



ORCHARD NETWORK

For Commercial Apple Producers

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ORCHARD MANAGEMENT

Watch for Early Harvest of Cultivars Going Into Long Term Storage

John Gardner, Apple Specialist, OMAFRA, London

One of the more outstanding trends I have observed in the last decade or two is the movement of average harvest dates away from the historical timings. Growers are having to make labour and equipment arrangements earlier on average than they have ever done in the past.

Decisions around harvest date can be very complex especially with the introduction of new and various strains of cultivars. The range in maturity dates can be quite varied even for a variety like McIntosh. In Ontario, we now grow several different strains of Macs including Marshall®, Summerland, Imperial, Rogers, and Spur types, Marquis Mac, Pioneer Mac™ and now Miracle Mac. They each have their own peculiarities including the ways in which they ripen.

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This year we have had reports from growers who watch dates carefully saying that they are picking various tree fruit cultivars including some of the tender fruit varieties several days ahead of what we would call average and indeed several days ahead of their earliest ever dates found in their records.

Earlier picking dates can be influenced by several things, not the least of which is the bloom date and date of pollination. When we mix in stress factors like heat, high UV or runaway mite populations acting directly on the foliage and fruit along with moisture deficits and various sprays that can influence the generation of ethylene in the tree canopy we have a recipe for earliness.

Growers using aggressive treatments of calcium or perhaps a season long program of Surround Crop Protectant as we have found out can influence the best picking date for long term storage of fruit from a given block. It is only in recent years that we have had the ability to slow down the production of ethylene in the canopy and in the individual fruit with the use of ReTain. The problem here though is that ReTain is unlikely to over-ride the effects of various forms of tree and/or canopy stress.

Growers are advised to watch the starch degradation in varieties like McIntosh very carefully and to plan accordingly.

Ethylene Management Tool Best Applied to Trees That Are Not Stressed

John Gardner, Apple Specialist, OMAFRA, London

This is a good topic of discussion for 2007 as growers anticipate earlier harvest dates for many of the apple cultivars that are worthy of long term storage. The earlier dates this year are related to bloom dates and seasonal stresses including moisture deficits, high heat loads in the orchard, excessive soil temperatures and high UV ratings throughout the summer. Indicator cultivars including early maturing apples and tender fruit show that varieties are coming on stream in 2007 much earlier than average and in some cases earlier than ever for growers with good record keeping systems.

It is not that long ago that we did not really have any good way to control ethylene production and ensuing fruit maturity in the canopy of an apple tree in late summer. Crops more or less ripened when they wanted too and growers had to work around those dates. For many growers it meant in some cases watching tons of fruit drop to the ground or lose storage potential as the season progressed. This was especially true with cultivars that produced high levels of ethylene in the orchard like the various McIntosh strains.

ReTain has been used with various degrees of success now for several years in Ontario and in the Great Lakes Region on different cultivars. It has helped growers to manage their harvest operations and stretched out the windows of opportunity during the harvest season. What happens when ReTain is used successfully is that crops are delayed in their maturity, producing fewer drops, and resulting in better postharvest quality (reduced cracking in the stem bowl and factors like watercore are controlled). This response is the result of an inhibition of ethylene production in maturing apples.

When ethylene is managed, crops hang longer and maintain best quality attributes longer in the canopy, allowing the grower to get more quality fruit into the bin on a per acre basis. There are very few apple cultivars out here that hang well naturally without quality degradation on the tree.

Silken does come to mind as one cultivar that has a very wide window of opportunity naturally without the use of any ethylene management tools. Silken is however not considered to be a candidate for long term storage.

Cultivars vary in their sensitivity to ReTain. Gala strains, Honeycrisp and Jonagold are very sensitive to ReTain and higher rates can inhibit the development of characteristic colour and other fruit quality attributes. For this reason, rates are usually cut in half for these cultivars. Growers should use the 4-5 week standard when determining use dates for this product. For a cultivar like Gala it should be used 4 weeks ahead of the anticipated second picking date.

It has been my experience that ReTain will likely not override the effects of treatments used in the orchard that have been shown to accelerate fruit maturity. This would include aggressive treatments of various formulations of calcium in the attempt to combat disorders like bitter pit in cultivars like Honeycrisp.

It has been shown that aggressive use of calcium sprays can put ethylene levels in maturing fruit way over threshold levels several days ahead of control trees.

Chances of getting a response from ReTain on stressed trees or trees with poor foliage health (small, tattered and thin looking canopies) is not

good. As with all growth regulators, water volume and coverage are important in getting a response to using ReTain.

Stressed Out Trees

John Gardner, Apple Specialist, OMAFRA, London

One of the most recurrent words that I have heard this summer is stress. This refers mostly to stressed out trees but does not diminish the stress factor on growers looking for more predictable outcomes after hundreds of thousands of dollars in expense.

No doubt that this is a result of what I would call an asymmetrical weather pattern for the 2007 growing season. If I was asked what normal or seasonal is, I'm not sure how I would respond.

What we seem to be getting on average is earlier seasons and more and more volume of heat during our traditional growing season. There are elements in this "warming scenario" that could be argued as favourable but overall the unfavourable elements of this type of growing season can create havoc in the ways that we manage our orchards. Our harvest dates for indicator varieties seem to be on average getting earlier.

Rootstock selection can play a critical role under this aforementioned warming condition. What is not well understood by many is the degrees of tolerance that various rootstocks have for soil temperatures during the summer months. Way back in the 70's researchers Nelson and Tukey in the U.S.A. reported that the EM 9 was the most intolerant of high soil temperatures in the summer when compared to M26, EM 7 and MM 106. In fact the EM 9 performed best at 55 degrees F, poorly at 66 degrees F and poorest at 77 degrees F. This does help explain why we have better results from certain rootstocks during a hot summer like we are experiencing. Different strains of 9s no doubt vary in their tolerance to various soil temperatures.

