



ORCHARD NETWORK

For Commercial Apple Producers

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ORCHARD MANAGEMENT

Comments on Crop Load Management for 2007

John Gardner, Apple Specialist, OMAFRA, London

I was doing some rough calculations the other day trying to figure out how much it would cost to hand thin Ontario's apple acreage and came up with an estimate of \$18,000,000. This was based on a labour crew of 10,000 workers employed for about one month.

In comparison, a good spray thinning program over Ontario's commercial acreage probably cost growers around \$750,000.

Thinning of the crop load on a well set apple tree is probably the single most valuable cultural practice carried on in the orchard. Not only does it produce the best potential crop value, it can influence everything from insect and disease control to prospects for next year's return bloom and crop.



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

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

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

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

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

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

Leslie Huffman, Harrow
Weed Management Specialist
(Horticultural Crops)
☎ (519) 738-1256

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

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

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

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

This issue of the **Orchard Network
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Service Representative, Marian
Desjardine, OMAFRA, London.

Ontario's apple crop for the current year could be the first king bloom crop we have seen in a while. The development of fruit buds this spring has been slower than some of the past springs where buds developed quickly and invariably got caught in frost conditions. This frost factor has historically made thinning decisions quite tough to judge. This year, those decisions were easier to make.

The nice thing about a king bloom set is that the king will normally dominate the cluster of fruitlets and make it easier to separate it from the side bloom fruitlets when suitable thinning materials are applied. The king bloom fruitlet is considered to be the largest and best connected fruitlet on the spur.

I would have to rate the number of days and hours of conditions suitable for good bee activity in the orchard this year as being quite good. However, it's rare to have perfect dry warm conditions throughout bloom as we did in 1999.

Potential fruit size of well thinned crops and ultimately crop volume are directly related to pollen movement in the orchard and this only takes place when weather conditions favour good bee activity.

We have had in most cases an excellent return bloom in Ontario. Some trees did come out in what I would call a snowball bloom. This type of bloom takes a lot of energy out of the trees and in theory makes them easier to thin.

A snowball bloom will create a sink for nitrogen because of the pollen production by such massive numbers of flowers.

There is always the possibility of over thinning or under thinning. Many growers would prefer to deal with a crop that's slightly overthinned than one that's under thinned.

If you are using the growth regulator Apogee for the first time, you may find that it will increase the strength of the set to a point where you will have to adjust rates or materials if this growth regulator fits into your future plans for a certain block or cultivar. This is where good record keeping comes into play to know what was done in the past and what worked did not work so well.

The one thing I would encourage growers to do in early June is to section fruitlets to get some idea of potential seed count (Figure 1). This can be important as it relates to management decisions throughout the growing season.



Figure 1. Potential for high seed count, embryos are developing rapidly.

Poorly seeded fruit is at a disadvantage in terms of potential growth and development. It also may not have the same ability to influence uptake of a variety of nutrients, including calcium. Mutsu or Crispin with low seed count will demonstrate a high % of corking or bitter pit. Low seed counts may also influence the keeping ability of fruit when compared to apples with 7-10 seeds in the core.

One lesson we have learned is that we need to finish relatively few numbers of set fruitlets to actually make a crop of decent volume.

Varieties like Gala and Fuji need only 5-10% of the bloom finished in an average year to make a good crop. This means the elimination of all side bloom fruitlets plus every 2nd or 3rd king depending on tree vigour and the availability of water. These cultivars do best when the fruitlets are singulated to a spacing of several inches or 15 to 20 centimeters depending on what size objective the grower has.

Early to mid June has traditionally been a bad time to judge crop load in my experience. Trees that sometimes look light end up with a perfect balance of fruit to leaf ratios. June drop will also play a role in thinning down a canopy even in the absence of spray thinning treatments. June drop can be heavy with the advent of very warm dry weather following bloom.

Remember that it is not possible to grow everything the exact same size, as a crop will have fruit size distribution following a normal curve. The idea is to finish with most of the fruit in the larger size categories.

