Canadian Agri-Science Cluster for Horticulture 3

Update to Industry

2019-2020

Activity title: Optimizing Storage and Postharvest Practices to Reduce Apple Loss and Improve Quality

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Activity Objectives (as per approved workplan):

1) Optimize postharvest practices and storage regimes for rising cultivars (i.e. Honeycrisp, Ambrosia, and Gala strains)
2) Evaluate new low oxygen storage and dynamic regimes to reduce apple loss
3) Investigate new technology for harvest management and fruit maturity

Research Progress to Date (use plain language):

Apples are currently in storage for 2019-20 season. Results from 2018-19 storage season follow.

Objective 1. Optimize postharvest practices and storage regimes for rising cultivars

1.1. Temperature conditioning in combination with postharvest 1-methylcyclopropene (1-MCP) and/or diphenylamine (DPA) treatments, and controlled atmosphere (CA) storage were evaluated for 'Honeycrisp' apples. After 6 months of storage at 3°C, apples treated with 1-MCP had less ethylene, higher soluble solids and malic acid, less yellow/ more green background color, and less greasiness, compared to fruit not treated. There were few storage disorders and no notable effects of DPA.

1.2. 'Honeycrisp' apples from Quebec with high bitter pit development were temperature conditioned in the field, treated with postharvest 1-MCP, and held in either air or CA storage. After 2 months of air storage or 6 months of CA storage at 3°C, apples treated with 1-MCP had less bitter pit but more peel blotch and lenticel breakdown than non-treated fruit. There were no significant differences in these disorders when apples were placed immediately into CA or held 1 month in air prior to CA storage.

Objective 2. Evaluate new low oxygen storage and dynamic regimes to reduce apple loss

2.1. Postharvest 1-MCP treatments before or after storage were evaluated for 'Ambrosia' apples in combination with CA storage (2.5 vs 1.5 vs <1% O_2) at 0.5°C. Low oxygen <1% regime was based on fruit respiration measurements using dynamic SafePod™ technology. After 8 months of CA storage at 0.5°C, apples held in 2.5% O_2 were softer and had more internal browning than those held in 1.5% O_2. Apples held in <1% O_2 (0.4% low, using SafePod) had much less internal browning than fruit from higher O_2 regimes. 1-MCP treatment at harvest time or after removal from storage had no significant effects.

2.2. 'Honeycrisp' from four orchard blocks were harvested at optimum fruit maturity for storage and held in either air storage or CA (3 vs <1% O_2) at 3°C. Low oxygen <1% regime was based on fruit respiration measurements using dynamic SafePod™ technology. After 8 months of storage at 3°C, apples held in 3% O_2 had more internal CO_2 injury with and without cavities than fruit stored in air or <1% O_2 (0.8% low, using SafePod). Air-stored apples had

lower soluble solids, more yellow/ less green background color, and more bitter pit and greasiness than fruit from the CA regimes.

Objective 3. Investigate new technology for harvest management and fruit maturity

3.1. Orchard spray trials using different rates of 1-MCP and various application timings were investigated. Cultivars included McIntosh, Honeycrisp, Gala, Ambrosia, and Delicious, with complete rows of 30+ trees for each replicate within each treatment combination. There were comparisons of full vs half rates of 1-MCP, or split application timings using two low rates, and some late applications after harvest began. Thus far, it appears that some major effects of preharvest 1-MCP application are the following: reduced fruit drop and therefore, improved fruit color and size, and reduced number of harvests; less variability in fruit ethylene production at harvest time and therefore, more effective postharvest 1-MCP treatments; improved firmness and acidity retention after harvest; increased susceptibility to CO_2 injury and other stress-related disorders; slowed watercore dissipation often resulting in flesh browning; reduced superficial scald development and less senescent-related disorders; delayed color development in some years (depending on rate and application timing) in Gala, Ambrosia, and Honeycrisp; slowed starch degradation and narrower range of starch values in Gala, as well as reduced stem-end cracking and internal browning in Gala; less soft scald in Honeycrisp and Ambrosia; and reduced watercore development in Delicious.

3.2. Delta Absorbance measurements (I_{AD} from DA meter) were evaluated for 'Honeycrisp' fruit maturity and associated storage disorders. In collaboration with colleagues at the Universities of Minnesota and Maine, 'Honeycrisp' from three harvest timings in three locations were studied. There were regional inconsistencies and changes in I_{AD} patterns among harvest times, indicating that single I_{AD} standards should not be used to assess fruit maturity in different areas and growers should only use I_{AD} data as one of several methods (i.e. starch index, ground color) to judge 'Honeycrisp' fruit maturity. This research collaboration is ongoing.

Extension Activities (presentations to growers, articles, poster presentations, etc.):

Presentations

DeEll, J. 2019. Postharvest effects of 1-MCP orchard spray, Harvista™. Pre-Harvest Meeting, N.M. Bartlett Inc., Simcoe, Ontario (invited speaker)

DeEll, J. 2019. Storage of 'Honeycrisp' apples – Ontario perspective. Apple Storage Workshop, Cornell University, Ithaca, NY (invited speaker, Canadian apple packers in attendance)

DeEll, J. 2019. Storage of 'Gala' apples – Ontario perspective. Apple Storage Workshop, Cornell University, Ithaca, NY (invited speaker, Canadian apple packers in attendance).

DeEll, J. 2019. Internal browning in 'Gala' apples. Great Lakes Fruit Workers Annual Meeting, Simcoe, Ontario.

DeEll, J. 2019. Fruit maturity and storage disorders of apples. East Central Fruit and Vegetable Growers Annual Meeting & Ontario Apple Growers District 5 Annual Meeting, Bowmanville, Ontario (invited speaker)

DeEll, J. 2019. Postharvest challenges for 'Honeycrisp' and 'Gala' apples. Great Lakes Fruit and Vegetable Expo, Grand Rapids, Michigan (invited speaker, Canadian apple packers in attendance)

DeEll, J. 2020. Managing storage disorders in 'Gala' and 'Honeycrisp' apples. Ontario Fruit and Vegetable Convention, Niagara Falls, Ontario (invited speaker)

Newsletter articles

DeEll, J. 2019. Development of internal browning in 'Gala' apples. The Grower 69(5):18

DeEll, J. 2019. Harvesting apples at optimum maturity for storage. Orchard Network 23(3):21

DeEll, J. 2019. Storage of 'Honeycrisp' apples. Orchard Network 23(3):22

DeEll, J. 2019. Internal browning in 'Gala' apples. Orchard Network 23(3):23

DeEll, J. 2019. Recommandations d'entreposage 2019. Bulletin aux Pomiculteurs 42(1):3

Scientific paper

Serban, C., L. Kalcsits, J. DeEll, and J.P. Mattheis. 2019. Responses of 'Honeycrisp' apples to short-term controlled atmosphere storage established during temperature conditioning. HortScience 54:1532-1539

Early Outcomes (if any) or Challenges:
Outcomes are within Research Progress to Date

Key Message(s):

- Efficacy of pre-harvest 1-MCP sprays is very dependent on rate and application timing
- DA meter I_{AD} data should not be used alone to judge 'Honeycrisp' fruit maturity, and I_{AD} standards are not consistent among orchards and harvest times

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