ORCHARD NETWORK

For Commercial Apple Producers

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In this issue....

ORCHARD MANAGEMENT

Keeping Gala Trees Productive

John Gardner, Apple Specialist, OMAFRA, London

In the minds of many apple growers, Gala is a relatively new player in the variety mix here in Ontario. However, we've watched Gala plantings in Southern Ontario for the better part of a couple of decades now. A lot of those blocks planted in the last few years are looking very mature. In fact, many of these Gala trees have lost their ability to produce adequate fruit size for today's market place. Fruit size distribution in the tree canopy can decline rapidly if maturing trees don't get the best management options.

For some of these trees, their best days could be behind them if they are loosing vigour and becoming too spurry with little renewal growth in the canopy. A tree with these particular traits will produce an average fruit size that will diminish quite rapidly and with it, tonnage that won't return the dollars it should because fruit is just too small (Figure 1). Crop value can change rapidly with a pronounced reduction in fruit size on older spurs. Can anything be done? The answer is unequivocally yes.

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This issue of the **Orchard Network Newsletter** was compiled by Client Service Representatives, Marian Desjardine, OMAFRA, London and Leslie Parks, OMAFRA, Simcoe.

Unfortunately, both aggressive thinning treatments and application of extra nitrogen won't necessarily solve the problem. One of the more outstanding treatments resulting in a good tree response is reducing the numbers of fruiting spurs per centimeter of cross sectional area. This is a good topic of discussion in the field at a pruning demonstration or in the classroom. Dr Terrence Robinson of New York State has spoken on this topic many times, as all Gala growers in the Great Lakes area are looking at the same phenomenon regardless of the locality.

A number of years ago I witnessed some seemingly brutal tree treatment when an experienced grower raked off most of the spurs off the lower side of a branch with one swift brushing by hand. Other growers will actually carry out the same treatment with a swift brushing move using the end of the pruning lopper. Both of these treatments actually help dramatically and will remove hundreds of excess spurs very quickly. Small diameter Gala wood is generally considered to be more brittle and is easily broken or snapped in two.

Figure1. Tree tops showing an excessively spurry condition in a mature Gala trees.

Trying to solve the fruit size problem with growth regulators like Promalin won't work when temperatures are cool around the bloom/fruit set period and extra nitrogen could easily result in a higher degree of disease expression like fireblight. While thinning treatments will definitely help in the short term, the long term and sustainable solution has to go back to canopy renewal and spur extinction methods. Other treatments that could help with fruit size include the use of irrigation and particle film technology.

Canopy renewal in mature Gala can consist of the elimination of larger diameter "tree-like" offending branches (50% rule). There is always one or two of these branches. Cutting at a bit of an angle (Dutch cut) may help generate a bud break and a new shoot to fill in the canopy. It's these 2-3 year old branches that have the ability to produce the largest fruit.

Spur extinction by breaking off or cutting off every 2nd or 3rd spur will reduce the crop load and increase average fruit size. Stubbing back and removing a high percentage of 1-year-old wood will also reduce the energy and carbon getting into an unnecessarily large number of spur clusters (Figure 2).

Figure 2. Mike Versteegh demonstrate canopy renewal techniques on Gala at a recent pruning Workshop organized by apple growers in the Georgian Bay area.

Getting the Best Fruit Size in Apples

John Gardner, Apple Specialist, OMAFRA, London

Tonnage alone from any orchard is not nearly as important as **fruit size distribution** in a given crop. With adequate fruit size distribution we can talk more clearly about crop value. A moderately large crop of larger fruit handles easier with **less cost**, has more value, and is definitely much easier on the trees. Large crops of smaller fruit are more costly to handle, don't have the value and ultimately can negatively impact not only the year in which it is produced but in the following year as well.

The question is how we do as managers grow that perfect crop with great average fruit size and decent yields at the same time. The following factors all have a direct influence on fruit size and fruit size distribution in apples. I am assuming that when discussing these factors an adequate program is in place for competition control and **IPM** practices are employed.

We can start with **genetics** and **cultivars** that we grow and handle. **Honeycrisp** is relatively new and is genetically a large fruited cultivar that some growers, when hand thinning to touch things up, will pull off the largest fruitlets to reduce not only excessive size but to reduce the chances of bitter pit occurring because of enormous fruit size.

Cameo is another large fruited club cultivar from the U.S.A. that we now think is a variety that could be grown very well in some areas of Ontario. Other varieties like **Royal Gala, Chinook, and Empire** are genetically smaller fruited cultivars. Chinook in spite of having a very high quality flesh will generally not fill bins quickly at harvest because of its relatively small size.

Rootstock choices and fertility (e.g. K) play a role in maintaining fruit size. However, it is not a recommended practice to try and fertilize your way to greater fruit size if other tree factors are out of sync. We know from experience that trees like Gala, which are **spur bound** and of **low vigour**, will respond better to spur extinction practices and canopy renewal in maintaining adequate fruit size in combination with other best practices.

Multiple siring during pollination in any apple will normally produce an advantage in achieving greater fruit size over an apple that has been pollinated using only one cultivar. This is why **orchard design** is so important. Pollinators have a better chance of delivering pollen from more than one cultivar if blocks of trees of any one variety are not too large. Interplanting with crab pollenizers will help.

Thinning chemically and by hand **(green fruit thinning)** has in the past been called the single most important cultural practice that we carry on in

an orchard. A poorly thinned crop cannot be expected to generate crop value even if the tonnage is there.

The regulation of soil and **canopy temperature** in apple is critical if one expects to have great overall fruit size. **Water** and **water conservation practices** can make all the difference in the world to tree performance from the time the tree is planted and established to the mature years of best production. Various **mulches** can help considerably in keeping soils cool and moist through the heat of the summer. Mulching treatments could be more critical with some strains of M9 rootstock, as this rootstock is generally not as tolerant of warm soils as some of the more vigorous semi dwarf types like M26 or MM106.

Particle films like Surround Crop Protectant have been shown in both small and large scale demonstrations to produce a larger cleaner looking fruit especially with varieties like Golden Delicious in well managed blocks. There is evidence that Surround Crop Protectant will increase the rate of **photosynthesis** in the tree canopy, allowing the tree to capture and move more carbon reserves directly to the crop in plantings that are on rootstocks like M9.

Growth **bioregulators** like Promalin and Accel, when used on certain cultivars and when weather conditions are favourable (temperature), can have a large influence on growth rates and ultimately fruit size of varieties like Empire and Golden Delicious.