One of the more outstanding ways of combating heat stress in the orchard that we have found is with the use of particle film "Surround Crop Protectant". In some cases, I would have to say that it mimics the effects of irrigation in terms of tree performance. In controlled studies, it allowed

trees to produce fruit in size classes that one would normally expect from an irrigated orchard. Fruit finish is an added bonus when using 'Surround® WP Crop Protectant'. Growers that are doing a lot of summer pruning to enhance fruit quality will also find that it largely prevents high cullage rates due to sun burning of shoulder areas of newly exposed maturing apples.



Aurora Golden Gala trees treated with a season-long 'Surround Crop Protectant' program are being compared to untreated controls.

No doubt at some point there is not a replacement for water delivered to tree in the form of irrigation. Many growers are reporting that micro irrigation systems had trouble keeping up with tree demand this year. This is understandable since evapotranspiration rates were enormous in general. These temperature extremes started during the fruit set period of crop development and contributed in my opinion to excessive June drop in some cases. Other physiological results from a high heat growing season can include bitter pit and water core. Stressed out trees do not absorb and utilize growth regulators the same way as trees that are not suffering from the effects of excessive heat or poor canopy development as in the case with ReTain. ReTain works best on trees that are considered to be functioning close to peak performance.

There seems to be more interest in Ontario in various forms of mulching. Mulching can be a costly option but if one was to do a cost benefit analysis for a high value cultivar I think the results would be positive.

If you do plan on introducing a mulching system based on non-synthetic materials (straw, wood chips) you will likely have to adjust nitrogen requirements since the amount of carbon present in the mulch will demand free nitrogen to build up bacterial populations. Mulches of course do keep soils relatively cool compared to bare ground. Under a heavy layer of straw, bait stations for mice are recommended. The longevity of mulches relates to the source and thickness. While a layer of woodchips may take several years to break down, wheat straw may last only 2-3 years. Both types of mulch systems can require dressing up on an annual basis, as soils vary in their relative degree of biological activity.

Under-Pricing Takes the Value Out of "Value-Added"

Carl Fletcher, Strategic Business Planning Lead, OMAFRA, Guelph

Under valuing or under pricing your value-added product or service is a common mistake in bringing a product to market.

What is the value of a product? The phrase "value bundle" is often used to describe all the attributes of a product that give it value to the user or consumer. This value can include:

- how well the product or service meets the required need,
- the convenience of use,
- the consistency or reliability of repeated purchases,
- how easy it is to purchase,
- how rare or unique the product is – what is the competition?
- how positive the relationship experience is between the supplier and purchaser,
- how the product supports the buyers values and belief systems or promotes a favourable image,
- and of course the price per unit.

Value is always determined by the customer but the responsibility lies with the product or service provider to make the customer fully aware of the product's attributes.

Sales price is a significant measure of the value of the product in the marketplace. Sales price also has a direct impact on your profit margin per unit

sold. Since total profit is the profit margin per unit sold times the number of products sold - sales price matters.

R. Gary Morton of Morton Horticultural Associates stresses the importance of not giving away your profit margin by setting prices too low or offering too generous volume discounts. This is a great temptation and a common mistake in introducing new products.

Gary uses the following table to illustrate his point. For example, you have a 25% margin (calculated as a percentage of sales price – for example-sales price \$1.00 per unit, cost \$0.75 per unit giving a margin % of 25 % -- $\$.025/\1.00×100). You want to know how much more product you will have to

sell if you reduce the price by 10% in order to end up with the same amount of profits as compared with the starting price and volume .

Locate the 10% row in the left hand column. Follow the row until it meets the 25% Margin Column. The result is that you will need to sell 66.7% more product at a 10% less price to give the same total margin.

If at the lower price you sell more than the chart result then you will have more total profits. Because the margin is calculated as a percentage of sales price, if you drop your price by the same amount as your margin then there is no profit as sales price equals the cost of production.

What Percent More You Must Sell to Equal Total Profits as compared to the Starting Price								
If you cut your price by %	Present Margin calculated as a Percentage of Sales Price							
	5%	10%	15%	20%	25%	30%	35%	40%
1%	25.0	11.1	7.1	5.3	4.2	3.4	2.9	2.6
2	66.6	25.0	15.4	11.1	8.2	7.1	6.1	5.3
3	150.0	42.8	25.0	17.6	13.6	11.1	9.4	8.1
4	400.0	66.6	36.4	25.0	19.0	15.4	12.9	11.1
5		100.0	50.0	33.3	25.0	20.0	16.7	14.3
6		150.0	66.7	42.9	31.6	25.0	20.7	17.6
7		233.3	87.5	53.8	38.9	30.4	25.0	21.2
8		400.0	114.3	66.7	47.1	36.4	29.6	25.0
9		1000.0	160.0	81.8	56.2	42.3	34.6	29.0
10			200.0	100.0	66.7	50.0	40.0	33.3
11			273.0	122.2	78.6	57.9	45.8	37.9
12			400.0	150.0	92.3	66.7	52.2	42.9
13			850.0	185.7	108.3	76.5	50.1	48.1
14			1400.0	233.3	127.3	87.5	66.7	53.8
15				300.0	150.0	100.0	75.0	60.0
16				400.0	177.8	114.3	84.2	66.7
17				566.7	215.5	130.8	94.4	73.9
18				900.0	252.1	150.0	105.9	81.8
19				1900.0	316.7	172.7	118.8	90.5
20					400.0	200.0	133.3	100.0
21					525.0	233.3	150.0	110.5
22					733.3	275.0	169.2	122.2
23					1115.0	328.6	191.7	135.3
24					2400.0	400.0	218.2	150.0
25						500.0	250.0	166.7

Too often volume discounts are offered that wipe out profits. Also it is difficult to raise prices once you have introduced the product so time and effort should be invested in getting it right the first time.