A cultivar like Honeycrisp, which is relatively new to Ontario, may produce fruit that are too large if they are reduced to one fruitlet per spur. Based on growers' experience with Honeycrisp, it may be best to leave a high percentage of spurs with two fruitlets so the individual apples do not get too large. Honeycrisp is a cultivar that requires skilled crop load management to ensure fruit quality for the current season and return bloom the following year (see Figure 2).



Figure 2. Honeycrisp in late May. Leaving a high % of spurs with two fruitlets may help keep individual Honeycrisp apples from getting too large on average.

Gala Leaf Surface Area Requirements per Apple

John Gardner, Apple Specialist, OMAFRA, London

The importance of leaf function, nitrogen and their relationship to fruit size can be quantified. Leaf surface area requirement is an interesting concept to discuss from the point of view that in Ontario we now have the bulk of our plantings on fully dwarfing or semi dwarfing rootstock. The implication here is that these trees on dwarfing rootstock are capable of sending most of the carbon that the tree fixes to the crop at 70% and more.

When comparing trees on size controlling rootstocks to fully vigorous or seedling rootstocks we find that the bulk of the carbon these systems fix goes into growing wood and less than half of the fixed carbon goes to the actual crop. This is one of the outstanding advantages we have in growing fruit on M9 or M26 for example.

Researcher Dr. Lailiang Cheng at Cornell University in New York has studied the relationship between leaf surface area, nitrogen and fruit size in Gala apples under completely controlled conditions. Bearing Gala trees in their 5th leaf on M26 rootstock grown in containers were studied in sand culture after being fed with various concentrations of nitrogen using Hoagland's nutrient solution.

The high rate of nitrogen given to the trees was equivalent to about 50 lb/ac of actual N. This rate of nitrogen also produced the greatest bourse shoot growth and best rate of photosynthesis on a whole tree basis.

On M26 rootstock, approximately 70% of the dry matter that the tree accumulated ended up in the fruit and nitrogen appeared to be sufficient at 2.0 to 2.2% for leaf analysis taken in late July. These same trees produced fruit weighing 180 grams on average, which translates into a 113 count size or 3-inch diameter apples.

Dr. Cheng also found that each apple of the larger size category required a leaf surface area of 80-90 square inches or 550 square centimeters. This was based on a crop load maximum of 8.2 fruit per square centimeter of trunk cross sectional area.

Mature Gala leaves should be a dark green colour, according to Dr. Cheng.

I would estimate that a typical mature leaf of Gala in good form would be about 8-10 square inches in surface area (Figure 1). That would mean that each apple on the tree finished to 180 grams would need between 8 and 10 mature leaves to get the desired result.



Figure 1. Mature leaves of Gala should be dark green for best rates of photosynthesis and their surface area would typically be 8-10 square inches.

This study helps to explain why sustained large yields of count sized Gala require an adequate leaf surface area to accommodate not only the crop but the tree in general. A thousand bushel crop of Gala grown to an average fruit size of 180 grams would then require a leaf surface area of 8,000,000 square inches, 55,555 square feet or 5,500 square meters per acre.

Orchard Foliar Fertilization

Peter Zwart, Nutrition (Horticulture) Program Lead

Given the wide variety of rootstocks, cultivars, orchard systems and soil types, it is not easy to make generalized fertilizer recommendations for apples. In established orchards, the best strategy is a July foliar sample to see how your orchard lines up with the optimum levels of nutrients shown in Table 1. In-season correction of deficiencies can be successful with the following nutrients.

Nitrogen

Perhaps the most difficult nutrient to optimize is nitrogen. It often comes down to a balancing act between yield and size (more nitrogen) and quality (less nitrogen). Too much nitrogen leaves you at risk for poor colour development, fruit drop, disorders like corkspot and bitter pit, and more storage losses. 'Honeycrisp' appears to be particularly sensitive to high nitrogen. Most nitrogen goes down in early spring. A leaf analysis in early July will give you a chance to correct any deficiency in-season. The quickest way of getting N into the tree is with a foliar application of urea or fertigation. Do not apply nitrogen beyond the end of July to reduce the chance of quality problems. The leaf analysis will also help you pin down a nitrogen rate for next spring.