Harvest management can make or break ultimate crop volumes. Years ago when we were working on calcium use in McIntosh, we found that the aggressive use of these sprays pushed maturity ahead at an accelerated rate. Fruit that were ready 10 days ahead of unsprayed checks were also a lot smaller by at least 1-2 size classes. It goes without saying that fruit that can be held on the tree an extra few days will ultimately generate huge **gains in crop volume** and value if the maturity is held in check. Trees of cultivars like Royal Gala will size up the second picking rapidly once the first picking of apples is taken from the orchard.

Going Organic? Transition?

by Hugh Martin, Organic Crop Production Lead, OMAFRA, Guelph

Organic retail sales continue to grow in Canada at rates over 20% per year. It now makes up about 1.5% of retail food sales and higher than that for fresh fruits and vegetables. Have you looked at this market as a way to transition your farm? The transition period is 2-3 years to invest in your future growth in organic. Here are some key areas to look at.

1. Know your markets. If you grow organic product, where would you sell it? What crops, quality, products, etc would you be able to market and at what price? Would you use a wholesaler, processor, or direct sale to customers? These questions are the same as for any business but the answers for organic will likely be different than in conventional and are key to your success.
2. What changes are needed in production practices? Most growers think of fertilizers to solve nutrient concerns, and pesticides to control insects, diseases and weeds. In organic you need better (longer, more diversified) crop rotations. Use legumes to supply nitrogen. You may need to buy (or have) manure and compost on your farm to maintain phosphorous, potassium and organic matter. Your pest control program will emphasize an intensive IPM program where beneficials, pheromones, crop rotation and resistant varieties are key tools. This can be complemented in some cases with biopesticides or other products approved for use on organic farms.
3. How and when would you become certified? Organic farms will need to be certified for most markets. You cannot become certified until 36 months after the last application or use of non-organically approved practices. You need to apply for transitional inspection in the year prior to the production of your first organic crop, and each year afterwards to maintain your certification. Applications are usually made in early spring. It is good to contact the certification body in your first transition year to get a copy of their standards to find out what you can and cannot use on your organic farm. For more information on certification see http://www.omafra.gov.on.ca/english/crops/organic/certification.htm

4. During the transition you want to plant in the right crops to set your farm up for organic. Usually a combination of cereal crops or hay for 2-3 years is a good way to go. Use these crops to control the weeds and break pest cycles. Underseed the cereal grain crops with red clover or another legume to build up nitrogen in the soil. These crops will add organic matter. Plan to start with one or two fields and each year add more fields to the organic practices as your successes grow. Suggest using a good field as your first organic field, perhaps the one closest to your house where you will see it everyday. Use the transition period to improve your fields. Your initial revenues will not be as high but it will pay back after you are organic.

After 3 years of transition: You have your fields in shape; your certification is lined up; your markets are known; you have researched your crops; and you have talked to other farmers who are doing it successfully – Now have fun growing organically!

Vegetative Growth Control in Apples Using Apogee®

Dr. John Cline, University of Guelph, Simcoe

Apogee or prohexadione-calcium, is a plant growth regulator that reduces terminal shoot growth. Apogee inhibits the synthesis of gibberellins, the plant hormones responsible for cell elongation. Trees treated with Apogee often have the same number of shoots as untreated trees, but shoots from treated trees are thicker (greater diameter) and have compressed internodes.

When used properly in apple orchards, Apogee can:

- reduce shoot growth by 20-60%, diminishing the time required to dormant prune and/or summer prune
- lead to improved fruit colour on red-coloured cultivars
- result in a more open tree canopy, improving spray coverage
- reduce the incidence and severity of fire blight on shoots (shoot blight), but not blossom blight infections

Apogee does not have activity against the fire blight bacteria. Trees with reduced shoot growth make the trees less susceptible to fire blight development.

Apogee does not reduce the number of leaves or fruit size.

Time of Application & Rates

Patterns of terminal growth and fruit set differ among growing regions. Likewise, the response to Apogee® appears to differ depending upon where it is used. Therefore, the rate and calendar date of application may vary from region to region.

Timing: Make the first application when terminal shoots are no longer than 2.5 - 5 cm. This typically coincides with late bloom or petal fall, when the bourse shoots are beginning to grow and sufficient leaf area has developed for Apogee to be translocated into the leaf. Later timings will not provide satisfactory results. Apogee is non-toxic to bees, so the first application can be made before bees are removed from the orchard.

Once applied, Apogee requires about 14 days to slow growth. It breaks down in the trees within a few weeks, so at least one additional application may be necessary to maintain growth control throughout the entire growing season.

Rates: See Table 1, *Suggested Apogee rates and timings based on a tree-row volume dilute of 1000 L/ha.* The application rate is determined primarily by tree size, vigour (influenced by rootstock, cultivar, soil, crop load, site) and whether protection against shoot blight is an objective.

- for medium to high vigour trees, apply 45 g product per 100 L of dilute spray (125 ppm)
- for low to medium vigour trees, apply 27 g product per 100 L of dilute spray (75 ppm)

Repeat application(s) should be made at 14-21 day intervals, based on the level of growth control required.

Follow the steps on the label to adjust rates for tree-row volume dilute applications. Table 1 shows various rates for sprays applied at 1000 L/ha (dilute). Apogee® has been used effectively when applied in more concentrated sprays provided thorough wetting of the canopy is achieved. Low-volume spraying of plant growth regulators and chemical thinners is not recommended.

Do not tank mix Apogee with calcium sprays (i.e. calcium chloride). In the presence of calcium, Apogee will precipitate in the tank, clog nozzles and screens, and reduce tree response.

Table 1. Suggested Apogee rates and timings based on a tree-row volume dilute of 1000 L/ha
(this chart is to be used in conjunction with the product label)

Level	Tree vigor [1]	1st Spray	2nd Spray	3rd Spray	4th Spray	Season total (g/ha)[2]	Product cost per season ($/acre)[3]
↓	Typical Date[3] →	*25-May*	*8-Jun*	*22-Jun*	*6-Jul*		
	Stage →	*Petal Fall*	*Fruit set*	*June Drop*	*↓ growth*		
		(grams Apogee/ha based on **1000** L/ha TRV (tree row volume) Dilute)[4]					
1	Low - 1 spray	450				450	$ 44
2	Low - 2 sprays	270	270	-	-	540	$ 53
3	Medium - 2 sprays†	450	450	-	-	900	$ 88
4	Medium/High - 3 Sprays	450	450	270	-	1170	$ 115
5	High - 3 sprays	450	450	450	-	1350	$ 133
6	High - 4 sprays	450	450	450	270	1620	$ 159

† - suggested base rate. Move to next higher or lower level based on factors listed below.

