Canadian Agri-Science Cluster for Horticulture 3

Update to Industry

2020-21 – Semi-Annual

Activity title:
Activity 3 - Optimizing Storage and Postharvest Practices to Reduce Apple Loss and Improve Quality

Name of Lead Researcher: Dr. Jennifer DeEll

Names of Collaborators and Institutions: Ontario Ministry of Agriculture, Food and Rural Affairs

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:

Apples are currently in storage for 2020-21 season.
Updates from 2019-20 storage season follow –

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

1.1. Three temperature regimes for six 'Honeycrisp' orchards with varying susceptibility to bitter pit were evaluated for the 2019 storage season. In addition, in collaboration with Dr. Chris Watkins from Cornell University, along with research colleagues in Maine, Maryland, Michigan, Pennsylvania, and Washington state, a *Passive Method* and the *Genomics Approach* were evaluated to predict bitter pit in 'Honeycrisp' apples. Data are currently being analyzed, while the temperature regimes with a *Passive Method* to predict bitter pit in seven 'Honeycrisp' orchards are further being evaluated in Ontario for the 2020-21 season.

1.2. Six temperature regimes for 'Honeycrisp' apples from Quebec were also evaluated during the 2019 storage season. Interrupting air storage at 3°C after 1 month with 1 day at room temperature did not significantly reduce soft scald incidence (7 or 4%). However, this interruption increased lenticel breakdown (2 to 13%) and rot development (3 to 14%), and decreased firmness retention (16.8 to 15.7 lb).

1.3. Temperature conditioning in combination with postharvest 1-methylcyclopropene (1-MCP) and/or diphenylamine (DPA) treatments, and controlled atmosphere (CA) storage were evaluated for a second year in 'Honeycrisp' apples. Data are currently being analyzed and years compared.

1.4. 'Cortland' apples from Quebec were treated one to three times postharvest with 1-MCP and held in CA storage at 0.5 or 3°C. After 8 months of storage, apples held at 0.5°C developed substantially more internal browning than those held at 3°C (19-26% vs. <1%, respectively). More than one application of 1-MCP had little additional effect.

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

2.1. Postharvest 1-MCP treatments before or after CA storage were evaluated for a second year in 'Ambrosia' apples, in combination with low oxygen regimes (2.5 vs 1.5 vs <1% O_2) at 0.5°C. The low O_2 regime of <1% was based on fruit respiration measurements using dynamic LabPod™ technology. After 8 months of storage, apples held in lower O_2 were firmer and had much less internal browning than those held in higher O_2 regimes. Data are currently being analyzed and years compared.

2.2. Postharvest 1-MCP treatment before or after CA storage was also evaluated in 'Honeycrisp' apples, in combination with low oxygen (3 vs ~1% O_2) at 3°C. After 8 months of storage, there was low O2 injury in apples from both O_2 regimes and 1-MCP treatment appeared to reduce it. Data are currently being analyzed.

2.3. 'Gala' apples with or without preharvest 1-MCP application (Harvista™) were treated with or without postharvest 1-MCP (SmartFresh™) before or after CA storage with low oxygen (1.5 vs 0.6% O_2) at 0.5°C. After 8 months of storage, apples held in 0.6% O_2 had less internal browning than those held in 1.5 O_2 (0-7% vs 7-13%, respectively). Preharvest 1-MCP spray slightly reduced the development of internal browning during storage, while postharvest 1-MCP had no significant effect.

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, and Gala 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. Data are currently being analyzed and years compared.

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. These research results have now been published in a scientific paper (listed below).

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

Presentations

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

DeEll, J. 2020. Postharvest effects of Harvista™ on apples. Preharvest Apple Educational Meeting, hosted by AgroFresh Inc. and N.M. Bartlett Inc., for Canadian apple growers via Zoom (invited speaker)

Newsletter articles

DeEll, J. 2020. Cultivars with reputations for storage complications. Good Fruit Grower 71(2):18-19.

DeEll, J. 2020. Effects of 1-MCP orchard spray on apple quality. Orchard Network 24(3):25-26.

DeEll, J. 2020. Internal browning in 'Gala' apples during storage. The Grower 70(10):16.

DeEll, J. 2020. Recommandations d'entreposage 2020. Communiqué, Les Producteurs de Pommes du Québec.

DeEll, J. 2020. Troubles de conservation des pommes. Electronic poster, Les Producteurs de Pommes du Québec and Storage Control Systems Inc. (Sparta, Michigan).

Scientific paper

Moran, R., J. DeEll, and C.B.S. Tong. 2020. Regional variation in the index of absorbance difference as an indicator of maturity and predictor of storage disorders in 'Honeycrisp' and 'McIntosh' apples grown in Maine, Minnesota and Ontario. HortScience 55:1500-1508.

COVID-19 Related Challenges:

More local apples were used in experiments for the 2020-21 storage season due to travel restrictions.

Key Message(s):

- Efficacy of pre-harvest 1-MCP sprays is very dependent on rate and application timing
- Best postharvest practices and storage regimes for 'Honeycrisp' continue to evolve as seasonal problems arise
- DA meter (I_{AD} measurements) should not be used alone to judge fruit maturity (especially for 'Honeycrisp'), and I_{AD} standards are not consistent among orchards and harvest times

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