Too often people introduce a new product and aim at a price less than the existing market competitors rather than creating a product that is distinctive and then pricing and promoting the extra value of the product.

Again margin (and profit) is given away from the start putting unrealistic pressure on the product to sell quickly in order to get the sales volumes.

Finally, it is crucial to know your total cost per unit including production costs, marketing, selling, distribution costs and retail costs if applicable.

Make sure your business has information systems that can provide you with this information. If you don't know your real unit cost of production you cannot know your profit margin. Without knowing your profit margin per unit it is difficult to make let alone increase profits.

Understanding the interaction of sales price, sales volume and profit when introducing a new value added product or service leads to better decisions.

This article first appeared in the Better Decisions column of Better Farming.

A Taste of the Maritimes: Canadian Horticultural Council (CHC) Mid-Summer Apple Tour 2007 – Wolfville, Nova Scotia

Kathryn Carter, Apple IPM Specialist, OMAFRA, Simcoe

The Canadian Horticultural Council (CHC) mid-summer apple meeting/tour brings together government representatives, consultants, researchers and growers from across the country to discuss a variety of issues relating to the apple industry including Integrated Fruit Production, on-farm food safety, competitiveness, and trade. Following a one day meeting, the group toured local orchards in the area and discussed pest management, and fruit production. This year I had

the opportunity to attend this tour in Wolfville, Nova Scotia. Below are some of the highlights of the trip.

Altacor tour

DuPont Canada is conducting trials in apple orchards across Canada with Altacor (rynaxapyr) a new reduced risk insecticide. Trials in Nova Scotia focused on evaluating the efficacy of Altacor in managing 1st generation codling moth. In Ontario, trials were conducted evaluating the efficacy of this product in managing obliquebanded leafroller. The data presented from both provinces at this tour, suggest that this product is an excellent control product for codling moth and obliquebanded leafroller.

CHC summer tour

The tour was initiated at the Atlantic Food and Horticultural Research Centre (AAFC) in Kentville, NS.

Dr Gordon Braun (AAFC) conducted a fungicide trial for apple scab comparing the effectiveness of copper sulphate, lime sulphur, kumulus DF and hydrated lime applied during a prolonged wetting period. The results showed copper exhibited slightly better performance than the other products, however, the results were not statistically significant.

Dr. Julia Reekie (AAFC) is evaluating the use of reflective mulch in an organic Liberty apple orchard. The reflective mulch was installed on August 3, 2006 and apples were harvested 8 weeks later, and the colour of the apples was assessed. The results of the trial found that the treatment with the reflective mulch had 90% red apples and 10% green, while the treatment without reflective mulch had 75% red apples and 25% green. In 2007, the reflective mulch was installed earlier in the season (May 7, 2007) and data is being collected to evaluate the effect of the treatment on photosynthesis, tree growth and leaf morphology and fruit yield.

Dr. Mike Hardman is evaluating the impact of the size of herbicide strip on the mite complex in apple orchards. Dr. Hardman has found that orchards with wide herbicide strips have more problems with two spotted spider mites (TSSM) than orchards with narrow herbicide strips. Research

showed that there was a 60% higher ratio of TSSM eggs to adults in orchards with wide herbicide strips as compared to orchards with narrow herbicide strips.

The Nova Scotia Fruit Growers Association has initiated a trial evaluating Cocoflex and Flexterra mulches for their commercial value in preventing weed growth and enhancing the growing conditions below the drip line in commercial apple orchards. The results suggest that these products are promising for weed control. These products are made from all natural fibers and organic based polymers.

The tour visited Jerry van Oostrum, an apple grower in Canard. Jerry has reduced the size of his herbicide width and as a result has been significantly reducing the volume of herbicide applied on his farm without impacting his crop.

The tour also included a visit to a sweet cherry orchard that has been covered by tunnels. The goal of the tunnels is to prevent bird damage and to reduce pre-harvest splitting. The tunnels appear to be very effective.

The number of wineries in Nova Scotia has been increasing over the past few years, as growers have realized that they are able to produce a good crop of grapes. The tour visited Gaspereau vineyard, which produces several unique wines including L'Acadie Blanc, Seyval Blanc and New York Muscat.

Plan to Apply 2,4-D after Harvest in Orchards

Leslie Huffman, Weed Management Specialist (Horticultural Crops), OMAFRA, Harrow

Apple, peach, pear, plum, apricot and cherry growers have an excellent tool to cleanup broadleaf weeds with the application of 2,4-D Amine for dandelion control. Although this treatment is registered for either spring or fall, the fall timing can be very useful to reduce weed pressure next spring.

2,4-D Amine can be used after harvest on actively growing weeds. For apples, all juice apples need

to be cleaned up off the orchard floor before application. These two requirements may limit the usefulness of the timing to earlier harvest apples. However, in southwestern Ontario, we tested 2,4-D in apples as late as November, which resulted in excellent weed control of dandelions the next spring. The key is for weeds to be actively growing and to apply before fallen leaves block contact with weeds.



Where weeds like Canada thistle, sow-thistle or Canada fleabane seeds have blown into your orchards this summer, and seedling weeds are now establishing, a fall application of 2,4-D Amine can be very effective in controlling the seedling stage.

Again, be very cautious to avoid drift (including vapour drift) that can damage neighbouring plants like grapes, tomatoes, greenhouses and ornamental plants around homes, even with the fall timing.