Orchard and Environmental Factors to Adjust Apogee Rates and Number of Sprays

Heavy dormant pruning	increase rate by 10-20 % per hectare per spray
Longer growing season	add 3rd or 4th spray
Low crop load	move Apogee Program to next higher level (i.e. tree size)
Questionable coverage	move Apogee Program to next higher level (i.e. tree size)
Fire blight suppression	move Apogee Program to next higher level (i.e. tree size) or apply (65 g/100 L) initial rate

[1] - Vigour is defined as the total amount of shoot growth in a single season. Not to be confused with tree-row volume.

[2] - Maximum seasonal rate should not exceed a total of 5.4 kg of Apogee.

[3] - The first application will depend on growth development in your area and by cultivar. Apple trees in Niagara and south-western Ontario are often 7-10 days ahead in development compared with trees in the Georgian Bay and Eastern Ontario.

[4] - Tree row volume (see http://www.omafra.gov.on.ca/english/crops/facts/00-035.htm for more details). Rates need to be increased when higher water volumes are required for adequate spray coverage.

Adjuvants and Hard Water

- Include the spray adjuvant, Agral 90, with Apogee to improve the uptake of the prohexadione-calcium molecule by the leaf.
- In addition, if the spray water source contains high levels of calcium or magnesium (hard water), include an equal amount of ammonium sulphate (AMS) fertilizer by weight with Apogee. Use a high-quality grade of AMS (i.e., greenhouse grade) to avoid plugging of nozzles.

Obtain water hardness ratings from your municipal water supplier. Have well water tested for hardness. Consult www.ene.gov.on.ca/envision/water/sdwa/licensedlabs.htm for a list of accredited labs.

Precautions when using Apogee:

Increased Fruit Set: In some instances, Apogee may increase fruit set and make thinning more difficult. This response is not consistent, but is more likely at concentrations above 125 ppm (45 g/100 L). Apogee-treated trees may require more aggressive chemical or hand thinning to reduce the crop load to the desired level.

Fruit Cracking: Research in the U.S.A. suggests that Apogee can cause severe cracking on 'Empire' and 'Stayman' cultivars. The cause is

unclear and it has not been observed in research blocks at the University of Guelph, Simcoe after treatment of 'Empire' trees for several years. Producers who wish to use Apogee on 'Empire' should be aware of this precaution, and perhaps use it on a limited acreage of their 'Empire' trees for a few years to determine the real risk of cracking in our region.

Tip-bearing cultivars: Apogee may result in decreased yield and marketable yield of 'Cortland'. Despite this, clear benefits of using Apogee on tip bearing cultivars such as 'Cortland' and 'Northern Spy' have been observed in other regions of Canada, where the shortened internodes of Apogee treated trees has produced a more compact tree habit.

Suggested Strategy for Using Apogee®

- Consider using Apogee® on your most fire blight sensitive, high value, and most vigorous growing cultivars first.
- Compare your present summer and dormant pruning costs with the cost of using Apogee® (widely available at major Ag-chemical suppliers). Count on about 40% reduction in vegetative growth. Don't forget to include the other benefits of Apogee® when making this comparison.
- Consider using Apogee® on terminal bearing cultivars such as 'Cortland', 'Golden Russet' and 'Northern Spy'. It has been shown in Nova Scotia to change the tree habit of Cortland in a dramatic and positive way.
- Apply the first application early – no later than petal fall. Don't forget to add a surfactant and AMS if you have/suspect hard water. A second spray 14-21 days later is almost always required.
- If unsure about what rates to use, start with the standard rate of 45 g Apogee® per 100 L spray solution and apply tree-row volume dilute.
- Direct spray/adjust nozzles to apply more spray to the tops of trees.
- On young trees, consider applying to the top of the canopy only. This may provide added fire blight protection for sensitive cultivars (i.e. Gala), while maximizing growth potential.
- Be sure to leave several unsprayed trees for comparison purposes (and flag them).
- Consider measuring the length of ~100 randomly-selected extension shoots per cultivar (from treated and untreated trees) on a 7 or 10 day basis until terminal bud set. This will reveal when trees start and stop growing. I would really value this data in order to fine-tune the Ontario recommendation for the use of Apogee® on a regional and cultivar specific basis. Please contact me if interested in participating!

Winter Rest and the Breaking of Dormancy in Fruit Trees

John Gardner, Apple Specialist, OMAFRA, London

If I could describe the ideal dormancy for an apple tree it would occur starting in the fall with the steady decent of the tree into a cold and daylight induced rest. Winter temperatures would be moderately cold and not fluctuate too much. There would be adequate snow on the ground to insulate from the low temperature extremes.

Trees trunks would be protected from the effects of bright afternoon sunlight and subsequent freezing on moonlit nights. This dormancy would last well into March and early April with a gradual ascent into spring with temperatures remaining cool and buds tight as long as possible in the spring.

The ideal spring weather would bring the trees out of dormancy gradually. The best spring for an apple grower is one that remains cool and holds trees back as long as possible. During this period of time, the orchard manager also makes adequate preparations to keep deer and rodents from destroying fruit buds and bark. Prunings can be mulched up and general orchard preparations for the spray season can be made at a steady pace.

The preceding scenario of course never happens exactly the same way, at least not with any consistency from year to year in major fruit growing districts of Ontario. This past winter was strange in many ways. I am accustomed to making quick notes based on minimum temperatures that occur through the winter months in Southern Ontario. This past winter I made no notations at all as temperatures rarely sank deeper than the high teens Celsius in the south west fruit districts.

In general, Ontario orchard districts have the benefits of the Great Lakes moderating influence on temperatures. Isotherm lines can be drawn to show average minimums for winter temperatures or at least the frequency of occurrence of

damaging low temperatures. These lines usually follow the contours of the shoreline and every mile or so further away from the lake the probability of low temperature extremes get higher.

Low temperature injury is the most defining parameter in determining the distribution and success of various temperate climate tree crops. As you move back from the lakes, the frequency of damaging low temperatures occurs more often over a 50-year period. The winter of 2004-05 was indeed quite devastating to some apple cultivars in some blocks, including Mutsu, Gala, Northern Spy, and some strains of McIntosh. Look for more signs and effects from injuries that took place two winters ago.

Figure 3. Black Rot symptoms on winter injured Gala. This tree was injured during the winter of 2004/05 survived this 2005 growing season and finally succumbed to a combination of factors. The Black Rot organism moves in quickly on dead and dying trees.

Next to low temperature injury, the most damaging phenomenon in the winter months is the sudden drop in temperatures over a period of a few hours. These temperature descents are common in late December in the week or so before the holiday break.

The reason these descents are so damaging is that trees have not developed their maximum winter hardiness. That hardiness factor normally does not happen in apple until well into January in Ontario. This type of low temperature injury can also destroy tender fruit buds, but have minimal or little impact on the woody tissues in the tree.
Pruning apples before they have accumulated their full hardiness can set trees up for winterkill, especially so with cultivars that are less winter hardy. In general, pruning cuts are dehardening in the early winter and the larger the cut the more dehardening occurs.

