



# ORCHARD NETWORK

For Commercial Apple Producers

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## **ORCHARD MANAGEMENT**

### **Capping the Season**

*John Gardner, Apple Specialist, OMAF, London*

It's been an interesting growing season with lots going on here at home and on a global basis in terms of change and adaptation to production and marketing of apples. Anyone looking for a comfort zone to settle into in the business of apple growing better not decide to stay there too long. It's been a busy 4 months leading up to and into harvest with a lot of decision making to get us there. The spring was as tough as I have ever seen in terms of scab control.

Some growers are reporting very heavy crops while others are reporting average yields. This is no doubt a response to heavy rains in mid September over much of Ontario's apple acreage. Growers are reporting some good results with Retain on Macs and Galas. There should be more well finished king bloom apples this year as compared to the last 2 years.

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Newsletter** was compiled by  
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The brutal heat in Europe for much of the summer appears to have had quite an impact on their tree fruit industry, which includes apple.

I can imagine what a struggle it would be to keep apple trees happy with daily temperatures in the high 30s and into the mid 40s centigrade. We are also seeing this year a fair degree of russetting from spring weather conditions.

The Ontario marketplace remains a jewel of destination to produce marketers outside of this Country. Honeycrisp continues to win a greater following in the Northeast and in particular Ontario. Retail prices for this cultivar are impressive in some niche markets. I was not surprised to see some of China's Fuji apples finally arrive in significant volume to some of our retail stores here in Ontario. They appeared to be very carefully packed and presented. I thought by the colour of the fruit that they may have been bagged on the tree to give the pinkish hue.

Bagging apples on the tree for colour enhancement was at one time estimated to cost around \$0.15 per apple here at home with most of that flagged as labour charge. I just wonder what % of the Chinese crop of 350,000 acres of Fuji trees will eventually end up outside of China as infrastructure in that country improves. It's going to become much easier to find various goods from China being sold in Ontario, as they become full participating partners in the world trade organization.

Interesting to note, that the big push in the U.S.A. with the various apple research partners from state to state is the work to reduce cost of production in order remain globally competitive in the foreseeable future. One of the primary targets will be labour and how it's used in the orchard. No doubt, tighter acreages and more friendly tree growth habits will play a large role in identifying those elements of production that require less hands on manipulation and smoother traffic flow up and down the tree rows as labour crews go about their business.

In talking with various breeders, selections of apple with poor growth habits that are not suitable for high-density culture don't get too far along the evaluation trail. We are seeing this at home with some of the newer cultivars and selections that provide fruiting habits far superior to their namesake cultivars. I do like the growth habits of a variety like Ambrosia, which I am seeing in a fruiting habit on maturing trees for the first time here in Ontario this year. Our cultivar trials that were set out starting 4 years ago at 8 sites here in Ontario are showing nice results this year.

It's getting tougher to be a good business person in the fruit growing industry. I do see some interesting ways that growers are diversifying their farming enterprises and adding value to their crop on the farm. Many individuals in this business have the capability to do one thing very well and this went a long way at one time. Most growers are great dreamers, while some function best at production level while other function best as marketers or business decision-makers. It's rare to find an individual who possesses all of these traits. If I were asked to characterize what makes a successful business individual, I would say that they do several things well:

1. They are not afraid to move the bar higher on the standards and use their experience and knowledge to refocus on goals that they may have considered unachievable at one time or another in their careers.
2. Their success is not measured strictly by money but mostly by achievement. They do take time to enjoy the journey and pay special attention to relationships and industry partnerships.
3. Successful business people don't settle into comfort zones for any longer than it takes to reflect and hypothesize new strategies.
4. They are great at measuring risk and weighing the "what ifs". They usually have had a pretty good rate of failure at one time or another and learn quickly. They are also able visualize future events and happenings long before they come to realization.

## Fall Orchard Clean-up

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

With apple harvest underway, preparing your orchard for winter may not be a top priority. However, there are several things that growers can and should do to help get their orchard ready for the 2004 season.

This has been a particularly good year for fire blight infections, and it is not unusual to walk through an orchard and see infected terminals and/or limbs. *Erwinia amylovora*, the bacterium that causes fire blight, overwinters in cankers on

the tree. When temperatures begin to rise in the spring, the cankers begin to ooze, creating a source of infection that can spread within and between trees. As a result, orchard blocks with fire blight cankers provide an inoculum for the spread of this disease. Removal of fire blight cankers in the dormant season can reduce the amount of fire blight in the orchard in the spring, and reduce the spread of the disease. Sometimes these cankers can be difficult to see in the winter, so some growers may find it easier to mark limbs or terminals infected with fire blight during harvest (using paint or flagging tape) so they can easily be removed in the winter.