Weeds In Late Summer – Are They Worth Chasing?

Leslie Huffman, Weed Management Specialist (Horticultural Crops), OMAFRA, Harrow

Orchard weed control was looking good, especially where little rain had fallen to stimulate late weed germination. But where rains have come (even small showers), weed escapes have established under trees. The question now is: Are weed control efforts worth it at this time in the season?

We know from critical period research that only early season weeds will reduce yields. So from a money-return viewpoint, the answer would be NO, Don't bother controlling weeds now as there will not be any more increase in yield.

However, there are other factors to consider:

- Late weed escapes may hamper harvest. This is especially true for early escapes of pigweed and lamb's-quarters, which harden into "trees" and impede pickers. Also, picking up juice apples is much more efficient if weed growth is weak.
- Weed escapes will produce seeds, and may increase weed problems in the future. So for difficult weeds (especially perennials like thistles and quackgrass), it may be worth controlling them now (or preventing seeds).
- Thick weed cover may encourage rodents. Predators like hawks may have more difficulty in hunting rodents where weeds are thick.



Have you considered the benefits of late weed escapes? A cover of weedy growth under your trees can have many benefits including:

- Reducing rot in juice apples
- Preventing soil erosion (from both water and wind)
- Encouraging trees to harden off (by absorbing both moisture and nitrogen)
- Providing refuge for beneficial insects
- Adding organic matter to the soil (small quantities, but every bit helps)
- Encouraging soil organisms to flourish, in some cases encouraging herbicide breakdown

As you make your decision on further efforts to manage weeds, make some notes about problem areas for weeds to help you prepare your weed strategy for next season.

CROP PROTECTION

Biocontrols for Fire blight: What's in a Name?

BlightBan C9-1, BlightBan A506 and Bloomtime

Kathryn Carter, Apple IPM Specialist, OMAFRA, Simcoe and Antonet Svircev, AAFC Research Scientist

BlightBan C9-1 (Nufarm Agricultural Inc.) and Bloomtime (Northwest Agricultural Products) are registered biological control agents or biopesticides made available to Canadian apple and pear growers. These biopesticides contain different strains of a commonly occurring orchard bacteria *Pantoea agglomerans*. Most people are not aware that there are actually two products called Blightban. Here in Canada, Blightban C9-1 is registered, while in the US growers have access to Blightban A506 (*Pseudomonas fluorescens*).

BlightBan A506 was the first commercial biological control product for fire blight and it was registered in the US in 1995. A506 uses the bacterium *Pseudomonas fluorescens* A506. This bacterium multiplies rapidly and colonizes open flowers competing with the bacteria that cause fire blight (*Erwinia amylovora*) for nutrients on the blossoms. This antagonist must be applied before *E. amylovora* is present in order to be effective.

BlightBan C9-1 contains another bacterium *Pantoea agglomerans* strain C9-1. C9-1 produces multiple antibiotic compounds on its own that inhibit the multiplication of the fire blight pathogen in the floral cup. C9-1 must be applied to the flower before the arrival of the pathogen in order for it to be effectiveness. BlightBan C9-1 is currently in the registration process in the US.

Researchers, A.M. Svircev (AAFC-Vineland), A. Castle (Brock University), Peter Sholberg (AAFC-PARC), Vincent Phillon (IRDA-QC) and V.

Toussaint (AAFC-QC) are conducting demonstration trials with BlightBan C9-1 and Bloomtime using research orchards artificially inoculated with *E. amylovora*. In Ontario, trials with the same biopesticides are being carried out by B. Solyman, EarthTramper Consulting Inc. The efficacy of both biopesticides is greatly influenced by environmental conditions and proper timing of application. Biopesticides are not stand alone products and should never be used on their own to manage fire blight.

The biopesticides, BlightBan C9-1 and Bloomtime, should be used in an integrated fire blight control program which includes the use of a risk assessment model (Cougarblight or Maryblyt) and Streptomycin 17. Agriculture and Agri-Food Canada information factsheet on “New Biopesticides Help Manage Fire Blight: Good News for Apple and Pear Growers” is available at AAFC-Vineland, Reception Desk.

Exploring Fire Blight Management, Part I: Models

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

Fire blight, a disease primarily of pear and apple, has been recognized as a serious problem for over 100 years. The disease, caused by the bacterium *Erwinia amylovora*, is a perennial issue for growers in Ontario with some seasons being more conducive to the spread of the disease than others. Some research presented at the 11th International Workshop on Fire Blight in Oregon in August, 2007 may help to explain why the disease continues to elude the best efforts at management, at least in some years.

Models for predicting fire blight infection periods can help determine appropriate timing of antibiotic sprays (streptomycin in our area) or antagonistic bacteria applications (*Pantoea agglomerans* from “Bloomtime” or “BlightBan”). Models such as Maryblyt and Cougar Blight have proven exceptionally useful over the last two decades. Growers should be using these models or at least consulting regional reports that mention infection periods. However, these models do not provide perfect prediction and cannot guarantee disease

control. As Lawrence Pusey and Tim Smith (both from Washington) pointed out, there are multiple factors – some still poorly understood – that explain why something as simple as a four day temperature evaluation prior to a wetting period (as used in Cougar Blight) actually manages to usually effectively predict the potential for infection.

The four day period was originally incorporated into the model based on an assumption that flower stigmas support the growth of *E. amylovora* for only a few days after flower expansion. It is now known that flowers can be infected for a much longer period depending on environmental conditions, and that there is a continuum of multiple peaks of infection risk as new flowers open especially in areas where orchards bloom at different times because of gradients in climatic factors. Nonetheless, Cougar Blight and other models definitely assist in predicting peak infection periods and these models should always be used as part of an integrated approach to disease management.