Most apple growers with larger acreage are generally obliged to start pruning in early winter in order to get through this task. If trees are in good shape and have had annual pruning, then the risk is diminished. It has been a good practice to start on less valuable trees and trees that are more mature. If you have a small acreage or a few trees to prune then leave it as late as possible before bud swell.

Year-round temperature effects in an orchard planting are also greatly influenced by topography. Orchards planted on higher ground having good air drainage within accepted climatic districts usually have a lower probability of sustaining winter injury.

It doesn't matter how well trees are managed in this situation. If the trees are sitting in a cold or frost pocket they will have a much lower probability of producing a net return to the orchardist. Even if the trees escape winter injury, they can get hit with frost in the spring.

The last item to discuss is the chilling requirement for this class of tree crops. It's understandable why some individuals get really excited about a period of days that are unusually warm right in the middle of winter.

Most of the apple cultivars we grow in Ontario have a chilling requirement of anywhere from 1200 to ~1600 hours at temperatures less than 7°C. This means that trees are not normally prepared to break dormancy until this requirement is met. It's a built-in safety mechanism to keep trees shut down with the advent of mid-winter thaws.

Chilling requirements for apple are not usually fulfilled until very late in January. In contrast to apple, a crop like apricot has a chilling requirement of roughly half that of apple. This is why apricots are easily drawn out of dormancy.

Cultivar Notes on Thinning

John Gardner, Apple Specialist, OMAFRA, London

The following notes on apple cultivars will appear in the next issue of Publication 360. These comments are written to help with crop load management decisions on a cultivar-by-cultivar basis.

Ambrosia
This spurry upright growing cultivar has been successfully thinned in Ontario with moderate rates of Sevin XLR. A well-thinned crop of Ambrosia finishes strongly with regard to size and colour development. The picking window for Ambrosia is narrow if the crop is to be held in long term storage.

Cameo
Trees can normally handle heavy crop loads in a vigorous canopy. This cultivar has been shown to thin adequately with Sevin XLR (1 L per 1000 L water) on established trees.

Creston
Has been shown to over thin easily with low to moderate rates of Sevin XLR. Creston is a productive large size cultivar that requires two harvests.

Empire
Before applying NAA, make sure the king bloom fruitlet is set by checking sepal posture. Petal fall of king bloom can take place as early as 3–4 days past peak pollination. If NAA is used too early (full bloom to petal fall), the overall fruit size of unthinned apples may be reduced compared to treatment at a stage when the king fruitlet is 8–10 mm in diameter.

Enterprise
Appears to thin adequately with moderate rates of Sevin XLR.

Fortune
Is a large sized, highly coloured, dual purpose apple that requires thinning to avoid biennial bearing. Fortune requires a strong treatment of NAA in combination with Sevin XLR. Experienced growers have reported success with 10 ppm NAA plus 1L Sevin XLR /1000 L water on mature trees.

Fuji
Unthinned Fuji normally returns very little bloom the following year. This cultivar exhibits strong biennial characteristics. Fuji must be thinned aggressively for best results. Mature trees usually thin adequately with combinations of Sevin and NAA. Follow-up hand thinning is usually necessary to further reduce the number of king fruitlets. Excessive crop may prevent the fruit from maturing to premium quality.

Calculating Parts per Million (ppm)
1 ppm = 1 g active ingredient per 1,000 L water

Gala
Gala is relatively difficult to thin successfully. On mature trees, the approach must be aggressive. Good results have been achieved using a combination of NAA and Sevin at the rates listed for Golden Delicious. The suggested timing for this application is when king fruitlets are at 8–9 mm. Fruit size potential is determined within 2 weeks following calyx. Clusters must be thinned to 1 fruitlet (king bloom) by mid to late June. A follow-up hand thinning within 30 days of full bloom is normally required to further reduce crop load. Spur extinction techniques and canopy renewal are essential practices to maintain fruit size on mature Gala trees.

Gingergold
This cultivar appears to be more sensitive to thinners than McIntosh, Northern Spy and Empire. It can be over-thinned with high rates of NAA or strong combinations of NAA and Sevin XLR or Accel plus Sevin XLR. Most growers would consider this cultivar to be uncomplicated as far as thinning requirements go.

Golden Supreme
Unlike Golden Delicious, this mid season Golden Delicious type will thin adequately with 1 L of Sevin XLR/1000 L water.

Goldrush
Requires a combination of NAA and Seven XLR (10 ppm NAA + 1 L Sevin XLR per 1000 L water). This cultivar is much tougher to thin adequately.

Honeycrisp
This cultivar seems to be more sensitive to thinning treatments than Empire. Thin Honeycrisp cautiously, as it can easily become oversized and is very prone to bitterpit. Use of growth regulators, which enhance fruit size, may not be warranted for this large fruited cultivar. Use no more than 2.5 ppm NAA with 1 L Sevin XLR per 1000 L water as a starting point on established trees. Many growers report good results when the largest fruitlets are removed by hand-thinning following the spray thinning treatment. Honeycrisp is highly biennial in nature and may not return an adequate crop year after year. More mature trees may require stronger thinning treatments. For a discussion on crop load and trunk circumference with respect to thinning see OMAFRA factsheet: *Commercial Production of Honeycrisp*, Order no. 05-047

Jonagold
This cultivar thins relatively easily and has good size potential when clusters are thinned to singles. Most producers get adequate thinning with moderate rates of Sevin. Over-cropping Jonagold may result in very poor return bloom and fruit may not mature to a premium quality.

Shizuka
Thins similarly to Crispin with moderate rates of Sevin XLR**.**

Silken
Thins with 1–1.5 L of Sevin XLR per 1000 L water, depending on tree age. This cultivar bruises easily so even fruit distribution in the canopy, which enables careful picking and handling, is desirable.

