



# ORCHARD NETWORK

For Commercial Apple Producers

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## **ORCHARD MANAGEMENT**

### **Building the 2006 Ontario Apple Crop**

*John Gardner, Apple Specialist, OMAFRA, London*

After a really mild and temperate winter, apple trees emerged from dormancy earlier than average for much of Ontario. This meant, as all fruit growers know, that there was a good probability of running into frost issues around bloom this past spring. This of course did happen in some areas. There are in reality very few years when we do not see frost problems in the crop somewhere. Suffice it to say it still amazes me how well some trees and blocks emerge from these events with a pretty good looking crop under the care of a watchful orchardist.

Since those frosty nights way back in April while trees were in the prebloom stage of growth we have seen variable pollination conditions, too much scab in McIntosh for some, pretty good rainfall, hail, and more winter injury showing up from a couple of years ago. The scab issue is one that puzzles me – in spite of perfectly adequate preparations and programs by conscientious growers, McIntosh remains one of the most susceptible to this disease.

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I wonder if growers that sprayed in the rain this spring got away with less infection pressure from scab on sensitive cultivars like McIntosh. We had periods of very dry weather in the spring along with periods of tough rainy and windy conditions that lasted for a few days.

The new factsheet on Apogee is now available for anyone interested. I have seen some excellent results from the use of this product in various orchards from a 2-spray program. Cultivars like Northern Spy and Cortland do not look in any way similar to untreated trees from a canopy development point of view. Spy has always been a costly cultivar to manage because of its growth habit. Other varieties like Gingergold are equally endowed with liberal supplies of natural gibberellins that make their canopy growth almost impossible to deal with. We do have some evidence of cracking of maturing Empire fruitlets in Ontario this year.

I can remember sitting in meetings in Michigan several years ago listening to researchers describe this same cracking problem on Empire in Michigan. Although research in Ontario at the University of Guelph had never revealed this problem, the issue is talked about in our factsheet and on the label as a caution. New York has also experienced the same condition in Empire. Empire appears to require a certain flow of gibberellins that is somewhat different than other cultivars in the early cell division stages of growth. This appears to enable the expansion of cells in the skin of the fruit and in the flesh to progress in an uninhibited fashion. This is probably intimately related to weather events and fruitlet growth rates.

There is lots of growing season remaining at the time of writing this article. Once again growers do have an opportunity to see controlled experiments and trials set out across the Province in different areas comparing treatments on a cultivar-by-cultivar or block-by-block basis. As long as growers are willing to experiment and use new products and processes, then we can expect the look and state of the art of modern apple orcharding to keep evolving.

A field day starting in the early afternoon for Apple Growers has been developed in cooperation with The Lambton Middlesex Fruit and Vegetable Growers Association for August 17<sup>th</sup>. See program details under the Announcements and register by calling the London office of OMAFRA.

## Calcium Sprays for Bitter Pit

Peter Zwart, Crop Nutrition Program Lead – Horticulture, OMAFRA, Guelph

The decision on whether to spray apple trees with calcium is not a simple one. Many factors need to be considered to allow you to realistically assess the probable benefits, and weigh these against the potential downside. The upside of calcium sprays is less bitter pit. However, this result is not guaranteed, and it does not often eliminate the problem completely. The downside can be earlier maturity in some cases with associated yield and size reduction, and the potential for leaf-burn. So grab an apple and let's go through this. As it turns out, apples are good for your brain.

(<http://communications.medicine.dal.ca/newsroom/apples.htm>).

### Risk factors for bitter pit that should be considered:

1. Variety Sensitivity – Honeycrisp and Northern Spy appear particularly susceptible. Delicious, Idared, Crispin, Cortland, and Empire are less sensitive but can suffer from bitter pit under the right conditions.
2. Orchard History – from past experience, you know how much of a problem bitter pit is in your orchards.
3. Nitrogen Status – the temptation to step up N application for bigger apples increases the risk of bitter pit. More N results in more growth, calcium uptake can't keep pace so the calcium that is there gets diluted to a lower concentration.
4. Heavy Pruning – increases N content of the tree.
5. Light Crop Load/Excessive Thinning – results in larger apples and more susceptibility to bitter pit.
6. Young Trees – these tend to be growing fast, diluting the calcium in the tree and have lighter crop loads.
7. K and Mg Status – are positively charged ions just like calcium, and they compete for uptake. Higher levels of K and/or Mg result in less calcium uptake.
8. Boron (B) deficiency – B is involved in the process of moving calcium up the tree. Deficiency can be found by leaf analysis and corrected with foliar sprays.