No model can predict all blossom infections though. For one thing, models predict peak infection activity not all infections. In addition, there are sources of infection that the models cannot possibly predict or take into account (see Part 2 of this series on fire blight – “Infection Sources”).

The key to remember is that perfect control is unlikely in most years unless chance favours you through ideal environmental conditions for flowering but not for fire blight infection and there are no systemically infected blossoms already present in the orchard. As well, antibiotic sprays must be well-timed by the models (which are imperfect). Applications must be made under ideal conditions and with excellent coverage, follow-up monitoring, and additional application where needed.

Much work on the basic biology of *E. amylovora* continues and will help to refine the predictive disease models (for example, work at Cornell by Dewdney *et al.*, 2007). Predictive models are only part of the fire blight management puzzle; good management practices in all aspects of the

disease are necessary for adequate suppression of fire blight.

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Exploring Fire Blight Management, Part 2: Infection Sources

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

The most serious disease of pear and apple worldwide is fire blight, caused by the bacterium *Erwinia amylovora*. Infections can occur through various routes and the bacteria attack all parts of a tree, so symptoms are referred to by the plant part affected: blossom blight, shoot or twig blight, fruit blight, limb and trunk blight, and collar or rootstock blight.

The main reservoir of the bacteria is in cankers of infected trees. When the trees break dormancy in the spring, bacteria in cankers begin to multiply and can be spread to susceptible tissues, especially open blossoms and to a lesser extent into new shoots. Secondary infections can occur throughout the growing season, both from infected shoots and from oozing cankers. Rain, wind and insects can spread the disease.

Unfortunately, there are sources of bacteria and routes into susceptible tissues that cannot be

controlled. Researchers from Germany have observed that some blossom infections can actually come from within a previously infected tree (Moltmann and Viehrig 2007). In such situations, systemically infected trees showed blossom blight before it was warm enough in the spring for fire blight cankers to be a source of bacteria. In other words, the blossom infections occurred from bacteria moving systemically within the shoots rather than being moved into open blossoms from outside the tree. Antonet Svircev from AAFC in Vineland supports this concept based on observations that pear shoots cut in the winter (no chance of bacteria from cankers elsewhere in the orchard in winter) and forced to blossom in the lab do sometimes have *E. amylovora* present. These findings are a reminder that systemically infected trees are best removed entirely from the orchard so as not to be a continual source of secondary infections, early and late in the season.

It is also unfortunate that one of the primary insect vectors of the bacteria is one which is needed for pollination. Honey bees regularly pick up the bacteria from infected blossoms and unwittingly move it to other blossoms in their quest for nectar and pollen in the orchard. Austrian researchers have been working to overcome this problem by having honeybees deliver microbial fire blight antagonists (microbes that out-compete fire blight bacteria in the blossoms). Although more work is needed to fine tune dispenser construction and product formulation, the work has so far shown that honeybees can easily be manipulated to carry effective loads of strains of *Aureobasidium pullulans* to blossoms. *A. pullulans* is a fungus that competes with the fire blight bacterium but the product ("Blossom Protect") is not yet available in Ontario. Other insects such as pear psylla are also implicated in the spread of fire blight, so insect pest management is directly related to fire blight management.

Rain can spread *E. amylovora* from tree to tree or blossom to blossom. In fact, the bacteria can survive in water for some time. Researchers from Spain have demonstrated that the bacteria survive best in cooler water (5° C versus 26° C) and that they can survive in nutrient poor water and retain the ability to infect plants for at least 45 days and

as long as three years (Biosca et al. 2007). The mere presence of *E. amylovora* is nothing to be alarmed at though; there are bacteria everywhere, and *E. amylovora* in particular has been found in cherry and dandelion blossoms near pear orchards (Moltmann and Viehrig).

Infected tissues (especially oozing cankers) remain as the biggest source of secondary infections. A lively discussion on the appropriate time and methods of pruning fire blight strikes took place at the International Fire Blight Workshop this year. There is still a variety of opinions on pruning and especially on whether to remove prunings immediately or let them dry down in row middles before mowing. Part of the disagreement comes from the large number of prunings some areas have to deal with during the growing season as well as the uncertainty of whether workers can be careful enough to avoid spreading fire blight from actively oozing cankers. A few prunings in the row middles are likely not a significant source for fire blight spread but improperly handling those prunings on the way out of the orchard may be. Most participants agreed that sterilization of pruning tools was not necessary to avoid spreading the bacteria as long as shoots and wood were dry (remember the bacteria live quite well in water). Some felt that occasionally cleaning pruning tools with straight Lysol was prudent. Philion *et al.* (2007) found no benefit from sterilizing pruning tools when working with a young orchard newly infected with fire blight. They also showed that pruning reduced the severity of the disease but not disease incidence.

When considering the question of when and if to prune out fire blight strikes, it is a good idea to question how much chance there is of continued spread throughout the year. If high winds, heavy rains, or lots of insect activity (including pear psylla) are forecast, natural spread could be significant if infections are not removed.

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Late Season Pests of Apples

Kathryn Carter, Apple IPM specialist, OMAFRA

As harvest of early season varieties (Paula reds) begins, things become even busier in the orchard. With harvest in full swing, it can be difficult to find the time to continue monitoring for pests and applying control measures. However, there are some important late season pests of apples that if left uncontrolled can be a nightmare at harvest.