Table 7–19. Suggested rates for chemical thinning of mature apple trees[1]

Use ONE of the following:						
Cultivar	**NAD ppm[2]**	**NAA ppm[2]**	**Sevin XLR L/1,000 L**	**Sevin XLR +NAA ppm[2] per 1,000 L water**	**Accel (g BA/ha)[3]**	**Sevin XLR (L/1,000 L water)[2] + Accel (g BA/ha)[3]**
Lodi, Melba, Quinte, Yellow Transparent	50–75	—	—	1 L + 10–15 ppm	—	—
Early McIntosh	75–100	—	—	1 L + 5–10 ppm (at petal fall)	50–75	—
Jerseymac, VistaBella, Tydeman's Red	—	5–10	1–1.5	—	—	—
Paulared	50–75	12–15	1.0–1.5	1 L + 10–15 ppm	75	1 L + 50
Spartan, Russets		10–20	1.0–2.0	1 L + 10–15 ppm	—	—
Cortland	—	5–10	—	1–2 L + 2.5–5 ppm	—	—
Ambrosia	—	—	1-1.5	—	—	—
Silken	—	—	1-1.5	—	—	—
Cameo	--	--	1	--	--	--
Non-spur McIntosh	—	5–10	1.0–2.0	—	50	—
Spur-type McIntosh	—	10–12	—	1–2 L + 2.5–5 ppm	50–75	1 L + 50
Golden Delicious, Wealthy	75–100	10–20	1.0–2.0	1 L + 5–10 ppm	75	1–2 L + 50
Golden Supreme	--	--	1.0	--	--	--
Goldrush				1 L+10 ppm	--	--
Red Delicious	—	2–8	0.5–1.5	—	—	—
Spur-type Red Delicious	—	5–10	—	1–2 L + 5–10 ppm	—	—
Idared	—	2–8	—	—	50	—
Empire	—	7–10	1.0–1.5	1 L + 2.5–4 ppm	50–75	1 L + 50
Spy, Crispin (Mutsu)	—	5–10	0.5–1.5	—	—	—
Jonagold	—	—	1.0–1.5	—	50–75	—
Fuji	—	—	—	1–1.5 L + 10–12 ppm	—	1–2 L + 50–75
Gala	—	10–12	—	1 L + 5–10 ppm	75	1–2 L + 50
Honeycrisp	—	5	1–1.5	1 L + 2.5 ppm	—	—
Gingergold	—	7–10	1–1.5	1 L + 2.5–5 ppm	—	1 L + 50

"—" indicates treatment recommendation not available

[1] The above rates are suggested for trees with a settled cropping history. To chemically thin a first crop tree or trees considered to be immature is very risky.

[2] Sufficient water volume must be used to thoroughly wet trees. See *Steps in Thinning* on page xx.

[3] Consult Table 7–17, *Accel rate*, on page xx, to determine the actual ppm benzyladenine (BA) being applied. Concentration of BA should be no less than 50 ppm to be effective. 1 L of Accel contains approx. 19 g of BA.

Note: The rates for Sevin are amounts of product. Sevin XLR is 43% active ingredient and contains 480 g or approximately 0.5 kg of carbaryl per L. One litre of Sevin XLR is roughly equivalent to 1 kg of Sevin 50 W. For actual amounts of NAD and NAA refer to the label of the product being used.

Mobile Platforms for the Future of Apple Production

John Gardner, OMAFRA, London

One of the recurring themes that keeps appearing in various journals and news bulletins on fruit growing in North America is that of labour efficiencies in the orchard. It's rare to find any discussion on labour these days in orchards without hearing about mobile platforms that carry workers down the row without ladders being visible anywhere in the orchard. Some workers that have used this platform method in the U.S.A. claim they prefer to stand while doing jobs such as pruning rather than hauling ladders around.

These ideas are not new, as various pieces of equipment have been available from the mid 70's and are in use in various parts of Europe, Canada and the U.S.A.

I have had many discussions over the years here in Ontario with growers who have used this concept and/or developed various prototypes. With the current cost/price squeeze in tree fruit growing maybe it's time to look harder at this concept.

The general idea is to have workers carried on a mobile platform either pulled or self-propelled down between tree rows with individuals assigned to zones in the canopy. By eliminating the need to move ladders and walk between trees the whole job can be done more quickly and with greater savings when compared to traditional methods. This works best when the equipment is worker friendly and elements like noise levels from running power sources are not objectionable.

Researchers, growers and investigators in the U.S.A. claim efficiencies of up to 30% over traditional methods of labour access to trees year-round, for everything from installation of pheromone lures to green fruit thinning through to harvest of the crop and onto pruning.

The designs in use range from very simple adaptations of existing equipment like bin trailers modified to carry these mobile platforms to self-propelled units. Manufacturers in the U.S.A. are custom building platforms to specs based on tree height and row spacing.

Usually the outfit will have upper and lower decks and extensions to enable workers to cover the entire tree canopy. Safety rails are installed, hydraulics are kept to a minimum, and design elements are simple to keep costs down.

Probably the best tree shape for this type of equipment would be a flat-sided tree wall that would naturally evolve from a super spindle or vertical axe type planting. These plantings are more and more common in North Eastern North America and indeed in Ontario.

My guess is that it won't be long before we see more of this type of equipment in use in Ontario and throughout Great Lakes area, especially on trees that are over 9 feet in height and where there is currently a high proportion of ladder work involved tree and crop management.

Rosettes in Your Rosaceae?

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

Most orchards have weed growth under the trees in the so-called "weed-free" strip at this time of year. Look closely to see the many different kinds of weeds there, including annuals and perennials, grasses and broadleaves.

Already some of them are in bloom, and others will bloom by early summer. Many of these early bloomers are winter annuals, which are particularly adapted to the cycle of tree fruit production. These winter annuals germinated from seed late last summer or fall, when the rains returned. They grew in a dense, flattened form known as a rosette and stored enough energy last fall to overwinter and be ready to bloom early.

Winter annuals in orchards commonly include:

- Canada fleabane
- Common peppergrass (which is not a grass!)
- Common chickweed
- Thyme-leaved sandwort
- Mustards (wormseed mustard, common peppergrass, stinkweed or pennycress, shepherd's purse)
- Corn gromwell
- Henbit

Some **biennial and perennial weeds** may also establish in the fall. Dandelion, plantain, docks, buttercups, thistles, sheep sorrel, common mallow, creeping Charlie, and goldenrod that are starting from seed are in rosettes.

Figure 4. Canada Fleabane Rosette

What should a grower do? Winter annuals are more difficult to control once the flower stalks have bolted. Delaying the spring burndown will make it less effective it will be – so be prepared to get out there earlier, i.e. keep prunings chopped or cleaned up and get your weed sprayer ready now.

Are early spring weeds really a problem? Definitely. The critical weed-free period for apples is in early spring – **from budbreak until about 30 days after bloom**. Trees kept weed-free during this time have the best chance of producing unreduced yields when compared to tree rows that are weedy during the same period of time. Weeds growing after the critical weed-free period may cause other problems, e.g. hampering harvest or shading lower fruit, but have little yield effect.

Think about the activities of your trees during this time, e.g. blooming, setting seed, dividing cells in the fruit, as well as putting on terminal growth and growing new roots. It makes sense to remove weed competition during this critical time.

How large an area needs to be weed-free? The weed-free strip needs to extend past the drip line of the tree. The most active tree roots are in this area, collecting nutrients and moisture. If weeds are allowed to grow, they always win the battle and your trees lose.