9. Weather and Soil Moisture – hot weather or drought stress shuts down transpiration which shuts down movement of calcium up the tree. Roots cannot pick up calcium from dry soil.

### Precaution for Calcium Spraying

Ontario experience has shown that calcium spray advances maturity of McIntosh and Northern Spy. Use calcium only if bitter pit is expected for these varieties and avoid high use rates later in the season.

### Calcium Sources

1. **Calcium Chloride** (77% flakes) is the cheapest form of calcium. However, it is the most likely to cause leaf burn. Application to McIntosh, Golden Delicious or Idared varieties have shown excessive leaf burn and **should be avoided**.
2. **Calcium Nitrate** should not be used beyond the end of July unless foliar N is low. Otherwise reduced colour development and storage problems may arise. Application can cause fruit damage on Crispin and Golden Delicious and **should be avoided**.

### Calcium Timings and Rates - do not exceed these concentrations.

Time	Calcium kg/ha	Calcium chloride kg/ha/2000L	Calcium nitrate** kg/ha/2000L
Mid-July	3	10	15
End July	3.5	12	18
Mid-Aug	4	14	21
End Aug	4	14	21
Total	14.5	50	75

**Branded Calcium Sources** are available and should be applied at rates that give an equivalent rate of elemental calcium to the above table. Some examples:

This Ca, OligoCa	6 % calcium
Liqui-Cal	8 % calcium
CaB'y	10% calcium
Stopit	12% calcium

The goal of calcium sprays is to increase the concentration of Ca in the fruit. For this to occur, the spray must be absorbed by the fruit. Apply sufficient volume to completely wet the fruit. For much more information, consult the Factsheet "[Bitter Pit Control in Apples](#)"

## Is the Maturity of Honeycrisp Affected by Calcium Sprays?

*John Gardner, Apple Specialist, OMAFRA, London*

Good question – one definitely worthy of an exploratory type trial. Based on past experiences with calcium sprays on other varieties like “McIntosh” and “Northern Spy”, we know that an aggressive regime of calcium sprays can result in some wild and unforeseen changes in predictable maturity.

At the time in the late 90’s, these experiments and trials were being looked at because there was the general consensus that if you added foliar sprays of calcium to a cultivar like McIntosh you would delay the maturity and make the apple harder by more cementing of cell structure from the added calcium. What actually happened was the exact opposite, as the crop matured earlier and the fruit were generally softer with advanced maturity.

This appears to be related to ethylene generation in the canopy of treated trees. Back in the late 90’s when we were trying to figure out why growers applying up to 14 lbs of actual calcium per acre (if they could get it on) saw much of the crop on the ground long before it could be retrieved for storage and sale. We found ethylene at 8x’s the threshold in the canopy and fruit of trees treated with an aggressive spray program of calcium chloride, compared to untreated trees. This pushed the crop maturity about 10 days ahead of the untreated checks. We found that the more calcium chloride you got on, the worse the maturity problem got.

It is not so bad getting earlier maturity if you’re ready for it. One might hypothesize that it could potentially be used as a marketing tool on a small scale to get some fruit ready for immediate sale ahead of the bulk of the crop. The down side of course is that you loose on volume of production, as the last 10 days fruit are on the tree is normally the final quarter of an inch of growth and 20% of the crop volume. Harvesting fruit like McIntosh with a maturity of 5 or 6 on the starch index does not make for any long term storage potential.

To make a long story short, since the late 90’s we have invested huge sums of money into the cultivar Honeycrisp in Ontario and we have shown

that we can grow some of the finest looking fruit of this cultivar in North America.