This time of year also brings the return of rodents back into the orchard. Small rodents usually feed on grass seeds, herbs and bulbs during the spring and summer and then shift to feeding on bark in the fall and winter. Each year voles (mice), and rabbits cause significant economic injury in Ontario apple orchards.

During harvest look for indications of mice in the orchard, such as tunnelings, droppings, fresh grass clippings in the runways, and chewed apples. Dropped apples should be removed from the orchard after harvest since they attract rodents into the orchard, and provide an alternative food source, thereby reducing the effectiveness of poison baits.

There are two methods of using poison baits to control mice in orchards. The first method involves the broadcasting of the bait over the orchard floor before the grass falls over and the ground is covered with snow. This bait should be applied on bright sunny days when rain is not expected for several days. The problem with broadcasting bait is that often non-target animals (cats and dogs) can be poisoned unintentionally.

Another method of poisoning mice is the use of a bait station, which provides control for a longer time period than broadcasting. The "inverted T bait station" is possibly the most effective type of bait station available. Several teaspoons of bait are placed in the neck of the station and capped to protect the bait from the elements. The use of bait stations may result in fewer accidental poisonings, since the size of the station may prevent some non-target animals from entering. Bait stations should be used at a rate of

approximately 25 per hectare (10 per acre). These baits are poisonous to humans, domestic animals and wildlife, so follow all safety instructions on the label.

Mouse guards can also be used to protect trees from rodents. The most commonly used commercial mouse guards are spiral plastic or galvanized wire mesh guards. Wire mesh guards should be used in orchards with a history of dogwood borer damage, since spiral guards restrict the air flow around the trunk and provide excellent egg laying sites for borers. All tree guards should be checked each fall to ensure they are mouse tight, and are not interfering with root development. Spiral guards can cause severe problems with tree hardiness by preventing bark from maturing properly if the guard is too tight or left on the tree too long after planting.

Rabbits can damage fruit trees in winter months by feeding on the tree bark. Rabbit populations can increase quickly making controls important to reduce damage in the orchard. In the past apple trees have been painted in the early fall with a rabbit repellent latex thiram paint. However, the PMRA is currently re-evaluating this product, and as a result these products may not be available to apple growers this year. As an alternative wrap sacking around the top of the trunk above the mouse guard may help to protect young trees from rabbits. The wrapped tree should be secured to a strong stake to prevent snow and ice from breaking the tree. Mouse guards generally do not give protection against rabbits when the snow is deep.

As winter approaches, the leaves will begin to fall off the apple trees. These leaves provide an inoculum for diseases such as scab, as well as pests such as tentiform leafminer that pupate within these leaves, and emerge in spring. One of the best ways to minimize carryover from these pests is by flail mowing fallen leaves in the autumn or early spring, or by applying urea to leaves after harvest to decrease the amount of ascospores.

Following any or all of the practices listed above can help to prepare the orchard for the 2004 season. Remember the preventative practices you use today may help to reduce pest and disease problems next spring.

## Apple Team Members Visit Michigan Researchers

*John Gardner and the Ontario Apple Team*

In early August of this year, a few members of the Ontario Apple Team met with research and extension staff in Michigan. The objective was to check out what these teams of researchers were focusing on. Included in the group from Michigan were Phil Schwallier and Drs. Ron Perry, Larry Gut, David Epstein and Mark Longstroth.

Phil was working on new thinning materials called Exilis and MaxCel. These two thinners don't have the gibberellins present as in Accel. They are formulated using BA or benzyladenine. Phil's work focused on rates and their effect on crop load and return bloom.

Michigan does have an interest in Super Spindle from the perspective of accelerated return on investment. Phil had a plot where he was using the "Linda" strain of McIntosh in very tight inrow spacings. This cultivar is not the ideal one for super spindle because of its growth habit. When the growth regulator Apogee was used in this experiment the Linda Mac looked like it fit much better. Production in the treated section of rows looked more or less normal on trees with shortened internode growth.



**Figure 1.** Nectar reward planting for beneficial insects working in the organic apple plantings at Michigan's Clarksville Station.

Ron Perry showed us his work on organic apple production and rootstock research. Some of the highlights Ron pointed out included the fine look of Honeycrisp on the Belgian version of M9. He

also pointed out the excellent fireblight resistance of the G16 rootstock from Cornell. The "Supporter Series" of rootstocks from the Czech Republic have demonstrated some excellent size controlling characteristics. Pajam 2 from France has also looked very good in Ron's trials at Clarksville.

The focus of Larry Gut and David Epstein's work was on reduced risk strategies. The newer chemistries are almost all reduced risk according to the EPA as compared to the OP compounds. Orchards and farms with high insect pressure are not doing well with just the reduced risk chemistries used in management programs according to Larry and can run as high as 3x the cost of current standard programs.