By the way, you likely already know that all tree fruit are in the Rosaceae family – in case you are wondering about my title.

CROP PROTECTION

Worldwide Use of Mating Disruption Continues to Rise

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

Mating disruption products for the management of various insect pests have been in commercial use now for around 2 decades. Worldwide use of these products continues to grow rapidly with over 390,000 hectares treated annually. Indicative of this expanding use were the numerous and diverse presentations on research and extension efforts with mating disruption (MD) techniques at the Western Orchard Pest & Disease Management Conference in Portland, Oregon in January. Fifteen of around 80 talks were specifically on MD and at least that many again mentioned pest management trials that included MD somewhere in their comparisons. Walt Bentley from the University of California Kearney Research and Extension Center reported that 80 to 85% of fresh market peaches and around 50% of processing peach acreage in California now rely on MD for management of oriental fruit moth. Most of that acreage needs no supplemental insecticides for pest control. Of course California has a different climate and different pest pressures than Ontario, but it has been demonstrated that MD can be an effective and economic alternative to standard pesticide programs in our climate as well (see various MD articles in previous TFGV newsletters).

The intensive agriculture in California and other states has allowed the development of several novel pheromone dispensing systems including micro fibers, micro flakes, “meso-emitters”, “puffers”, and sprayable formulations. For the time being in Ontario, we are limited to point-source dispensers – mostly the twist-tie style of pheromone dispensers, although clip type dispensers are now in the registration process. Sprayable formulations are not in our marketplace anymore, but hopefully will return eventually as they are a useful adjunct to dispensers.

An important component of any IPM strategy, including MD programs, is regular, reliable monitoring. A monitoring plan should be in place before the growing season starts and there are private consultants who can assist you with that plan and the seasonal monitoring. Mating disruption is not a suitable strategy for all sites, so a site evaluation by an experienced consultant is important before moving to MD.

If you are considering adopting mating disruption for management of oriental fruit moth, grape berry moth, codling moth, or peach tree borer, there are two OMAFRA publications that can help you understand the basics of MD. *Mating Disruption for Management of Insect Pests*, Order No. 03-079 and *Mating Disruption for Management of Oriental Fruit Moth in Stone and Pome Fruit*, Order No. 04-029 are both available at OMAFRA offices or on our website.

Codling Moth Control Problems in Ontario Orchards: Where do we go from here?

Kathryn Carter, Apple IPM Specialist; and Hannah Fraser, Horticultural Crops Entomologist, OMAFRA

In the last few years increased damage from codling moth *Cydia pomonella* Linnaeus (CM) has been reported in Ontario and other major apple growing areas. There are several factors that may be responsible for this increase in damage, including use of less effective products, unseasonable weather, timing of sprays, low rates of conventional insecticides, and the development of pesticide resistance.

Apple growers continue to switch from using broad spectrum organophosphate (OP) insecticides to using more target specific "reduced-risk" products. While these products can be effective in managing pests, many work differently from conventional insecticides. Producers need to become familiar with them and gain some confidence in how best to use them in their IPM programs. Reduced-risk pesticides may be less persistent, may not result in rapid knock-down of the pest, may have reduced efficacy and may have different application timing and thresholds than conventional control products. In some cases, new products offer "suppression" of pests, and may not achieve levels of pest control that growers have become accustomed to. *Regular monitoring is critical for the successful use of many new products.*

As the financial benefits of being an apple producer remain low, an increasing number of growers are looking at lowering pesticide rates to reduce costs. However, decreasing pesticide application rates may result in decreased efficacy and an increase in CM damage. Use recommended rates.

In most areas in Ontario (except the Georgian Bay) there are two generations of CM per year. Some researchers have speculated that during years with extended warm summers development of a 3rd generation may occur in some apple growing regions. This 3rd generation of CM may cause an increase in the duration and severity of damage from this pest. Scouting and the extended use of pheromone traps should provide some indication if this is occurring on the farm.

Codling moth resistance to OP insecticides has been demonstrated in production areas worldwide. What is particularly disturbing are studies that have demonstrated correlated cross-resistance between the OP azinphos-methyl, pyrethroids, and a broad array of insecticide classes, including insect growth regulators tebufenozide (Confirm) and methoxy-fenozide (Intrepid). Other studies are underway to determine the relationship between observed resistance to OP's and neonicotinyls in Washington and Oregon. Resistance across a wide range of chemical classes would present some serious limitations for effective management. There has been some speculation that failures in CM management in Ontario are the result of OP resistance; however, this has not been evaluated and the status of resistance remains unknown. Those tree fruit growers who experienced the losses associated with Oriental fruit moth in peach back in the early 1990's will remember just how costly resistance is – and how much research is required to identify, quantify and develop solutions for it! The expertise and resources required to implement for this type of research program may not always be readily available, unfortunately.

The timing of pesticide sprays to manage CM in Ontario apple orchards involves the use of a degree day model, which is triggered by first sustained moth catch. Researchers have shown that pesticide resistant CM develop more slowly and have shorter life-spans than susceptible insects; in addition, their emergence patterns differ from those of susceptible populations. If the developmental times for resistant CM change, than flight patterns for these insects will alter, making the developmental model that is used to predict the timing of insecticides inaccurate. Without the developmental model, it would be difficult to properly time sprays for codling moth.

So what can growers do that have been seeing an increase in CM damage in their orchards?

1. Be prepared: Understand the biology of the pest and plan your IPM program before the season starts.
2. Hire a crop consultant to monitor CM populations and time sprays accordingly.
3. Avoid using border sprays for a few years, until CM populations have decreased.
4. Do not go below label rates.
5. Growers with a history of problems with CM in the past few years may want to avoid using OP insecticides altogether. Those who still prefer to use OP's should limit their use to target a single generation, and alternate with a pesticide with another mode of action (Assail 70WP®, Intrepid 240F®) for subsequent generations.
6. Be aware of the residual and timing requirements for all pesticides used. Some of the newer chemistries, such as Intrepid, have ovicidal activity (although it is also toxic to larvae by ingestion) and should be applied 1-2 days earlier than conventional products.
7. Be aware that CM often overwinter in apple bins, and monitor CM populations in the area of bins closely. Keep in mind their emergence from bins may differ somewhat from that in the field (tends to be extended).
8. Ensure proper pesticide coverage: prune trees, calibrate sprayers, and avoid using alternate row sprays.

Insecticides are useful tools in pest management, but they are not the only ones worth consideration by the grower. There have been many recent advances in the application of mating disruption for codling moth either alone or in combination with granulosis virus or pear esters (Michigan, Pennsylvania, California, Washington). While there have been challenges in implementing this technology in Ontario, there are opportunities to integrate mating disruption for codling moth into apple pest management programs.