If you are using fertigation through drip-lines, bear in mind that in crops where it has been studied, a fertigation N rate of somewhere around half the granular N rate gives a similar response. This difference does vary quite a bit depending on the crop and site studied and there have been few direct comparisons done in apples. Cutting your N rate in half if it is supplied by fertigation is a good starting point. Also, research is indicating that getting fertigation nitrogen on earlier and tapering it off by the end of June is a good scheduling strategy for maintaining quality.

Potassium

On sites with low soil-test K, addition of potassium

has been shown to improve fruit colour development, size titratable acidity and taste. Excessive N worsens any K deficiency. Little response has been seen where soil tested medium for potassium. Since magnesium and potassium compete for uptake, too much K will induce a deficiency in Mg. Foliar applications of potassium nitrate or potassium sulfate can be used to correct in-season deficiency, but soil application is the best long-term solution.

Calcium

Calcium deficiency is implicated in bitter pit, but the relationship is not clear or well understood. Nonetheless, foliar applications are prudent when bitter pit is of concern. Bear in mind that calcium sprays to 'McIntosh' and 'Honeycrisp' have been demonstrated to advance maturity in Ontario. Watch closely for early ripening, especially when using higher rates later in the season. A good discussion of rates and timing can be found in the OMAFRA FactSheet "Bitter Pit Control in Apples" (<http://www.omafra.gov.on.ca/english/crops/facts/00-009.htm>).

Magnesium

Magnesium deficiency becomes more common when higher rates of potassium are applied. Mg deficiency is known to induce premature fruit-drop in 'McIntosh'. Foliar sprays can correct a deficiency in-season, whereas soil application is the better long-term solution.

Boron, Iron, and Manganese

These micronutrients should be applied to address deficiencies uncovered by visual symptoms or leaf analysis. Deficiency tends to occur more on higher pH soils. Foliar applications are best used to correct deficiencies because the soil pH that causes the problem renders soil applications unavailable for uptake. Boron deficiency is likely the most common in Ontario and is more likely in dry years without irrigation. Judicious use of micronutrients is important because excess boron or manganese can result in reductions in yield and/or quality.

Table 1. Optimum ranges of nutrients in leaf samples taken in July.

	N	P	K	Ca	Mg	MN	Fe	Zn	B
	% dry weight					ppm			
Delicious, Crispin	2.2-2.7	.15-.40	1.4-2.2	.8-1.5	.25-.40	20-200	25-200	15-100	20-60
Empire, Russet, Northern Spy	2.1-2.6	.15-.40	1.3-2.1	.7-1.5	.25-.40	20-200	25-200	15-100	20-60
McIntosh & Other Varieties	2.0-2.04	.15-.40	1.2-2.0	.8-1.5	.25-.40	20-200	25-200	15-100	20-60

NOTES: - Optimum N ranges will be approximately 0.2% higher if the planting is not yet bearing
 - Increase optimum N ranges by 0.2% for all apple cultivars on size controlling rootstocks.

Pinching Technique Could Help Ambrosia Establish

John Gardner, Apple Specialist, OMAFRA, London

Ontario growers' investment in new apple acreage is considerable and a few cultivars stand out as far as their looks go after they have been in the ground for at least one growing season. Ambrosia is relatively easy to pick out because of its' looks early after planting. This cultivar sends out a profusion of branches along it's axis near the top of the tree.

It can be described as a very tight looking, brushy growth habit that makes the tree appear to be stalling out before limbs start to break and shoot out at their familiar acute branch angles and before any limb positioning occurs.

Some of these breaks are in close proximity to the tree leader and probably keep the leader from stretching out because they compete directly with the leader of the tree.

The leader can be released by pinching out competing shoots near the tip. This could be especially important where a more rapid establishment of the tree is desirable.

In the photo below (Figure 1) you can see what appears to be competing shoots at the top of the tree. Two or 3 of those shoots have been pinched out and/or broken off to allow the leader to play a more dominant role and to escape. Ultimately this technique will help trees establish quicker and to produce fruit in a shorter period of time. Branches can either be tied or positioned to flatter angles using positioning clips, or perhaps clothes pegs.