## Cultivar Trial Update

*John Gardner, Apple Specialist, OMAF, London*

It was good to see the general interest by Ontario growers in new cultivars by the turnout at Birnam Orchards, Lambton County in late August of this year. The plantings at this site and at the other sites in the trial, made in 2000 and 2001 have progressed sufficiently to get a pretty good look at the selections and cultivars. This is the first year I have seen a fully bearing tree of Ambrosia here in Ontario. At this point in time, Ambrosia is one of 3 or 4 outstanding cultivars on bearing trees in this trial.



**Figure 1.** Mature tree of the cultivar **Ambrosia** showing growth habit and fruit development as of early September/03, Birnam Orchard Site, Lambton County. Ambrosia as shown here is about 3-4 weeks from harvest. Note the very upright and spurry habit of Ambrosia.

The selections and cultivars from Quebec planted in the spring of 2002 are not sufficiently advanced to pass any sort of judgement. Included in the lot from Quebec were Galarina and Reinette Russet. The trees that were planted into these trial sites during the spring of 2003 include the following.

Five selections from PICO:

- 8NE-07072
  - 8S-69-23 (Aurora Golden Gala)
  - 8S-26-50
  - 8M- 2 –871
  - 8B-20-73
- **Aurora Golden Gala** - (formerly 8S-69-23) - The 8S-69-23 is the most outstanding selection in this grouping. It's a yellow colour apple resulting from a cross of Gala x Splendour described in the ONNL spring edition Volume 7 Issue 2. Tree growth habit is very friendly and highly suitable for high-density apple culture. It matures with Red Delicious and has superior texture and flavour as compared to McIntosh, Gala, and Fuji. There appears to be some good interest in this apple here in Ontario. 8S-69-23 from PICO has been officially named. It is now known as the cultivar "Aurora Golden Gala".

Also planted this year (spring 2003) are the following

- **Sinta** - A golden delicious type with flavour said to be superior to Golden Delicious itself. This is an older named cultivar out of the BC breeding program that appeared in the Cedar Springs trial a few years back. It was in my opinion an outstanding apple for looks and taste. It's major drawback is that it may not be as productive as some of the other selections and cultivars in the Golden Delicious mold.
- **Relieka** and **PIA** out of Europe. PIA is a nice looking early maturing apple that is characterized by a pink blush over a yellow green background. The tree is very upright and doesn't appear to have any outstanding disease problems. Relieka is a precocious solid rose coloured apple produced on trees that are very precocious and highly suitable for high-density apple culture. The apple is not large. Maturity and storage characteristics of these two European selections are largely unknown.

- **Shizuka** is also included with this group of trees. This is the sister variety to Mutsu and although not immune to blister spot it does appear to be more highly tolerant of it. Shizuka is a fairly vigorous tree producing fruit that are of very high quality but in some ways not as favourable for long-term storage or as good in flesh characteristics when compared directly to Crispin when grown side by side according to some researchers in the U.S.A.

Many thanks go out to the following 8 cultivar trial cooperators for their continued interest in this project: There appears to be enough yield on some of the trees to get a feel for storage characteristics at some of the sites. These growers have provided some excellent insight into the potential usefulness of the various cultivars and selections.

Robert Taylor, Oaklane Orchards, Georgian Bay  
 John Ardiel, Georgian Bay  
 Gary Ireland, Norfolk County  
 Harold Schooley, Norfolk County  
 Pete Geerts and Bert Veens, Birnam Orchards, Lambton County  
 Brent Siwicky, Brighton  
 Steve Koning, Eastern Ontario  
 Dennis Taylor, Cannamore Orchards, Ottawa Valley

I would also like to acknowledge the support of:  
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 Ontario Fruit Testing Association

## ***CROP PROTECTION***

### **Fire Blight - When to Prune and When Not to Prune**

*Michael Celetti, Plant Pathologist, (Horticultural Crops), OMAF, University of Guelph, Guelph*

Fire blight is one of the most serious diseases of apples and pears worldwide. Several orchards in Ontario became infected with fire blight during the 2003 season. The pathogenic bacteria *Erwinia amylovora* that causes fire blight can infect all plant parts of susceptible apple and pear trees including blooms, fruit, leaves, shoots limbs, trunks and rootstocks. Once the disease gets into the trunk or rootstock of a tree, the tree usually dies.