Insects

Codling moth

Second generation codling moth flight has begun and insecticides have been applied in most areas of the province. There has been an increase in codling moth damage in apples over the past few years. There are several potential reasons why this may be occurring including pesticide resistance, improper spray timing and coverage. Dr. Ian Scott, a toxicologist from Agriculture and Agri-Food Canada, is hoping to conduct some research to evaluate the development of pesticide resistance in codling moth populations. In the meantime, growers should be sure to keep their crop protected from this pest. Since codling moth flight can continue into the end of August, growers should maintain coverage for this pest. Preferred products for codling moth at this time of year are border sprays of OP insecticides (in orchards that are uniform in shape and size and have not had a history of damage over the past few years) or cover sprays of neonicotinoids. OP insecticides (Imidan, Guthion) should be re-applied every 18-21 days to ensure an adequate residual. Cover sprays of neonicotinoids such as Calypso and Assail provide control of both codling moth and apple maggot. These products should be applied every 10-14 days to ensure adequate residual. Rimon and Intrepid are also registered for controlling codling moth; however, they do not provide subsequent control of apple maggot.

Apple maggot

Despite the hot dry weather, monitoring by apple consultants suggest that apple maggot pressure is high this year. Apple maggot is a quarantine pest and there is zero tolerance for damage. The application of OP insecticides or neonicotinoids to control codling moth will also control apple maggot.

Oriental fruit moth

In 2001 and 2002, apple growers in Norfolk, Leamington, and Niagara were seeing considerable crop loss from Oriental fruit moth. With no products registered, growers had few options available for managing this pest. Over the past few years, growers have done a great job of managing OFM using mating disruption and/or insecticides (Assail, Calyspo, Intrepid, Rimon), and as a result there has been very little incidence of damage from OFM at harvest. However, it is important to remember that OFM has not been eradicated from orchards. There are many wild hosts for OFM and although we are not seeing damage from this pest in orchards, we still need to manage it. This year we have started to see an increase in OFM damage in orchards that have stopped using mating disruption and/or reduced insecticide applications targeting this pest. Late season OFM can cause considerable damage to apples, and damage can go undetected through a packing line resulting in quality issues.

Diseases

Pin Point apple scab

Despite the hot dry year, apple scab is present in many apple orchards across the province. The presence of this inoculum increases the vulnerability of the crop to pin point scab. Pin point scab develops when fruit become infected during the last several weeks before harvest. Fruit with late season infections may not exhibit symptoms at harvest; however, lesions can develop on the fruit during the first 30-45 days in cold storage. Optimum conditions for pin point apple scab include: 1) abundant scab inoculum, 2) lack of fungicide residue before harvest, and 3) wetting periods longer than 30-36 hours occur after the fungicide residue is depleted. Late season Captan cover sprays should be applied

leading up to harvest in orchards with optimum conditions for pin point scab.

Black rot

There has been an increase in the incidence of black rot in orchards in recent years. One of the reasons there is more black rot showing up is due to the cold injury in some orchards a few years ago. The black rot fungus colonizes wounded branches, causing cankers, and acts a source of inoculum. Chemical thinners that leave small fruit are very susceptible to colonization of the black rot fungus, resulting in mummification, which then acts as a source of inoculum for mature fruit near harvest. These mummified small fruit left on trees from chemical thinning become infected with black rot and late season rains and dews spread the fungus from the fruit mummies onto developing fruit. Although the heaviest infections from black rot occur during the four to six week period following petal fall, secondary infections can occur throughout the summer. Keep fruit protected with Captan, Sovran or Flint.

Flyspeck and Sooty blotch

Flyspeck and sooty blotch are summer diseases that begin to appear on apples from mid summer through harvest. Flyspeck and sooty blotch can be controlled by most fungicides that manage scab, except Nova and Nustar. Where flyspeck and sooty blotch are a concern, fungicide programs should be initiated in August and September and continued through harvest.

What Did We Learn? A Wrap-Up of the Orchard Sprayer Workshops.

Denise Beaton, John Gardner, Kathryn Carter, Todd Leuty, Helmut Spieser, OMAFRA

In June and July of this year, the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) held 5 orchard sprayer workshops across the apple-growing regions of Ontario. The purpose of these workshops was to evaluate sprayer performance and recommend ways to improve coverage and spray deposition.

At the workshop, we looked at the spray deposition with different water volumes, air speeds (no air at some sites), travel speeds and cover

sprays versus alternate row sprays. We used the spraying practices typically used by the grower on site as the standard.

These side by side trials were installed before the workshop started using Surround® WP Crop Protectant. Surround WP is a useful visual tool for checking spray deposition.

What did we find out? At some sites alternate row spraying didn't look too bad, depending on factors such as canopy thickness and porosity. However, at each site it was shown that alternate row spraying was not as consistent as spraying every row. While spraying every row does take extra time and fuel, the probability of getting better coverage is very good. Just think of apple scab. Poor coverage for this disease normally results in poor control.

From a quick visual assessment, there didn't appear to be any disasters when comparing the different water volumes, air speeds and travel speeds trials. There appeared to be slightly better coverage with a higher water volume.

Also, using some air helps with droplet distribution and deposition; however, if the air speed is too high, too much spray may be forced through the intended target row setting up two or three rows over.

Another demonstration was shown using a patternator that was built by John Gardner and other OMAFRA staff, using the design principles developed by Dr. Andrew Landers of Cornell University.

The sprayer is readied and positioned beside the patternator, roughly the distance it would be from the row during spraying. The patternator takes a sample of the wall of spray delivered by the sprayer at different height intervals all done from a stationary position. A more detailed description was given previously in the June 2007 Orchard Network Newsletter. This is not a quantitative test. It is a tool that shows where the spray is going at different heights. What we were looking at during these workshops was pattern symmetry.

When using the patternator, if it is shown that disproportionate amounts of water are collected at

various heights in the canopy, adjustments to the sprayer should be made. This may involve resizing, turning off certain nozzles or adjusting nozzle angle and/or airflow pattern. Clogged nozzles show up wonderfully well when using the patternator.