Honeycrisp is a variety that is subject to bitter pit. We have installed a small experiment to see if repeated sprays of a few recommended calcium source materials for bitter pit, have any effect on maturity of this exciting and relatively new cultivar.

This experiment is located in Middlesex County and can be seen on August 17<sup>th</sup> at the Apple Growers Field Day sponsored by the Lambton Middlesex Fruit and Vegetable Growers Association. See the announcement at the end of this newsletter for details.

## Fruitlet Mummification – A Puzzling and Costly Problem

*John Gardner, Apple Specialist, OMAFRA, London; Michael Celetti, Plant Pathologist, Horticultural Crops, OMAFRA, Guelph; and Dr. John Cline, University of Guelph, Simcoe*

One of the more outstanding issues around the process of thinning successfully is the residual number of fruitlets that sometimes hang onto the spur, shrivel and mummify. This is not serious in terms of drawing resources from the tree during the growing season. The problem comes in when these mummified fruitlets are colonized by the black rot fungi found in most Ontario orchards. The problem is chronic and costly in cultivars like “Gala”, “Fuji”, “Goldens” and “Idared”, as well as cultivars like “Northern Spy”. “Honeycrisp” is also a candidate because of its susceptibility to this disease.

Estimated losses in any one block of trees are serious, with the potential for 20-30% of the fruit on any given tree to be infected with black rot at harvest. What happens is that everything looks fine until about 2 weeks before harvest, when purplish spots appear on the fruit probably through lenticel infections. These infections are related to sporulation of the fungus on the mummy hanging directly above the maturing apple (see Figure 1).



Figure 1 - Failed abscission of Gala fruitlet directly above maturing apple is a potential site for black rot infection by way of colonization of the fruitlet by the black rot fungus as the fruitlet shrivels and dies.

To understand what happens during the thinning process, we have to look at the bloom fruit set period and the ensuing process through pollination and embryo development in the seed of the maturing fruitlet. As the fruitlet grows into an apple, the seed sends a signal to the rest of the spur by way of the stem tissue. These signals are controlled by the developing seed. The seed more or less tells the rest of the tree how to finish what was started during the bloom period.

During successful thinning, the developing fruitlet manages to get the message out to the stem to abscise and drop by presumably stimulating the formation of the abscission layer where the fruitlet is attached to the tree. If the thinning treatment kills out the developing seed in the fruitlet before those signals are complete, then the fruitlet remains attached and does not develop as would a fruitlet with living seed. These fruitlets eventually die on the spur and are easily colonized by the opportunistic black rot fungus *Botryphaeria obtusa*.

This year we are experimenting with different timings and treatments on “Gala” to determine if one or another treatment will produce more or less mummification with ensuing cullage from black rot infection. We are looking for the cleanliness of the thinning job, failed fruitlet abscission, mummification and black rot infection at harvest. The experiment has been designed using a variety of thinning treatments and timings ranging from petal fall through to 8 mm and onto a late timing of 12-14 mm king diameter. Thinning

materials in the experiment include combinations of NAA, Sevin and Maxcel with the use of Regulaid. This experiment is being done in Middlesex County on a block of mature Royal Gala on M9.

## Aurora Golden Gala – Attributes and Weaknesses

*John Gardner, Apple Specialist, OMAFRA, London*

There are several things I really like about this cultivar, which is a recent introduction from PICO and out of the breeding work done in B.C. Some growers in Ontario have planted quite a few trees this year to have a closer look at this cultivar. My first introduction to it took place a few years back when I had a chance to taste it from a sample lot delivered to the OFVC by the folks out in B.C. There is no question as to its flesh quality and presumably its storability. Most apples that get this far along in the trial process have to meet all sorts of standards and excel at many. In some regards they have to be better than existing varieties. They have to have the potential to fill a niche.

This cultivar is an early Golden Delicious type apple, maturing in the same season as red Delicious. What is outstanding about it is its excellent and tight growth habit, making it highly suitable for high density plantings. It does fit into the super spindle type system very well, as fruit set up easily along a central axis and distribute uniformly through a very compact canopy. It does not appear to have outstanding disease problems when grown under our conditions here in Ontario.