When fire blight infects an orchard, sometimes a few strikes are noticed, where as in other cases, several fire blight strikes are observed. Growers often ask what they should do? Should the fire blight strikes be pruned out immediately or should they be left until the dormant season? On one hand, excessive pruning during the summer may stimulate trees to produce succulent shoots that are very susceptible to fire blight infection, which could make the situation worse. On the other hand, if the fire blight strikes are left in the orchard, they will serve as a source of inoculum should conditions for pathogen dissemination and infection occur again in the season. Researchers in Israel studied the timing of pruning on the effectiveness of controlling fire blight in infected pears. Their results and conclusions are probably just as relevant in North America and may be applied to apples.

In replicated trials, researchers pruned out fire blight strike at different times during the season and recorded the growth habits of the infected tree before and after pruning. They also recorded whether the disease was eradicated or if became more severe after pruning. They concluded that the decision to prune out strikes during the growing season depends upon the time of season the fire blight is noticed (spring or fall), the growing condition of the tree (growing vigorously or growing normal and limited), and the tissue exhibiting symptoms (limb canker or blighted shoot).

Pruning out shoot and blossom strikes from trees with many fire blight strikes early in the growing season stimulated the trees to produce succulent shoots, which made the tree more susceptible to fire blight infections. Strikes on low vigor trees that were not pruned appeared to only colonize the infected spur and did not move into the major limbs or trunks. They concluded that trees with many strikes and low vigor growth should not be pruned until the dormant season.

Researchers noticed the harmful effect of pruning out fire blight strikes in trees with high vigor compared to trees with low vigor. Trees with high vigor and few strikes pruned out resulted in complete control of fire blight since the tree was not stimulated to produce susceptible succulent growth. However, vigorously growing trees with many strikes pruned out resulted in shoot growth stimulation

and once again the fire blight severity increased. They concluded that trees with high vigor and few strikes should be pruned if noticed early in the season. However, it is best not to prune trees with high vigor and many strikes until the dormant season since the disease will not be eradicated from the trees and pruning could make the situation worse.

Strikes in trees regardless of vigor that became infected late in the season either due to injury caused by hail (Trauma blight) or shoot blight should be pruned out immediately. Late season infections tend to be more dangerous in Isreal than early spring infections.

Pruning out cankers on major limbs and trunks early in the season did not eradicate the cankers from the trees. In fact, many more active and larger cankers were observed on trees that had been pruned early in the season than on trees that were not pruned. Less disease occurred the following season when pruning out cankers was delayed to mid- summer and even less when delayed until autumn. Best results were obtained when cankers on limbs and trunks were marked with bright paint and pruned out during the dormant winter season.

Based on the results of this study, pruning out fire blight strikes or cankers observed early in the season should be delayed until the dormant season unless there are few strikes to prune and the pruning will not stimulate the tree to produce succulent shoots. Late season infections should be pruned out immediately.

When pruning out fire blight, the cuts should be made about 30 cm (12 inches) or more below the visible symptom, into 2-year old wood or older. It is advisable to disinfect tools between cuts by dipping them into a 70-75% denatured ethyl alcohol solution (one part denatured alcohol to three parts water) or a 6% sodium hypochlorite solution (one part laundry bleach to four parts water) particularly if pruning is done during the growing season.

## **OFM: The Pest that Wasn't - This Year**

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

As we come to the end of the 2003 growing season, it becomes increasingly apparent that internal lepidoptera larvae such as oriental fruit moth and codling moth, that caused such high levels of damage in apple orchards last year, were difficult to find in apple orchards this year. While last year it was unusual to walk into an orchard in infected areas such as Norfolk, and not see evidence of OFM damage, this year we are seeing very little damage--if any. Michigan, Pennsylvania, and New York are also reporting less damage from OFM in the 2003. So why has this pest seemingly faded into the woodwork?

There are several possible reasons why OFM pressure has been so low this year. As many of you recall we had a fairly harsh winter followed by an extended cool wet spring this year. The cold winter may have helped to reduce the overwintering population by killing off the larvae, which overwinter in a cocoon under tree bark and on the orchard floor. The prolonged period of cool weather we experienced in the spring, may have reduced reproductive ability and fitness of OFM adults, resulting in a reduction in population pressure.

Monitoring is crucial to managing OFM since the larvae tunnel into the fruit quickly after hatching. Once the larvae are inside the apple, insecticides are no longer effective in managing this pest. As a result, diligent monitoring and timing of insecticide sprays (based on monitoring) are crucial for managing this pest. High levels of OFM damage in 2002 has increased awareness of this pest and resulted in more diligent monitoring for this pest in apple orchards in 2003. This improvement in monitoring and subsequent timing of insecticide sprays (based on monitoring) has likely helped to reduce OFM populations.