OMAFRA Specialists Kathryn Carter, Todd Leuty and John Gardner ready the patternator at one of the sites during the recent sprayer workshops held across Ontario.

Information on windbreaks was covered at the workshops. Highlights of this presentation were:

- 1 to 3 rows of trees is optimal for windbreaks
- Plant at least 3 different tree species, such as spruce, pine, white cedar, gray alder, Russian olive (note: Russian olive is not a host for fire blight)
- 50% porosity is ideal (50% is air space; 50% is needles, leaves and branches)
- For an effective spray drift buffer, the windbreak should be about twice the height of the spray release height. A width of 30 to 100 feet, consisting of diverse trees, shrubs, vines

and herbaceous plants will effectively catch 50 to 90 percent of drifting spray material. Conifers ensure drift buffers are working early in the spring before other deciduous species have leafed out.

Another point raised was that spray record keeping is becoming increasingly more important. Plan to keep detailed records of your pesticide applications. It is a good idea to include the wind speed at the time of spraying in these records.

A special thank you to Paul Frankis, Murray Porteus, Art Moyer, Charles Stevens and John Ardiel for hosting the sprayer workshops. Also, thanks goes to the sprayer equipment dealers for presenting on nozzle orientation and new sprayer technologies. We appreciate the time and effort all of you put towards these workshops.

Thank you to BASF Canada Inc. and Engage Agro for supplying the Surround WP for the spray demonstrations. We are grateful for the support. Also, thank you to the growers and consultants for attending these workshops. It is encouraging to see Ontario growers continuing their education in pesticide application.

POSTHARVEST

B.C. Experiences with 'Ambrosia' Maturity

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

During a recent meeting with the New Variety Development Council in Summerland, BC it was suggested that I share their experiences with 'Ambrosia' in BC with the apple growers in Ontario. As a result, Charlotte Leaming (with the Okanagan Tree Fruit Company field service) generously supplied me with an array of notes to create this article from.

Growers have the greatest influence on the eating quality of 'Ambrosia' apples out of storage by harvesting at optimal maturity. This will minimize firmness loss and disorder development during storage. In a 3-year study from 2001 to 2004, Dr. Sam Lau refined optimum harvest maturity and storage guidelines for 'Ambrosia'. On the 9-point

starch chart that he developed, 'Ambrosia' should be harvested at:

- 2.5 to 3.5 for 5-6 months in CA
- 3.5 to 5.0 for 2-4 months in CA
- 5.0 to 6.0 for short-term storage and immediate consumption only

Average starch movement is 1.5 points per week, although in warm years starch movement can be considerably quicker. The harvest window is shorter than many cultivars, normally lasting 7-10 days.

'Ambrosia' should be harvested based on the starch charts. Once sufficient starch clearing has occurred, all fruit down to the minimum colour requirements should be harvested. A second harvest may be made 4-7 days after the first. 'Ambrosia' may be harvested in one or at most, two picks.

According to Dr. Sam Lau, 'Ambrosia' has a 7-10 day harvest window if fruit harvest is initiated at a starch index of 2.5 (22% of the cross sectional areas clear of starch) on a 0-9 scale. For each additional day of harvest delay after the starch index has reached 2.5, the harvest window for a given block will be reduced by 1 day and the storage life reduced by 1 week or more (particularly in late picked fruit with starch index >5.0). Fruit destined for 4-5 month storage are best picked at a starch index of 2.5-4.0 (22-28% of cross sectional area clear of starch).

Although red-colour development occurs within a few weeks of harvest, it is not a good indicator of maturity. The amount and intensity of red colour depends on the nutritional status of the trees, as well as the day and night-time temperatures close to harvest.

Current colour requirements for 'Ambrosia' packing is 30% #4 red colour for Extra Fancy and 25% #2 red colour for Fancy. Often the first pick can take-off 80% of the crop, but most growers do not pick deep enough on the first harvest. Growers should pick right down to the minimum colour for Extra Fancy. However, do not wait until the background is yellow to harvest, as the fruit will be over-mature for storage. Background colour has more to do with nitrogen levels in the fruit than maturity and background colour usually changes in storage. 'Ambrosia' colour charts, developed by Rita Yastremski, are available to growers through the New Variety Development Council (BC) for \$15.

Guidelines for CA Storage of Apples Treated with SmartFresh (1-MCP)

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

'Empire'

SmartFresh (1-MCP) on 'Empire' apples increases the risk for external CO₂ injury, and the use of ReTain further increases this risk. The best precaution is to drench with DPA (≥ 250 ppm) at harvest time and then standard CA (2.5% O₂ + 2.0% CO₂ at 2°C) can be used. Note – DPA is registered as an inhibitor of superficial scald and thus must be applied according to the label for that purpose. An alternate precaution is to hold the CO₂ concentration below 0.5%, especially for the first 30 days of storage. However, there may still be a small risk of external CO₂ injury without the use of DPA. Research in New York by Watkins et al. recently showed that if 'Empire' fruit are not cooled after SmartFresh treatment and before application of CA then there is a substantial increase in the risk of CO₂ injury development. CA storage for longer than 8 months increases the potential for internal browning and low temperature disorders in 'Empire'.

