and B-complex vitamins.
6. Many bacteria can reside in healthy animals, without them showing any signs of illness. For the potentially harmful bacteria *E. coli* O157:H7, cattle is the primary host but this bacteria has also been found in sheep, goats, deer, horses, cats, dogs, birds and rabbits.

Answers

Most of the answers are TRUE except for questions 1 and 2. In a thorough analysis, the Centre for Disease Control estimated 76 million foodborne illnesses/year, which works out to almost 1 in 3 chances of people contracting foodborne illness each year in the United States. For Ontario—partially based on the U.S. estimate - is approximately 2 million foodborne illnesses per year or between 1 in 4 and 1 in 5 chances per year.

Symptoms of foodborne illness can appear anywhere from thirty minutes to several weeks, although it usually happens in the first 4 to 48 hours. This delay can make it difficult to link an illness to a particular food.

ANNOUNCEMENT

PMRA Audit of Ontario Apple Growers

This year the Pest Management Regulatory Agency (PMRA) will be conducting a national crop sampling program to assess pesticide residues on apples. The purpose of the program is to monitor for pesticide misuse including the use of unregistered pest control products, as well as the unregistered use (eg "off-label") of registered control products. Samples will be taken during the growing season to coincide with pesticide applications. Composite apple leaf samples will be collected from orchards randomly selected across southern Ontario during the summer months.

Individual growers will be advised of positive results. Negative results are available upon request. The apple grower's steering committee can also request a summary once all analyses are completed. This summary would consist of general notes, including active ingredients detected, number of samples taken, etc.

For more information please contact: Harold Collins, Regional Pesticides Officer - PMRA Ontario at 1-519-826-2827.

Readership Questionnaire (Orchard Network News)

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Please return to: John Gardner
Apple Specialist
Ministry of Agriculture & Food
667 Exeter Rd.
London, ON
N63 1L3

Fax: 519-873-4062