In the past, there were no products registered for managing OFM in apple. Therefore, growers with an OFM problem could only apply sprays aimed at managing other pests, and hope that they might provide subsequent control of OFM. However, the activity of OFM is very different

from other apple pests and therefore, it is unlikely that sprays aimed at controlling other pests provided effective control of OFM. The registration of products (Assail, Decis, and Isomate M100) for managing OFM in apples has provided apple growers with important tools for managing this pest.

It is difficult to make any conclusions as to why OFM hasn't been an issue in 2003. It is likely that many, or perhaps all, of the points listed above contributed to OFM populations being so low this year. Since OFM populations seem to be so low in 2003, does this mean we can forget about managing OFM in apples and concentrate on other pests? Well the answer to that question is a resounding NO! While OFM populations are low, these insects are still present in apple orchards with a history of OFM damage. As a result, they will still need to be managed carefully in the upcoming year. However, the good news is that since OFM populations are so low this fall, we should continue to have low population pressure in the spring. As a result, the opportunity is available for growers to look at using newer technologies that work better under low population pressure (such as mating disruption) to manage this pest.

## Your Fall Weed Challenge: Winter Annuals in Your Orchard

*Leslie Huffman, Weed Management Specialist (Horticultural Crops), OMAF, Harrow*

Your weed problems for next year may already be in your orchard. Moist soils in the fall signal winter annual weed seeds to break dormancy and germinate.

**What are winter annual weeds?** They are weeds with a growth cycle that begins in the fall. They grow from seed into a tiny rosette that lays flat on the soil. During the fall, they grow a small taproot and a few leaves before becoming dormant for the winter. Some stay green under the snow, ready for springtime.

When spring brings warmer temperatures, winter annuals will bolt a flower stalk early in the season. They flower and set seed in early summer, often shedding their seeds before the heat of the summer comes. By October, these seeds have either germinated or are waiting for fall rains to germinate.

Some weeds can be both summer annuals and winter annuals, like common chickweed and groundsel.

**Why should we be concerned about winter annuals?** Winter annual weeds cause crop losses by reducing yields and interfering with harvest. They avoid our traditional weed management programs, causing extra expense to control them.

Winter annual weeds are very successful in orchards and other perennial crops. They are also more problematic wherever reduced tillage is practiced. Recently, more problems with winter annual weeds like Canada fleabane, garlic mustard, buttercups, shepherd's purse and pepper grass have been observed.

The growth cycle of winter annual weeds gives them several advantages. Their growth periods coincide with periods of good soil moisture. They grow when crops do not need moisture or nutrients. Their small size at the rosette stage makes them inconspicuous, and they may be less susceptible to traditional weed control tools and timings. Plus, they often shed large numbers of seeds to help them survive the summer.

**How can we control winter annuals?** Early fall gives us a window to **prevent** winter annuals from establishing in orchards. Mow field edges before seed shed to prevent winter annuals from moving into your orchard. Soil-applied residual herbicides applied in the fall can control the rosette stage, but should be applied either after harvest or within the preharvest interval where labeled.

**What if winter annuals are already established?** Scout your orchards several times throughout the fall to know what to expect next spring. Plan to use early spring tillage or burndowns to destroy established winter annuals, but remember that the high range of herbicide rates may be needed as plants start to flower.

Winter annuals are not all bad! Remember that winter annual weeds can be effective ground cover to prevent erosion over winter. Where this is a concern, it is better to leave those rosettes for now - but be ready next spring!

## POSTHARVEST

### CA Storage Guidelines and Recommendations for Apples - 2003

*Dr. Jennifer R. DeEll, Fresh Market Quality Program Lead, OMAF, Simcoe and Dr. Dennis P. Murr, University of Guelph*

#### Harvesting Apples at Optimum Maturity

For successful controlled atmosphere (CA) storage, apples must be harvested when they are physiologically mature but not ripe. Each cultivar must be harvested at the proper maturity in order to achieve maximum storage life and marketing season. If apples are harvested too early, they are of poor color, small size and have little flavor, they will fail to ripen or may ripen abnormally, and the overall quality will be poor. High water loss, low sugar content, high acidity, low aroma volatile production, and high starch content are characteristics of immature apples that contribute to inadequate flavor development. Immature apples are also more likely to develop storage disorders like superficial scald and bitter pit. Harvesting apples too late can result in a short storage life. Such apples are too soft for long-term CA storage, and are more susceptible to mechanical injury and disease infection. Over-mature apples may develop poor eating quality and off-flavors, and are more susceptible to watercore and internal breakdown.