'McIntosh'

SmartFresh on 'McIntosh' apples also increases the risk for external CO₂ injury, and ReTain further increases this risk. Similar to 'Empire', the best precaution is to drench with DPA at harvest time and then standard CA (2.5% O₂ + 2.5% CO₂ 1st month and 4.5% CO₂ thereafter, at 3°C) can be used. An alternate precaution is to hold the CO₂ concentration below 2.5%, but there may still be some risk of external CO₂ injury without DPA. Elevated CO₂ improves the firmness retention of 'McIntosh' in long-term storage, so its reduction could lead to greater softening as the effects of SmartFresh become reduced with time. CA storage for longer than 8 months increases the potential for internal browning and low temperature disorders in 'McIntosh'. Therefore, maintaining the recommended storage of 3°C is important, although senescent core browning may become a problem with increased storage duration.

Other Cultivars

The standard CA recommendation of 2.5% O₂ + 2.5% CO₂ at 0°C for 'Delicious', 'Idared', 'Northern Spy', and 'Spartan' can also be used when these fruit are treated with SmartFresh. Conversely, 'Gala'

treated with SmartFresh should be stored in standard CA (2.5% O₂ + 2.5% CO₂) at 3°C due to chilling sensitivity.

Effects of CA Storage, SmartFresh (1-MCP) and Cooling Delays on 'Honeycrisp' Apples

Dr. Jennifer DeEll, Fresh Market Quality Program Lead, OMAFRA, Simcoe; and Dr. Dennis Murr, University of Guelph

The following is a brief summary of one experiment from the 2-year project *Optimum Postharvest Handling and Storage of 'Honeycrisp' Apples*, which is supported by the Ontario Apple Growers through the CORD funding program and the Agricultural Adaptation Council.

'Honeycrisp' apples were harvested three times (September 11, 15 and 25th) from a commercial orchard in Norfolk County, Ontario. Each harvest consisted of 27 boxes taken randomly from several 7-year-old trees on M7 rootstocks. Three boxes (reps) from each harvest were handled and stored as follows:

1. held for 5 days at 3°C and then placed into CA-1 (2.5% O₂ + 2.5% CO₂)
2. held for 5 days at 3°C and then placed into CA-2 (1.7% O₂ + 1% CO₂)
3. held for 5 days at 10°C and then placed into CA-1 (2.5% O₂ + 2.5% CO₂)
4. held for 5 days at 10°C and then placed into CA-2 (1.7% O₂ + 1% CO₂)
5. treated with 1-MCP at 3°C and stored in air at 3°C
6. no 1-MCP and stored in air at 3°C
7. held for 5 days at 10°C, then treated with 1-MCP at 3°C and stored in air at 3°C
8. held for 5 days at 10°C, no 1-MCP and stored in air at 3°C
9. treated with 1-MCP at 10°C, held for 5 days at 10°C, and stored in air at 3°C

All 1-MCP (SmartFresh™) treatments consisted of 1 ppm for 24 hours. Fruit were held for 4 and 6 months in either controlled atmosphere (CA) or air storage as noted above.

Table 1 - Maturity of 'Honeycrisp' apples at harvest

	IEC (ppm)	Diameter (cm)	Blush (% red)	Firmness (lb)	SSC (%)	Starch (1-8)
Harvest 1 = Sept 11	4.19	9.0	80.5	15.3	13.0	4.7
Harvest 2 = Sept 15	10.89	9.3	73.5	15.4	13.0	4.5
Harvest 3 = Sept 25	28.08	9.1	84.0	14.4	13.2	6.7

* Each value is the average of 10 fruit

IEC = internal ethylene concentration, SSC = soluble solids concentration

Overall, 'Honeycrisp' apples stored in CA tended to be slightly firmer (1-2 lb) and have lower internal ethylene (IEC) and higher soluble solids concentration (SSC) than those stored in air. However, upon removal to room temperature, IEC of the CA-stored apples quickly increased and became similar or higher than the levels found in fruit from air storage. CA-stored fruit did not appear to soften much during storage nor during the post-storage 7-day ripening period at 22°C. However, in air-stored apples there was some flesh softening during storage and ripening, especially in fruit from harvest 3. There was little difference between apples from the two CA regimes.

Bitter pit and lenticel breakdown were found in CA-stored fruit, with higher incidences in apples from the first harvest (up to 36 and 14%, respectively). Fruit that did not receive a cooling delay of 5 days at 10°C tended to have less lenticel breakdown than those subjected to the cooling delay. Some external CO₂ injury developed in CA-stored 'Honeycrisp' from the first harvest (up to 13%), but this was likely due to an unstable CA regime during the first week of storage. It is worth noting that the incidence was highest in apples that did not receive a cooling delay and were held in CA with 2.5% CO₂. Soft scald developed on a few apples in CA, but there was no apparent association with any specific treatment.

Some low temperature breakdown developed in apples stored in CA and this was more prominent

in fruit from the first harvest (up to 23%). However, it is important to note again that the CA regime was not stable for fruit from the first harvest for the first week of storage. There appeared to be greater incidence of low temperature breakdown in apples that did not receive a cooling delay of 5 days at 10°C, but this needs to be investigated further with more steady CA regimes.

In general, 'Honeycrisp' treated postharvest with gaseous SmartFresh (1-MCP) had lower IEC than those not treated. However, this effect was less evident with more time in storage and in later harvests. The lowest levels of IEC were found in fruit treated with SmartFresh and not subjected to a cooling delay (<2 ppm). There was little difference in fruit firmness and SSC among apples from the various treatments.

Bitter pit also developed in air-stored fruit, with the lowest incidence in fruit treated with SmartFresh and not subjected to a cooling delay. Lenticel breakdown occurred in a few apples held in air storage, but the incidence was much lower compared to CA-stored fruit.

Core breakdown developed in air-stored 'Honeycrisp' and there tended to be more in SmartFresh-treated apples with no cooling delay (up to 47%). There was no core breakdown in CA-stored fruit, whereas there was no low temperature breakdown in air-stored apples. These types of disorders need to be investigated further before any conclusions can be made.