Keep in mind that there are many causes for failure of a product to manage a pest population. Prior to assuming a population is resistant to a product, consider the following factors in the pest management program: product choice, water volume, rate, calibration and coverage, timing, pH in spray tank water, time required for knockdown of pest, and weather conditions. Judicious use of pesticides will help reduce the development of resistant populations and conserve the effectiveness of existing products.

Minimizing Shothole Borer Damage in Orchards

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

Shothole borers are very small beetles that attack trees. Virtually every species of tree has several types of borers which may feed on it. At a recent presentation in Portland, Oregon, Mike Doerr from Washington State University Tree Fruit Research and Extension Center spoke about a particular shothole borer, *Scolytus rugulosus*, that is becoming a more common problem in Washington cherries. *S. rugulosus* is present in Ontario and around the Great Lakes and has a host range including cherry, peach, plum, apple, pear, and apricot, as well as many common forest and ornamental trees. The primary infestations have occurred where large piles of orchard wood were stacked as firewood in or immediately beside an orchard. The solution for shothole borer infestations is very simple – remove and destroy wood piles, dead trees, and prunings from the orchard as quickly as possible.

Shothole borers can attack freshly killed or diseased trees, stressed or low vigour trees, fresh prunings and newly planted trees. If present in sufficient numbers, they can also cause damage to, or even kill otherwise healthy, productive trees. Although there are many different species of *Scolytidae* (the family of bark beetles which includes shothole borers) they are fairly distinct small (1.8 to 2.5 mm) stubby beetles with their head concealed from above by a "hooded" thorax. They look a bit like they have run into a wall and permanently pushed their heads back into their bodies. Larvae infesting wood are small (0.5 to 4.0 mm) white, legless grubs with slightly darker head capsules. Feeding galleries of the larvae can be found under the bark even in winter. Two generations per year of *S. rugulosus* are likely in Ontario but the precise timing is uncertain – most likely peak flights of adults occur in May to June and again in August to September.

In Washington, as elsewhere where shothole beetles have been reported in orchards, their damage is pronounced on orchard edges near stacked woodpiles. Generally, these little beetles travel only about 10 to 50 m before boring into a host tree, confining their damage primarily to the outer 2 or 3 rows of orchard trees. Although not usually necessary, monitoring for adult beetle emergence and movement is easy with yellow sticky cards. Recognizing the first signs of infestation by scouting orchard borders

(especially near stacked wood or pruning piles along orchard edges) is a better way to monitor. Look for sudden wilting of twigs or yellowing of shoots and small entrance holes about 1.5 mm wide at the base of buds and spurs. Watch also for sap leaking from small entrance holes in trunks or branches.

Even severe infestations of shothole borers are easy to clean up with simple orchard sanitation. To avoid problems with shothole borers, burn prunings promptly and don't store firewood stacks in or beside orchards. If you think you are suffering from shothole borer damage, let me know and I can help you determine whether the damage is from *S. rugulosus* or some other boring beetle.

Apple Scab Management in 2006

Kathryn Carter, Apple IPM Specialist, OMAFRA; Margaret Appleby, IPM Systems Specialist, OMAFRA; and Wendy McFadden-Smith, McSmith Agricultural Research Services

With the warm weather we have been having lately, there are no doubts that spring is here. With the onset of spring comes rain, warmer weather and bud movement. With these conditions, every apple grower's greatest foe, apple scab is ready to infect.

Last year was not a stellar apple scab year, so hopefully there won't be a large inoculum load going into this season. However, that doesn't mean that growers should let up on their scab control programs. It only takes one successful overwintering pseudothecia to release several ascospores and initiate a scab infection. So, as always growers should be looking at applying fungicides as soon as green tissue is present in the orchard. With the relatively warm winter we have been having, apple scab maturity is likely more advanced than usual, and the ascospores are ready to release and infect green tissue as soon as it appears in orchards. Preventing apple scab lesions in the orchard is always more effective than trying to minimize the spread of the disease once infections are present. While some products have characteristics that may help to reduce the spread of apple scab, they should only be used curatively in emergency situations. The curative use of fungicides encourages the selection of fungicide-resistant populations of the scab disease organism.

Although Michigan, New York, and Quebec have documented cases of resistance to Sterol Inhibitors (SI's) such as Nova and Nustar, surveys have not been conducted to determine if SI resistance is present here in Ontario. Dr. Wendy McFadden-Smith, a private consultant is planning on conducting trials this year to determine the levels of SI resistance in some Ontario apple orchards, and hopefully the results will be available next year. Until the results of this study are known, the best strategy for managing apple scab in Ontario apple orchards is to use a resistance management strategy (see Apple Scab Resistance Management Strategy).

There are a wide variety of different fungicides available for managing early season scab. Scala SC (pyrimethanil) was recently registered for managing apple scab prior to bloom. Scala is in the same fungicide class as Vanguard (Anilinopyrimadines or AP's), and the two fungicides share some similar characteristics. Scala and Vanguard are ineffective against powdery mildew or rust, and are less effective against fruit scab. They both perform best in cool weather. As a result, Scala should only be used on apples prior to bloom. Research from Michigan and New York has shown that applying Scala in combination with a ½ rate application of Dithane, Captan or Mancozeb provides effective control of scab. Use Scala in a 7-day spray interval. Do not apply Scala in the rain, since the product must dry on the leaf for maximum effectiveness. Scala provides approximately 48 hr of post-infection activity against apple scab when applied at the full rate (1 L/ha). Scala may provide another option for growers who use early season oil sprays that are incompatible with Captan. For more information on the timing and application of Scala and other fungicides to control apple scab please refer to publication 360 available at your local OMAFRA office in June, or available online at: http://www.omafra.gov.on.ca/english/crops/facts/360applecalendar.htm.

Apple Scab Resistance Management Strategy

- Rotate between chemistries in a fungicide program.
- Avoid the application of more than four sprays of Sterile Inhibitors (SI's) or strobilurins per season.
- Always use full rates of SI fungicides with ½ rate of protectant fungicide.
- Don't miss fungicide sprays at green tip. Be prepared to spray even in the rain if necessary (with Supra Captan, Maestro, Dikar, Manzate, Dithane, Penncozeb, Polyram), but keep in mind that you will lose your residual. Don't spray Nova, Sovran, Flint, Vangard or Scala in the rain.
- Always apply fungicides preventatively (before infection) not curatively (after infection). The curative application of fungicides increases the probability of selecting fungicide-resistant populations of scab.