For the above reasons, the determination of optimum apple maturity for harvest is essential for maximum storage life and quality, while minimizing postharvest losses. Numerous methods have been suggested for determining harvest date, but no single test is completely satisfactory, and some are too unpredictable, complicated or expensive. Days after full bloom is generally fairly constant, but can vary in any one year. Therefore, days after full bloom should be used as a general reference to indicate the approximate date when apples might reach harvest maturity, which is then confirmed using tests such as internal ethylene concentration (IEC), starch-iodine staining, flesh firmness, and soluble solids content (sugars). In general, an IEC of 1 ppm is considered to be the ultimate threshold above which fruit ripening and flesh softening are initiated and progress rapidly. Harvest for long-term storage should be completed before 20% of the apples have an IEC higher than 0.2 ppm. Using the starch-iodine test, apples destined for long-term storage should have 100%

of the core tissue starch degraded (no stain) with greater than 60% of the flesh tissue still having starch present (stain). However, it is important to note that not all apples mature and ripen in the same manner each year, and often there will be a need to compromise between correct maturity and the required firmness and sugar levels for market.

#### Guidelines for Placing Apples into CA Storage

Apples can be segregated into lots at harvest by their storage potential. The following types of apples should not be designated for long-term storage because of their potential for internal breakdown (or to develop bitter pit): 1) large fruit from lightly cropped trees, 2) fruit from excessively vigorous trees, 3) fruit from young trees just coming into bearing, 4) fruit from interior portions of trees that are heavily shaded, 5) early-picked fruit high in starch, and 6) fruit with a low number of seeds (< 5 per fruit).

After harvest, cool the apples as rapidly as possible. Fruit off the tree mature much faster and begin to ripen sooner the warmer the temperature. Try to get the harvest from each day into the cooler by nightfall. However, do not strain the capacity of your cooling system to the detriment of apples already pre-cooled and in storage, or the entire lot. When using CA storage, the quicker you cool the apples and achieve the desired atmosphere, the longer the apples will store and be of good quality upon removal. The longer it takes to adjust the oxygen (O<sub>2</sub>) and carbon dioxide (CO<sub>2</sub>) levels, the less effective the length of storage. The objective should be to cool the apples and achieve the desired atmosphere within 5-7 days from initial harvest.

**CA storage will not improve fruit quality**, and thus only the best fruit should be placed in CA storage. If over- or under-mature or poor-quality apples are put into CA, the result will be poor-quality apples upon removal. Successful CA storage begins by harvesting apples at the proper maturity, followed by rapid cooling and establishment of the CA, and then proper maintenance of the desired temperature and atmosphere thereafter. In general, the current standard CA recommendations range between 2.5-3% O<sub>2</sub> and 2.5-4.5% CO<sub>2</sub> at 0-3°C. However, due to recent research using new storage technologies and strategies, these current CA recommendations needed to be reviewed. The following table lists CA storage recommendations for commercial apple cultivars in 2003, including storage atmospheres, temperature, and approximate storage-life.

## Storage Atmospheres, Temperature, and Approximate Storage-Life for Commercial Apple Cultivars (2003)

Cultivar	Regime	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	Temperature (°C)	Storage-life (mo.)
Cortland	Standard CA	2.5	2.5	0	4-6
	Low O <sub>2</sub>	1.5	1.5	0	6-7
	Programmable	2.5 (2 mo.)	2.5 (2 mo.)	3	6-7
		1.5 (2 mo.)	1.5 (2 mo.)	3	
0.7 (2 mo.)		1.0 (2 mo.)	0		
Crispin (Mutsu)	Standard CA	2.5	2.5	0	6-8
Delicious	Standard CA	2.5	2.5	0	7-9
Empire <sup>2</sup>	Standard CA + SmartFresh <sup>1</sup>	2.5	2.0	1-2	5-7
		2.5	<0.5	1-2	6-8
	Low O <sub>2</sub> + SmartFresh <sup>1</sup>	1.5	1.5	1-2	6-8
		1.0	<0.5	1-2	7-9
Gala	Standard CA	2.5	2.5	0	5-7
	Low O <sub>2</sub>	1.5	1.5	0	6-8
Golden Delicious	Standard CA	2.5	2.5	0	5-7
	Low O <sub>2</sub>	1.5	1.5	0	6-8
Honeycrisp	CA not recommended				
Idared	Standard CA	2.5	2.5	0	7-8
McIntosh	Standard CA	2.5	2.5 (1 mo.)	3	5-6
			4.5 (>1 mo.)		
	+ SmartFresh <sup>1</sup>	2.5	2.5	3	5-7
	Low O <sub>2</sub> <sup>3</sup> + SmartFresh <sup>1</sup>	1.0	1.0	3	6-8
1.0		<0.5	3	6-8	
Northern Spy	Standard CA	2.5	2.5	0	7-9
Spartan	Standard CA	2.5	2.5	0	6-7

<sup>1</sup> SmartFresh™ (1-methylcyclopropene; 1-MCP) is currently not registered in Canada; it significantly improves firmness retention and extends storage life; it may alter the requirement for current O<sub>2</sub>/CO<sub>2</sub> levels in CA.

