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'HONEYCRISP' APPLES GROWN IN NOVA SCOTIA

Management for a unique cultivar

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Introduction: Nova Scotia's first commercial planting of 'Honeycrisp' apples occurred in 1996 following a visit by field advisor L. Lutz and several Nova Scotia apple growers to the Washington State USA apple industry in February 1996. Several evaluation plantings of 30 trees by the NSFGA Grower Testing Association (GTA) were also established in 1996. The rapid increase in commercial 'Honeycrisp' plantings and subsequent production has challenged researchers to provide relevant production and post-harvest to Nova Scotia 'Honeycrisp' growers

A trickle irrigation field trial initiated in 1997 that included 'Honeycrisp' provided the first local information available in Nova Scotia for this cultivar. The project developed by C. Embree, D. Hebb, T. Webster, L. Lutz, D. Ryan and K. McRae was supported by Scotian Gold Cooperative Ltd., Spurr Brothers, Blake Sarsfield and matched by AAFC MII funding. C. Deslaurier and D. Davison in May, 1998 provided a summary to growers on the cultivar. In this 'Variety Fact Sheet' they reported large fruit size crisp texture and low tree vigor for 'Honeycrisp' apples. R. Prange reported in 'Storage Notes' the occurrence of the post harvest disorder soft scald in 'Honeycrisp' apples stored in regular and controlled atmosphere storage during February 1999. The acceptance of 'Honeycrisp' by Nova Scotia consumers was reported by research scientist K. Sanford in 1999. C. Embree and D. Hebb et. al. (2001), reported in the 01-03 technical report that yield and grade data indicated excessive yield resulted in poorer fruit quality. Since the first deliveries, grower returns have increased by 250% to 400% when compared with other commercial Nova Scotia fresh cultivars. Reports of small, poor-coloured fruit on trees that had over-cropped and more storage-related disorders were more widespread. Scientists R. Prange, C. Embree and J. Delong during 2001 and 2002 independently conducted, crop-load, maturity, delayed cooling and storage temperature experiments at AFHRC. B. Craig of AgraPoint International and D. Davison of Scotian Gold Cooperative Ltd directed discussions at orchard tour and pruning workshop gatherings on the production challenges of 'Honeycrisp' trees.

To further enhance 'Honeycrisp' research at Kentville the NSFGA secured funding from the National Research Council Industrial Research Assistance Program (IRAP) in the spring of 2003 to partner with AAFC, Grower cooperators, Scotian Gold Cooperative Ltd and AgraPoint International in a project that would address the mounting production and storage challenges being observed with 'Honeycrisp' apples grown in Nova Scotia.

Characteristics: As the name implies, Nova Scotia grown 'Honeycrisp' fruit are crisp-textured and sweet. On young trees the fruit are exceptionally large and well-coloured; however, color development and size reduction occur with higher fruit density of mature trees**.** Leaves and fruit are reported to be moderately resistant to apple scab, but can develop yellow / brown chlorotic areas on leaves. Biennial bearing occurs on mature trees and there is low vegetative vigor on cloned rootstocks.

To reduce the potential for 'Honeycrisp' trees to produce excessive crops, as well as storage disorders and rots, we provide the following information.

Field Factors that Boost 'Honeycrisp' Fruit Quality

Tree vigor: The low vigor growth habit of 'Honeycrisp' increases the need for greater attention to provide optimum growing conditions. During the first three years of orchard life, growers should ensure adequate canopy development. 'Honeycrisp' trees can be considered full grown as early as five years of age. Comparisons of trunk cross-sectional area (TCA) between 'Honeycrisp' and Spur Red Delicious trees following five years of growth showed 'Honeycrisp' to be 30 -50% smaller on the same rootstock.

To attain fresh market quality fruit, detailed spur pruning as well as blossom and fruitlet removal when trees are full-grown will be necessary to counter the tree's high fruiting potential.

Crop density: In a crop-load adjustment experiment, hand thinning as late as the third week of July (Table 1) increased fruit weight proportional to reductions in crop density. In a similar experiment, blossom density adjustments through removal of blossom clusters was completed in early June as an initial method of crop reduction. This resulted in a 25% increase in fruit weight at harvest compared to later fruit removal.

Crop density adjustments that increased final fruit weight also improved fruit colour at lower fruit densities (Table 1 and Figure 1). Fruit colour development, however, was found to be inconsistent between sites. The colour difference was attributed to the training of the canopy and to microclimates in different orchard systems. The configuration and amount of canopy per tree also affected final fruit quality. At harvest, 'Honeycrisp' flesh firmness and soluble solids content were higher in larger fruit produced on trees with the lower crop densities (Table 1). The effect of the various crop densities on return bloom will be documented in 2004.

Table 1. Effects of fruit density adjustments on crop-load, fruit weight, colour, firmness and soluble solids content on 'Honeycrisp' at 2003 harvest.

Treatments employed	Fruit removed	Fruit harvested	Crop-load	Fruit weight	Fruit colour (% red-orange)		Flesh firmness	Soluble solids
frt/cm² TCA	frt /cm² TCA	frt /cm² TCA	kg / cm² TCA	(g)	avg	> 50%	(lbs)	(%)
3	17	3	0.7	214	58	77	16.9	13.8
6	14	7	1.2	168	55	70	15.7	13.2
9	10	10	1.3	129	48	62	15.4	12.8
Cntl	0	20	1.8	99	39	21	15.6	11.8

Figure 1. As crop density decreases from high to low, 'Honeycrisp' fruit size and colour improves. (Taken from AFHRC Technical Report 04-01.) Note that each sample consists of 24 apples.