One of its main drawbacks is its appearance under Ontario growing conditions. Much like the problems we have had in the past with cultivars like the standard Golden Delicious regarding shape and skin finish. From the few fruit I have seen matured in Ontario in some locations it can be squatty and lack a quality finish. It may not be suitable for all geographic and climatic areas of Ontario.

In a small experiment at the Birnam orchard cultivar trial site in Lambton County, we are trying to modify the looks and finish of this cultivar by using Promalin during the fruit set and early cell division stage, followed by the use of particle film

up to early August. This experiment is designed to see if this treatment regime can give us the same results as observed in trials with “Golden Delicious”, which we’ve now had for a few years.

We have found that the use of both Promalin and Surround Crop Protectant particle film or Surround alone on various strains of “Golden Delicious” significantly improves yield, finish and crop value compared to untreated checks.

As of late July this year, the treated “Auroras” (Promalin/Surround) on average are larger and more *typey* than fruit from untreated trees. We have not yet been able to determine if there is any influence on finish. See attached photos taken in late July at the Birnam cultivar trial site in Lambton County (Figures 2 and 3).



Figure 2 – Average fruit size for treated (Promalin/Surround) Aurora is significantly larger than untreated fruit. Treated fruit are more “typey” than untreated.



Figure 3 – Untreated Aurora late July. Both Figures 2 and 3 were photographed at the same time.

## Numbered Selection SJCA38R6A74 Now Named “Eden”

*John Gardner, Apple Specialist, OMAFRA, London*

One of the numbered selections in our Ontario Provincial Apple Trial has now gained both a name and some notoriety since it was planted out in our test sites in 2002. Dr. Shahrokh Khanizadeh of AAFC explains that he was in the process of identifying new apple cultivars for Quebec apple cider producers that had disease resistance when he noticed one particular apple that stayed white after cutting for a few days.

Dr. Khanizadeh had been screening numbered selections by way of their phenolic antioxidant compound content when making this discovery. These phenolic compounds are common to scab resistant cultivars.

This numbered selection that resisted browning has since been named “Eden”. The obvious use of this apple is in various processed products including slices and fillings.

The apple itself is a late maturing bicolour apple with a dark red over greenish yellow skin with a pure white flesh. It hangs well in the tree canopy and could potentially be used for ice cider making.

## CROP PROTECTION

### Japanese Beetles: Insects with Expensive Taste

*Kathryn Carter, Pome Fruit IPM Specialist, OMAFRA, Simcoe; and Neil Carter, Tender Fruit and Grape IPM Specialist, OMAFRA, Guelph*

Japanese beetles were introduced into North America on nursery stock from Japan in 1913. They have become seasonal pests of many crops including tree fruit and berries. Of particular concern to apple growers is their attraction to young plantings of “Honeycrisp” apples—a variety which is being planted more and more in Ontario, and is providing growers with good returns.

Injury from Japanese beetles is beginning to appear in some orchards. While feeding on apples is usually concentrated on the foliage, fruit

feeding can occur in stone fruits, especially as they ripen or where other surface damage is present. This year it appears that Japanese beetles have a distinct preference for plum foliage (Figure 5) over nearby peaches and pears. Clusters of feeding (and mating) beetles are also easy to find on ripe, damaged peaches. Although the beetles' habit of aggregating on damaged fruit sometimes means that less fruit overall are attacked, even the smallest blemish or bird peck is enough to start a feeding frenzy. Field workers and the public are also annoyed or alarmed at the beetles defensive posture (legs outstretched and waving) and their habit of flying straight at whatever disturbs them.

Adults beetles are 10-13 mm long, metallic green to greenish-bronze, with coppery red wings and small white tufts on the sides and tip of their abdomen (Fig 4). Adults feed on the upper surface of apple foliage, chewing the tissue between the veins, creating a skeletonized appearance (Fig 5). Beetles usually feed in groups starting at the top of the plant and moving downward. They can fly as far as 8 km, but usually only make short flights as they move around to feed and lay eggs. Japanese beetles produce aggregation pheromones that attract more males and females to feed and mate. Odours emitted from damaged plants may also attract more beetles into the orchard.