<sup>2</sup> DPA (diphenylamine) drench applied cosmetically to help control CO<sub>2</sub> injury.

<sup>3</sup> Not 'Marshall' McIntosh, this strain is low O<sub>2</sub> sensitive and may develop low O<sub>2</sub> injury.

### Susceptibility to Storage Disorders for the 2003 Apple Season

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

CIPRA is a computer-based program used to predict disease and pests of several horticultural crops, based on weather data. The program was developed by the research team of Dr. Gaétan Bourgeois, Agriculture and Agri-Food Canada, St-Jean-sur-Richelieu, Québec. More recently, CIPRA has been expanded to predict the risk susceptibility of apples to certain storage

disorders (Bourgeois, DeEll, and Plouffe). These models not only consider the weather data, but also fruit maturity at harvest. CIPRA is presently being used commercially in Quebec, while it is currently being evaluated and adapted for Ontario (Bourgeois, DeEll, and Nichols).

According to the CIPRA model for low temperature disorders (e.g. vascular breakdown, internal browning...), **the risk susceptibility is 23.6% for the 2003 harvest**. This means that there is a 23.6% chance that chilling sensitive cultivars, such as 'McIntosh', will develop low temperature disorders during long-term storage

this year. It is important to note that this value is based on weather data from Frelighsburg, Quebec. However, this risk factor has been a reasonable indicator in Ontario during the past couple of years.

Superficial scald susceptibility is largely dependent on the number of hours below 10°C in the orchard prior to harvest (Bramlage). The more hours below 10°C, the less susceptible the fruit is to scald development. This is the reason that apples harvested earlier are more susceptible to scald than those harvested later. According to the model of Bramlage and adaptations made in CIPRA, the number of hours below 10°C from August 1<sup>st</sup> until harvest needed to reduce the risk of superficial scald for the 2003 season is as follows –

- >250 hours below 10°C = 0% risk
- 125-250 hours below 10°C = 0-40% risk
- 65-125 hours below 10°C = 40-100% risk
- <65 hours below 10°C = 100% risk

Again, it is important to note that these values are based on weather data from Frelighsburg, Quebec. However, it is probably a reasonable guideline for Ontario.

As the CIPRA models for storage disorders continue to evolve, such risk factors for storage disorders will be available using Ontario data and conditions for the 2004 growing season.

## **Apple Storage and Washing Effects on Patulin Levels in Apple Cider**

*John Henderson, Risk Management Specialist, OMAF, Brighton and  
Sandra Jones, On-Farm Food Safety Program Lead, OMAF, Guelph*

In the past two issues of this newsletter, a recent research report in the Journal of Food Protection has been reviewed. The report presented information on how apple quality, storage and washing treatments affected patulin levels in apple cider. The following information highlights the effects of apple storage and washing on patulin levels in apple cider from that report.

Tree picked apples of several cultivars were put in cold storage (0 to 2 C) for four to six weeks. Controlled Atmosphere (CA) apples were also obtained from a commercial storage. After storage, apples were divided into two groups,

culled and not culled. Batches that were not culled contained apples with visible damage and mould (this also included bird pecks, skin breaks, hail damage or major bruising).

Patulin was not detected when apples were culled prior to pressing but was found in five of the seven cultivars in cider pressed from uncultured fruit. Data in this study indicates that although fungal growth is reduced at temperatures less than 10 C, the growth of *P. expansum* and the production of toxin are not prevented during cold storage.

Patulin levels in cider pressed from CA stored uncultured apples (three trials) were found to be greater than 59 ppb, while in two trials of cider pressed from CA fruit that had been culled had no patulin detected. The third trial found 15.1 ppb of patulin.

The overall results indicate that culling is an important method to reduce patulin levels in cider made from cold or CA stored fruit. Stringent culling procedures are needed to keep patulin levels to a minimum in cider pressed from stored fruit.

Batches of ground harvested golden delicious apples (not culled) containing different patulin levels were given one of three treatments prior to pressing: (1) no wash, (2) a chlorine solution wash (100 or 200 ppm), or (3) a potable water wash. Washing treatments reduced the patulin levels in cider by 10 to 100% depending on the initial patulin level and the type of wash solution used. No significant difference was found in patulin levels for cider made from apples washed with 100 or 200 ppm chlorine solutions. Two trials did not show chlorine solutions to be more effective than water in removing patulin from contaminated apples. This study, along with other work highlighted, indicates that wash treatments cannot ensure that patulin levels are below the 50 ppb action level established by regulatory agencies.