Methods to Reduce 'Honeycrisp' Post-harvest Disorders

Fruit: 'Honeycrisp' appears to carry a high crop load (kg/cm^2 TCA), at acceptable fruit densities (fruit/ cm^2 TCA) compared with other commercial apple cultivars (Table 1). This may be due to the potential for large fruit in this cultivar. Fruit punctures, mainly from stems, during harvest and grading can cause up to 8 to 12% fruit loss in fresh pack 'Honeycrisp' apples. Fruit handling protocols to minimize bruising and skin punctures are presently under evaluation by industry to reduce fruit damage, ie. fruit peduncle clipping.

Maturity indicators: 'Honeycrisp' maturity is difficult to measure because of the unique internal characteristics of this cultivar, e.g. low amounts of starch when the fruit appears ready to harvest. We currently feel that a change in background colour from green to cream is a good visual indicator of when to harvest. The harvest window for 'Honeycrisp' in Nova Scotia appears to be between September 28 and October 8. Research results to date suggest that fruit from trees with lower fruit density (i.e. less than 6 fruit/cm^{2}TCA) tend to have an earlier harvest date. Growers may prefer later harvest dates to improve fruit colour; however, the incidence of storage disorders can increase.

Figure 2. Soft scald

Pre-storage treatment: Post-harvest internal breakdown, soft scald, bitter pit and Jonathan spot can cause significant fruit losses. High incidence of fruit decay in storage can also occur and fruit can also develop undesirable "off" flavors during storage. Delayed cooling of 'Honeycrisp' apples appears to be effective in controlling soft scald (Figure 2) and internal breakdown (Figure 3).

Figure 3. Internal breakdown (resembles low temperature breakdown)

In recent studies delayed cooling treatments consisted of placing harvested 'Honeycrisp' apples in a warm room at 10 to 20 ^{o}C for 4 to 7 days prior to long-term storage. This delayed cooling treatment of the apples stored in the most recent trial (2003-2004) exhibited control of soft scald and internal breakdown (Table 2) supporting previous research on delayed cooling of 'Honeycrisp' apples.

Table 2. Effect of pre-storage delayed cooling (mean of 3 sites after 3 months storage in the 2003-2004 season) on flesh firmness, soluble solids, titratable acidity, soft scald, internal breakdown, and greasiness.

Pre-storage treatment	Flesh firmness	Soluble solids	Titratable acidity	Soft scald	Internal breakdown	Greasiness
	(lbs)	(%)	(mg Malic acid/100ml)	(%)	(%)	0 (none) – 3 (severe) scale
No delayed cooling	16.1	12.1	455.3	12.1	7.3	0.3
Delayed cooling	16.2	12.1	429.8	0.0	0.4	0.4

Storage treatment: Controlled atmosphere (CA) storage does not appear to affect the overall quality or prevent storage disorders of the apples. This is illustrated in Table 3 showing the effects on quality after 3 months in storage. CA does appear to reduce fruit greasiness.

Both soft scald and internal breakdown are chilling-induced disorders. The incidence of soft scald and/or internal browning can be as high as 20% if fruit are stored at less that 3°C. Therefore a storage temperature between 3 and 5°C is recommended to minimize these chilling-based disorders.

Storage rot incidences in 'Honeycrisp' fruit can exceed 10% at removal from storage. Fungal pathogens entries are often at stem (peduncle) puncture sites or insect wounds. Methods to control storage rots could include clipping the fruit stem as the fruit are removed from the tree at harvest.

Table 3. Effect of storage regime (mean of 3 sites after 3 months storage in the 2003-2004 season) on flesh firmness, soluble solids, titratable acidity, rots, soft scald, internal breakdown, and greasiness of Honeycrisp™.

Storage treatment	Flesh firmness	Soluble solids	Titratable acidity	Rots	Soft scald	Internal breakdown	Greasiness
	(lbs)	(%)	(mg Malic acid/100ml)	(%)	(%)	(%)	0 (none) – 3 (severe) scale
Air storage	16.1	12.2	437.0	4.9	5.6	3.0	0.6
CA storage	16.3	12.2	450.8	5.9	6.3	4.5	0.1

'Honeycrisp' Best Management Practices

- Detailed spur pruning reduces blossom density and may improve tree vigor and fruit size.
- Blossom cluster thinning may provide a 25% increase in fruit size.
- A blossom and or fruit-thinning program will successfully reduce crop density of older 'Honeycrisp' trees.
- To attain 200 gram (3.12 in) or larger apples, up to 80% reduction in fruit density after "June Drop" may be necessary with "snow ball" bloom and normal fruit set conditions.
- Fruit number to tree canopy volume ratio is an important consideration when adjusting fruit density for quality and yield.
- Hand thinning may be necessary in addition to chemical thinning to reduce fruit density for highest quality fruit production.
- Avoid excessive nitrogen supply regardless of tree vigor to obtain good fruit quality.
- Delayed cooling of fruit (4-7 days at 10°C) is necessary to reduce the incidence of storage disorders.
- Large fruit grown on young trees are more prone to internal breakdown.

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