Figure 1. A competing shoot has been broken out off the main axis just below the tree leader. This technique helps with tree establishment.

CROP PROTECTION

Patternator to Be Used for Workshops

John Gardner, Apple Specialist, OMAFRA, London; Kathryn Carter Apple IPM Specialist, OMAFRA, Simcoe

OMAFRA staff have worked together this spring to build an orchard sprayer patternator. This piece of equipment should play a key role in measuring the performance of the orchard sprayers to be tested at the upcoming Sprayer Performance Workshops in late June and early July. See the announcement at the end of this newsletter.

Many remember the talk given by Dr. Andrew Landers in February at Brock University. Andrew showed a couple of versions of the patternator they have used to test the performance of orchard sprayers in New York State. These are variants of the type of equipment used in Europe to look at sprayer performance.

They all do more or less the same thing. That is to collect a sample of the wall of spray at different vertical heights, from ~1 foot up to 12 feet and higher, while the sprayer is operating in a stationary position.

The patternator we built in Ontario and to be used later this month is based on a series of collection screens positioned every 30 centimeters or every foot up a telescoping frame work. The screens will allow a certain amount of spray through without interrupting pattern set up by the sprayer itself. What is measured is the relative proportion of the total amount of spray coming from a bank of nozzles and it is collected by the screens at different heights. See Figure 1.

By comparison, in New York they have used both the screen design and a design that uses funnels and sends the collected spray liquid by gravitational forces to a rack of graduated cylinders on the ground. The idea then, is to correct or verify the symmetry of the spray profile by modifying nozzle angle/size, airflow and general set-up.

The key element of our design is the telescoping framework that holds the set of collection screens. Each screen has been fitted with a trough and downspout that sends the captured liquids down and into a rack of cylinders. Each cylinder represents a specific height on the tower.



Figure 1. Helmut Speiser, Pesticide Application Engineer with OMAFRA discusses sprayer options with apple growers at a test site in the London area. The patternator is shown on the right hand side of the photo.

Frog-Eye Leaf and Spot Black Rot

Michael Celetti, Plant Pathologist Program Lead – Horticulture Crops, OMAFRA, Guelph; John Gardner, Pome Fruit Specialist, OMAFRA, London; and Kathryn Carter, Pome Fruit IPM Specialist, OMAFRA, Simcoe

Frog-eye leaf spots caused by the fungus *Botryosphaeria obtusa* appears to be common in several apple orchards this year. The disease often first shows up 1-3 weeks after petal fall; however, this year the disease appears to be more common in some orchards than in previous years. On leaves the disease first appears as a tiny purple fleck, which eventually enlarges into a circular lesion about 4-5 mm in diameter (Figure 1). As the lesion enlarges, the margin remains purple while the center turns tan or brown giving the lesion a “frog-eye” appearance. The optimum temperature for leaf infections is around 26.6°C with 4.5 hours of leaf wetness.

Fruit can also be infected by the fungus resulting in the disease known as black rot (Figure 2). Initial symptoms on young fruit appear as red flecks that develop into purplish, slightly raised pimples, which often are unnoticed at first. Infections of mature fruit appear as irregular black spots surrounded by red halos. Regardless, as the fruit begins to mature and ripen, the lesions begin to enlarge and produce concentric dark rings. Often a colonized mummified fruit is located in close proximity to the black rot infected fruit.



Figure 1. Frog-eye leaf spot symptoms on apple leaf.



Figure 2. Advanced fruit symptoms of black rot on Royal Gala.

Sepals of fruit can become infected early in the season just after bud scales become loose. Red specks on sepals are the first symptoms of early infection that turn purple surrounded by red rings. Early sepal infections eventually develop into blossom end rot. The fungus can also proceed into the core, which becomes rotten and results in premature fruit drop before external symptoms on the fruit are noticeable.

Damage to limbs caused by wounds, cankers from other disease, insects or winter injury can provide an entrance for the fungus to invade and become established. Limb cankers first appear as reddish or pinkish, brown sunken areas in the bark (Figure 3). Cankers often remain small and superficial but can sometimes enlarge up to half a meter in length along the infected limb, killing the bark which eventually cracks.