For detailed report information and supporting documentation refer to the Journal of Food Protection, Vol. 66, No. 4, 2003, Pages 618-624 "Apple Quality, Storage, and Washing Treatments Affect Patulin Levels in Apple Cider" by Lauren S Jackson, Tina Beachham-Bowden, Susanne E Keller, Chaitali Adhikari, Kirk T. Taylor, Stewart J. Chirtel and Robert I. Merker

## Do You Know The Risks?

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

If you make unpasteurized juice, then you need to be aware of the possibility of contamination from harmful bacteria, such as *Escherichia coli* (*E. coli* 0157:H7) and *Salmonella* sp. These microbes can make some people very sick.

There have been reported outbreaks of *E. coli* 0157:H7 linked to unpasteurized apple juice. It was first associated with apple cider in a 1980 outbreak in Ontario. Since then, there have been outbreaks in Massachusetts (1991), Connecticut (1996), Ontario (1998), and Oklahoma (1999). Last year in Ontario, there was a voluntary recall of unpasteurized apple cider, as it may have contained *E. coli* 0157:H7.

Fresh cider has a pH of 3.5 to 4.1 depending on the apple variety and the storage time, with the pH tending to increase with storage time. At one time it was believed that bacteria could not survive at pH below 4. However, *E. coli*, *Cryptosporidium* and *Salmonella* can survive for a few weeks in unpasteurized apple juice or cider.

Do not assume your juice is safe because the pH of your juice is in the lower range. In 2002, a Wisconsin researcher looked at methods to reduce *E. coli* 0157:H7 in cider as the United States is requiring apple cider producers to manage the risk. This researcher started with cider that had a pH of 3.3 and either a 11 or 14% Brix. If no method was applied to reduce the bacterial number, *E. coli* 0157:H7 survived in this pH environment at both sugar concentrations.

In response to concerns about the safety of fresh fruit juices, the Canadian Food Inspection Agency (CFIA) has come up with some key points in order to reduce the risk of contamination. They are:

- Avoid using fruit that has dropped to the ground for unpasteurized juice
- Wash, brush and rinse fruit prior to pressing
- Clean and sanitize equipment regularly
- Label products properly
- Keep unpasteurized juices/ciders refrigerated.

For more information, apple juice/cider processors should read the OMAF workbook, Food Safety Practices in the Production of Unpasteurized Apple Cider (available free of charge to all juice/cider processors) or at the following link:

[http://www.gov.on.ca/OMAFRA/english/food/inspection/juice/cider\\_workbook\\_text\\_only.html](http://www.gov.on.ca/OMAFRA/english/food/inspection/juice/cider_workbook_text_only.html)

and the Code of Practice for the Production of Unpasteurized Apple Juice/Cider from the CFIA <http://www.inspection.gc.ca/english/plaveg/process/ed/codee.shtml>

Reference:

Ingham, Steven and Schoeller, Nicolas. (2002). Acceptability of a multi-step intervention system to improve apple cider safety. Food Research International. 35:611-618.

## ANNOUNCEMENTS

### Rescheduled Unpasteurized Apple Cider/Juice Food Safety and Sanitation Workshop

The workshops originally scheduled for August 19 and 20 have been rescheduled to:

**Tuesday, November 25** - Tyrone Orange Hall and Tyrone Mill, Tyrone, 2656 Concession 7, Bowmanville, Ontario L1C 3K6

**Wednesday, November 26** - Hergotts Cider Mill, 928 Erb St. West, Waterloo, Ontario, N2J 3Z4

Topics to be discussed include:

- What the Ontario Industry looks like – results of the OMAF 2001 Baseline Study
- Food safety concerns with pathogens and mycotoxins including: *E. coli*, *Cryptosporidium* and patulin. (Presentations from OMAF and the Canadian Food Inspection Agency (CFIA))
- Potential risk reduction options.
- Cleaning and Sanitation – proper methods of cleaning and sanitation, what chemicals and methods to use and are they working, e.g. monitoring methods (test strips, meters). This session will include a hands-on presentation by Johnson Diversey in the cider facility.

Detailed information will be mailed to cider producers in November. If you have any suggestions or questions please call John Henderson at (613) 475-5175.

## **Apple Program Set for February 18, 2004 at the Ontario Fruit and Vegetable Convention (OFVC)**

Plans are underway for the delivery of an exciting Apple Session on Wednesday, February 18, 2004 as part of the OFVC at Brock University. Some details have already been released regarding the Conference Administrative Structure.

Theme: "Building on Success"

**February 18 & 19<sup>th</sup>, 2004**  
Brock University, St. Catharines

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More details to follow!