Adults begin emerging in late-June to early-July and they will live for 30 to 45 days. Females lay 40 to 60 eggs in the soil during July and August, and the larvae hatch in 10 to 14 days. Larvae are "C" shaped, white to cream-coloured grubs with brown heads. The grubs feed on organic matter and grass roots prior to moving into over-wintering sites.

In most years, sprays for Japanese beetles are not necessary in apple orchards, but in orchards where populations are high and the insects are feeding on susceptible varieties ("Honeycrisp") or on immature trees, control measures may be necessary. Imidan (phosmet) is registered for Japanese beetle on tree fruit but note that the spray solution must be at pH 5.5 to 6.5 for best results. The application of a pyrethroid, or Assail to manage other pests may also control Japanese beetle. The tendency of beetles to feed at the top of trees makes good coverage essential for adequate control. The migration of these insects

into orchards from surrounding areas may make multiple applications necessary.

Japanese beetle traps are available at garden centers. Although the pheromone and floral lures sold with the traps are very effective and can attract many beetles each day, research has shown that the traps attract more beetles than are caught. As a result, susceptible plants in the vicinity of the trap are likely to suffer more damage than if no traps were used.



Figure 4 - Adult Japanese beetles on raspberry leaf.



Figure 5 - Foliage at top of plum tree skeletonized by Japanese beetles.

## Red Belted Clearwing Moth - What's All the Buzz About?

*Kathryn Carter, Pome Fruit IPM Specialist; OMAFRA, Simcoe; and Denise Beaton, Crop Protection Program Lead, OMAFRA, Guelph*

Many apple growers who have had pheromone traps placed in their orchards by the Canadian Food Inspection Agency (CFIA) are wondering what is going on. Last year the apple clearwing moth (*Synanthedon myopaeformis*), also known as the small red-belted clearwing moth, was found for the first time in North America in British Columbia. The apple clearwing moth is a pest of apple, pear, crabapple, quince, plums, apricots, cherries, hawthorn and mountain ash in Europe. The CFIA is conducting a national survey in all fruit growing regions in Canada in 2006.

The larvae tunnel under the bark in the tree trunk causing irregular feeding galleries. They prefer burr knots, especially on M 9 rootstock, and infestations in Europe have been associated with the European canker caused by *Nectria galligena*. Similar to dogwood borer, larval feeding shortens the life of trees and may lead to considerable yield loss. There is only one generation of this insect each year. Unfortunately adult emergence lasts from May through September, and as a result insecticide sprays aimed at managing dogwood borer may not provide subsequent control of the apple clearwing moth.

The CFIA is using peach tree borer pheromone traps to monitor for the adult clearwing moth. Adults have a 20-25 mm wingspan, with a dark blue-black body and a bright red band across the abdomen, behind the base of the transparent wings. The larvae are 15-20 mm in length and white with reddish-brown head.

The CFIA is monitoring more than 50 orchards in Ontario to determine if this insect is present. Currently they have not announced the results of their 2006 survey. Should the apple clearwing moth be found here in Ontario, many of the cultural controls already used for managing dogwood borers (i.e. painting the trees white to deter oviposition, managing weeds near tree trunks, and avoiding the use of mouseguards that encourage egg laying) would help to manage this pest. Since this is a new pest to North America, there are no pesticides registered yet in Canada

for the control of apple clearwing moth. Research trials are being conducted in British Columbia using Isomate-P mating disruption. Preliminary results are expected at the end of the season. For more information on the apple clearwing moth refer to the British Columbia Ministry of Agriculture and Lands website at <http://www.agf.gov.bc.ca/cropprot/tfipm/clearwing.htm>

## Mounding Soil to Avoid Infestations of Dogwood Borer in Apple

*Ron Perry, Horticulture and Larry Gut, Entomology, MSU, Michigan*

"We began a study in our IPM Apple System work at Clarksville in 1998 to determine the potential of mounding soil compared to insecticides to control dogwood borer in apple. The paper, authored by Dr. Gut, et. al., published in December 2005 (Gut, L.J., P.H. McGhee and R. Perry. 2005. Soil Mounding as a Control for Dogwood Borer in Apple. HortScienc. HortScience 40(7):2066-2070), recently was awarded the most outstanding Extension paper published in the three American Society for Hort Science journals for 2005 (note abstract below).