Figure 3. Early black rot canker on apple tree limb.

One reason for the higher incidence of this disease in Ontario orchards over the past 2 years may be due to the winter injury on limbs sustained in some apple orchards during the 2004-5 winters, which provided the entrance wounds for the pathogen during the 2005 and 2006 seasons. Cankers that developed in orchards in 2005 provide the inoculum resulting in more mummified fruit last year in 2006. The mummified fruit left in trees is now providing inoculum for leaf infections resulting in the higher incidence of Frog-eyed leaf spot observed this time of year. Usually, a mummified fruit can be found within the vicinity of where the patches of frog-eye leaf spot symptoms are observed.

Pruning out diseased limbs and dead wood is an important practice to reduce the inoculum sources within the orchard. Be sure to remove the prunings from the orchard or burn them, since the fungus can survive on dead tissue. Alternatively, chopping up the prunings on the orchard floor with a flail mower will also reduce inoculum levels without the hassle of removing them from the orchard.

Pruning cuts can sometimes be categorized as wounds that won't heal. This is because the cut is not made to wound periderm and has no possibility of healing. Always cut to wound periderm to prevent fungus from colonizing an unhealed pruning cut.

Since, mummified fruit often left in trees become infected with the fungus and remain as a source of inoculum within the orchard, the removal of mummified fruit will also help reduce the potential of the inoculum building up within the orchard that can infect leaves and fruit. Fungicide sprays with Captan starting at silver tip on a 10 to 14 day schedule will protect leaves from getting the frog-eye leaf spot as well as the fruit from becoming infected and developing black rot.

POSTHARVEST

Maturity and Ripening of 'Ambrosia' Apples

Jennifer DeEll, Fresh Market Quality Program Lead, and Behrouz Ehsani, Research Assistant, OMAFRA, Simcoe; and Peter Toivonen, AAFC, Summerland, BC.

As part of a larger project, 'Ambrosia' apple maturity was monitored during the 2006 commercial harvest. Fruit maturity was evaluated on 10-apple samples twice a week from two commercial orchards in the Simcoe area of Ontario.

It appears that 'Ambrosia' is a low producer of ethylene, in that there was little change in internal ethylene concentration (continually <1 ppm) from Sept. 26th to Oct. 6th while the starch index increased by three levels. This

makes 'Ambrosia' an ideal candidate for SmartFresh (1-MCP) treatment, because the effectiveness of 1-MCP is optimal when apples are pre-climacteric and have little ethylene present.

Soluble solids content also increased (1.2-1.8%) in 'Ambrosia' during this time period. Conversely, there was relatively little loss of firmness (varying, <1 lb) while fruit matured on the tree.

It is important to note that the trends of apple maturity can vary enormously year-to-year and that this work represents only the maturity development of 'Ambrosia' during one season, 2006. Therefore, these evaluations need to be continued for additional growing seasons before confident conclusions can be made.

'Ambrosia' maturity from two orchards near Simcoe, Ontario – 2006¹

Orchard	Date	Fruit diameter (mm)	Blush (%)	Firmness (lb)	Soluble solids (%)	Starch (1-8) ²	Internal ethylene (ppm)
1	Sept. 22	70	68.0	19.2	11.4	3.8	0.2
	Sept. 25	72	61.0	19.1	11.2	3.5	0.1
	Sept. 29	73	75.0	17.7	11.3	5.7	0.1
	Oct. 2	71	74.0	18.0	12.3	4.1	0.0
	Oct. 6	72	73.0	18.3	12.6	5.3	0.1
2	Sept. 22	73	62.5	17.2	12.1	3.6	0.3
	Sept. 25	75	58.0	17.8	12.6	3.7	0.2
	Sept. 29	76	66.5	17.4	13.2	6.3	0.9
	Oct. 2	77	63.0	17.8	12.9	5.2	0.1
	Oct. 6	75	63.5	17.1	13.9	5.9	0.2

¹ Values are the average of 10 apples, taken from several trees scattered within the block/rows.

² Cornell generic starch chart, 1-8 scale.