- Always use full label rates of fungicides. Reducing the rates of fungicides may increase the number of resistant individuals present in an orchard.
- Coverage is Imperative. Alternate row spraying is not recommended.
- Read label to determine if product can be applied using tree row volume applications.
- Don't extend your spray intervals beyond those listed on the label. Shorten spray intervals during rainy periods.
- Urea sprays may be applied to leaves on the orchard floor in November and/or the spring to increase leaf decomposition and reduce the apple scab inoculum the following spring. Flail mowing and mulching of the leaf litter has also been shown to reduce inoculum levels.

POSTHARVEST

Does 1-MCP Help an Apple Keep the Doctor Away?

D.D. MacLean[1], D.P. Murr[1] and J.R. DeEll[2],
[1]University of Guelph, [2]OMAFRA, Simcoe

There is a growing interest in flavonoids as an integral antioxidant of the human diet, due in part to its demonstrated strong anticarcinogenic activity and inhibition of tumor cell proliferation (1). Apples have been shown to contain high amounts of flavonoids, including anthocyanins, flavonols (e.g. quercetin) and flavan-3-ols (e.g. catechin), and the simple phenol chlorogenic acid (2)(see below). In the North American diet, apples are the largest source of flavonoids, and have the second highest level of antioxidant activity (3). Listed below is a list of the 4 main classes of phenolics found in apple, and some examples of their role in human health and nutrition.

Anthocyanins: The compound responsible for the red pigmentation of apple, it is also an important antioxidant and anticarcinogenic agent. Other good dietary sources of anthocyanins include blueberry, elderberry, red grape, red wine and cherry.

Flavonols: Best represented in apple by the specific compound called quercetin, it is an excellent metal chelator and a strong antioxidant. High levels of quercetin have been correlated with a reduced incidence of various cancers (breast, colon and liver), heart disease (modulation of platelets), and lipid peroxidation. Other good dietary sources of flavonols include broccoli, red onion, kale and teas.

Flavan-3-ols: Also known as tannins or catechins, this group of flavonoids is what makes tea healthy. A powerful antioxidant, it can also inhibit low-density lipoprotein (LDL; a.k.a. "bad cholesterol") oxidation, and colon cancer. Aside from apple, other good dietary sources of flavan-3-ols include chocolate and red wine.

Chlorogenic acid: A simple phenol (not a flavonoid) with very high peroxyl free radical scavenging capability. Peroxyl radicals have been linked with tumor promotion and carcinogenesis, as well as physically damaging DNA. High levels of chlorogenic acid are also found in coffee (contributes to the upset stomach some people get from drinking too much coffee), tea, potato, cocoa and various fiber sources.
With respect to apple physiology, it is known that both the content of the flavonoids and the production of ethylene increase with harvest maturity, suggesting that the flavonoid pathway may be regulated (whole or in part) by ethylene. This raises concerns that a treatment of 1-methylcyclopropene (1-MCP), a potent inhibitor of ethylene action, may adversely affect the total flavonoid content of the fruit. Neither the commercial harvesting practices, nor a 1-MCP treatment have been investigated for their effect on the flavonoid content in apple.

***The Study*:** The objective of this study was to determine the effect of a postharvest treatment of 1-MCP on the various nutraceutical compounds and antioxidant scavenging capacity of apple.

1-MCP Treatment Effect on Nutraceuticals: The 1-MCP treatment resulted in a significant increase in the total amount of flavonoids, with the greatest increase occurring in the red pigment-forming anthocyanin class of flavonoids (Table 1). However, the 1-MCP treatment also resulted in a 25% decrease in the total amount of chlorogenic acid.

Total Antioxidant Capacity: Using the TOSC assay (a test to determine the total antioxidant capacity of a given tissue; TAC), it was found that red 'Delicious' had the highest level of antioxidants, with 'Empire' having the least, and 'McIntosh' tissues being intermediary (Table 2). However, in all cases, a treatment of 1-MCP resulted in a higher level of antioxidants during storage than in the non-treated control.
In general, for red 'Delicious' it appears that a 1-MCP treatment will result in a slightly higher level of flavonoids (+5%), and total antioxidant capacity (+3%), but with a rather large reduction in chlorogenic acid levels (-25%). This reduction in chlorogenic acid

in 1-MCP treated fruit is only seen in early harvested fruit, and is likely due to the inhibition of chlorogenic acid synthesis in the ripening fruit by the 1-MCP. Although a late harvest would result in a higher level of flavonoids and chlorogenic acid by minimizing this inhibition, it would unfortunately also result in a loss of the beneficial effects of the 1-MCP treatment, such as firmness retention and inhibition of ethylene perception. In conclusion, the overall net effect of a treatment of 1-MCP on apple nutraceutical compounds appears to be of benefit for human health and nutrition.

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Table 1. The total flavonoid and chlorogenic acid contents of red 'Delicious' apple over all cold storage removals (0, 30, 60, 90 and 120 d), harvest maturities (-7, 0 and +7 d) and shelf-life periods (+1 and +8 d)(µg g^{-1} f.w.)

	Anthocyanin	Flavonol	Flavan-3-ol	Total Flavonoids	Chlorogenic acid
Control	993	818	879	2613	377
1-MCP	1005	802	911	2732	286
Difference	**+ 8%**	**- 2%**	**+ 4%**	**+ 5%**	**- 25%**
Significance [a]	Yes	No	Yes	Yes	Yes

[a] No, Yes; not significant and significant at P<0.001, respectively. Modified from (4)

Table 2. The effects of 1-MCP on the antioxidant capacity of four apple tissues after 120 d of 0ºC storage (ηmoles Trolox Equivalents g^{-1})

	McIntosh Green Skin	McIntosh Red Skin	Delicious (Red)	Empire
Control	1314	1497	2182	1096
1-MCP	1413	1726	2256	1135
Difference	**+ 8%**	**+ 15%**	**+ 3%**	**+ 4%**
Significance	Yes	Yes	Yes	Yes

Yes is significant and significant at P<0.01. Modified from (5)

ANNOUNCEMENTS

Canadian Agricultural Skills Services (CASS)

This program is targeted to assist farmers and their spouses, with net family incomes of $45,000 or less, increase their family income.

CASS Eligibility

- Farm families with income averaging no greater than $45,000 over the past three years
- Farmers, beginning farmers, and their spouses (includes up to five farmers and five spouses from a partnership, corporation or cooperative)
- The farmer must be:
  - Engaged in farming, with annual gross farm sales >$10,000; (beginning farmers with projected annual gross farm sales >$10,000);
  - Out of school system for 2 years;
  - Not receiving EI Part II funding for training.

Program Benefits

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   - identify their skills and strengths,
   - develop business or employment goals, and
   - create a Learning Plan that identifies what training activities are needed to meet their goals.
2. Financial assistance to help cover the cost of formal and informal learning and training activities both agricultural and non agricultural including;
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   - Eligible costs can include tuition, textbooks and related expenses such as travel and dependent care.

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