In an MSU Fruit Area of Expertise meeting this past winter, I discussed the prospects of recommending the mounding practice to apple growers in Michigan. In the meeting where I discussed the recommended protocol, a question arose regarding the consequences of exposed roots and subsequent herbicide damage. This past week I had a chance to inspect trees in orchards at Clarksville in our research plantings where we have been making applications of herbicides over several years. In all cases, phytotoxicity is not apparent and in some cases adventitious shoots (suckers) have sprouted from exposed roots without indication of injury. During our discussion, I speculated that we should not see injury since exposed roots which develop secondary growth develop a cortex and bark tissue not unlike that of stem tissue. Obviously, young roots, like succulent new shoots, are subject to herbicide injury, but usually are covered by soil."

### **Abstract from the HortScience paper**

“The relationship between the extent of burrknots on apple rootstocks and dogwood borer [*Synanthedon scitula* Harris] infestation, and the efficacy of a cultural management strategy for this pest were studied in heavily infested plots at the Michigan State University Clarksville Horticulture Experiment Station. Spearman rank correlation Rho values of 0.85 and 0.75 in consecutive years of the study substantiated a strong positive correlation between the number of larvae present in the rootstock and the surface area of the rootstock covered by burrknots. Cultivar type affected the level of the dogwood borer infestation in the rootstock. Larval densities were 8- to 11-times higher in Mark rootstocks when the grafted scion was 'Idared' instead of 'Liberty'. This cultivar related difference in larval infestation was associated with a greater number of burrknots on 'Idared'/Mark compared to 'Liberty'/Mark trees. Mounding of soil to cover the exposed rootstock was found to be a highly effective alternative to insecticides for dogwood borer control. Under conditions of heavy pest pressure, this cultural control tactic provided 76 to 99% reductions in larval densities. These levels of control are comparable to or better than those reported for trunk sprays with chlorpyrifos, the most effective of currently available insecticides”.

### **Comments and discussion regarding mounding**

“Although the practice of mounding or berming of soil can suppress an existing dogwood borer population, it is probably a costly method of treating an established orchard. The practice of mounding and berming are equivalent in effectiveness to suppress dogwood borer. The construction of a berm is more economical and it can be easily constructed in young and newly established orchards. Berming of tree rows can be accomplished at a reasonable cost by simply using a side tool-bar hoe and should be considered a viable practice for dogwood borer control.

Our experience to date suggests that the berm should be formed in the first season, preferably soon after planting while the soil is loose and cultivatable. Inspect the berms during the second growing season to make sure burrknots are covered; follow up with a closer inspection in the third growing season to avoid scion rooting. Should the graft unions be buried by soil, scion

rooting may occur within the first three years following construction of a berm.

Our orchard experience indicates that exposure of newly formed adventitious scion roots to air will functionally disable roots without any negative impact on the tree. In the fall of 1998, we formed a berm on newly established trees with the soil level at 7 to 11 centimeters above the graft unions. Inspecting trees in the summer of 1999 revealed that soil had naturally settled to graft union height or below and no scion rooting appeared on trees where some soil still covered the graft union. It is evident that the increasing prevalence of semi-dwarf and dwarf apple rootstocks has fostered an increase in the incidence and severity of dogwood borer infestation.

This insect has a high potential to become an even greater pest of Midwestern and Northeastern apple production systems. Not only are more burrknot-forming rootstocks being planted, but there are few options available for controlling dogwood borer. The availability of the most effective control tactic, insecticide trunk sprays, is jeopardized by worker safety concerns. Even if this approach continues to be allowed, it may not be adequate for suppression of heavy infestations.

We have demonstrated that soil mounding of apple rootstocks is a highly effective alternative to insecticides for dogwood borer control. The practice can be adopted for orchards managed conventionally as well as organically. It is highly recommended for new plantings if the rootstocks are known to be prone to burrknot formation, but can also provide excellent control even with densities averaging over a dozen larvae per tree in exposed rootstocks in established plantings.” Rootstocks which produce burrknots readily include the popular dwarfing stocks such as M.9, M.26, etc.”

### **Nectrotic Leaf Blotch and Apple**

Kathryn Carter, Pome Fruit IPM Specialist,  
OMAFRA, Simcoe

This year necrotic leaf blotch has been noticed in many apple growing areas in Ontario. Necrotic leaf blotch is a relatively common disease that is considered to be restricted to Golden Delicious

cultivars and its offspring. The disease is a physiological disorder that usually starts to appear in apple orchards in late June or early July, but was observed in orchards as early as May this year. Necrotic leaf blotch is usually most severe in the latter part of the growing season.

Generally, symptoms only appear on mature leaves on the base of the center of upright, succulent, rapid growing shoots. Infected leaves initially have necrotic yellow blotches on them, and eventually irregular brown blotches appear on the leaves (Fig. 6). Infected leaves often turn yellow and drop off a few days after the necrotic blotches first appear.

This disease does not appear to be caused by a fungus, bacterium, air pollutant or nutrient deficiency. It is considered to be a physiological disorder that occurs when a cool rainy period of 4 to 5 days precedes several hot, sunny days. It is considered to be linked to a hormonal imbalance in the tree.

Although leaf blotch is not associated with any fungus, extension agents in the U.S. recommend the use of EBDC fungicides during cover sprays to reduce symptoms of the disease. In most years control measures are not necessary. Trees that have an annual moderate crop of fruit have less necrotic leaf blotch than trees that have a biennial bearing habit or a light fruit crop. Golden Delicious trees pruned to a central leader also have less leaf blotch than those pruned to an open center.



Figure 6 - Necrotic leaf blotch symptoms

## POSTHARVEST

### Commercial Application of 1-Methylcyclopropene Affects the Storability and Disorders of 'Empire' and 'Delicious' Apples

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This study evaluated the effects of 1-MCP on 'Empire' and 'Delicious' apples in commercial controlled atmosphere (CA) storage for 12 months, and in commercial cold storage for 6 months. Apples were harvested and delivered by growers to a local commercial storage facility. Four different grower lots were chosen for each of three 'Empire' and two 'Delicious' storage rooms. Fruit were treated with 1-MCP (~ 0.8-1.0  $\mu\text{L}\cdot\text{L}^{-1}$ ) for 24 hours, while control fruit samples were held in a similar nearby storage room. Following treatment, control samples were placed with matching MCP-treated samples either into CA storage (2.5%  $\text{O}_2$  + 2.5%  $\text{CO}_2$  at 2.2 or 0°C for 'Empire' and 'Delicious', respectively) or air storage at 0-1°C. Initial maturity was relatively uniform among the grower lots, with internal ethylene concentration (IEC) averaging <1  $\mu\text{L}\cdot\text{L}^{-1}$  for 'Empire' and 2-3  $\mu\text{L}\cdot\text{L}^{-1}$  for 'Delicious'. IEC was lower in apples treated with 1-MCP after air (3 or 6 months) or CA (6, 9, or 12 months) storage, but this effect was reduced after a 14 d ripening period at 22°C, and less dramatic in fruit from CA than from air storage. Apples treated with 1-MCP were also firmer than non-treated fruit upon removal from storage, and this difference became greater with increased post-storage time at 22°C (up to 4 lb differences). 1-MCP treated apples stored in air had higher soluble solids concentration (SSC) (up to 0.5% difference), while there was no significant effect of 1-MCP on SSC in fruit held in CA. Core browning developed in 'Empire' held in air for 6 months (up to 52% incidence) or in CA for 9 or 12 months (up to 34%), and in 'Delicious' after 9 and 12 months in CA (up to 27%). 1-MCP decreased the incidence of this disorder in 'Empire', but increased the incidence in 'Delicious'. There was no significant effect of 1-MCP on the incidence of internal browning and storage rots, which developed in both cultivars.