Storage Recommendations and New Methods for Treating Apples with DPA

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Storage Guidelines

These apples should NOT be destined for long-term storage due to high risks of physiological disorders…

- Large fruit from lightly cropped trees
- Fruit from excessively vigorous trees
- Fruit from young trees just coming into bearing
- Fruit from interior portions of the tree that are heavily shaded
- Early picked fruit high in starch
- Over-mature fruit high in ethylene
- Fruit with low seed counts (< 5 per fruit)

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Storage Guidelines

Follow harvest maturity guidelines

Over-mature fruit ripen and soften faster in storage

Cool fruit as quickly as possible

Maintain proper storage temperature and CA atmospheres

CA storage will not improve fruit quality

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'McIntosh'

Storage Temperature = 3°C

Oxygen = 2.5%

CO_2 = 2.5% 1 mo., then gradually up to 4.5%

* If using SmartFresh and no DPA, keep CO_2 close to zero for 2 mo.

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'Empire'

Storage Temperature = 2°C

Oxygen = 2.5%

CO_2 = 2.0%

* If using SmartFresh and no DPA, keep CO_2 close to zero for 2 mo.

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'Cortland'

Storage Temperature = 0°C

Oxygen = 2.5%

CO_2 = 2.5%

* If using SmartFresh, then 2-3°C

* If using SmartFresh and no DPA, keep CO_2 close to zero for 2 mo.

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'Gala'

Storage Temperature = 0°C

Oxygen = 2.5%

CO_2 = 2.5%

* If using SmartFresh, then 2-3°C

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'Spartan' / 'Idared' / 'Delicious' / 'Golden Delicious' / 'N. Spy'

Storage Temperature = 0°C

Oxygen = 2.5%

CO_2 = 2.5%

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'Honeycrisp'

- Storage temperature **at least 3°C**
- Cooling delay to reduce disorder development
  - **5-7 days at 10°C** recommended
  - >10°C further increases ethylene production, shrivel, greasiness, and bitter pit
  - >15°C causes reduced acidity, as well as associated sensory attributes (i.e. astringency, bitterness)

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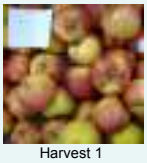
Maturity vs. Soft Scald

2008 Harvest
Simcoe orchard

	Sept. 15	Sept. 23
Starch	6	6.7
Firmness	18	15.2 lb
SSC	13.3	13.0%
6 mo. Air 0°C		
Soft scald	7	47%


Harvest 1


Harvest 2

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Effect of Storage Temperature on Soft Scald

2008 – 3 Months

at 0°C

at 3°C

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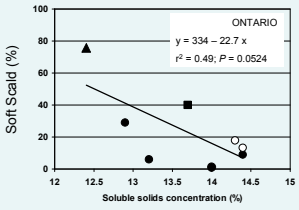
Collaboration with
Dr. Renae Moran, University of Maine

2001– 2008 data

Soft scald correlated negatively with
SSC at harvest in Ontario



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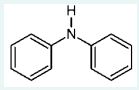
Diphenylamine = DPA

$(C_6H_5)_2NH$



- organic compound with antioxidant properties
- registered as a plant growth regulator
- used to control superficial scald development
- also reduces external CO_2 injury

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Diphenylamine = DPA

- applied postharvest, often as a drench
- usually 1000-2000 ppm
- No Scald (Decco)
- Shield DPA (Pace International)

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DPA thermo-fogging /aerosol technology

Pace Intl. - Thermo-fogging

- submitted registration package for EcoFog 100 (DPA) in January 2010 and the package for EcoFog 160 (Primethanil) in April
- expected timeline is 12 to 18 months for the issuance of the labels

Decco - Aerosol

- registration US EPA in May 2008
- submitted registration package to PMRA in spring 2009 but was returned with request for efficacy data
- re-submitted earlier this year with data from ON and QC

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Thermo-fogging

Technique for vapor application of chemicals to fruit in storage – Pace International

Chemical heated and droplets sheared to ≤ 1 μm

Used for 20+ yr in Europe, on apples and pears
Proven technology for DPA, ethoxyquin
Fungicides are now being used

Comparable cost and efficacy as drenching

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Equipment

Pace International

Ontario Trials

- Research permit from PMRA for 2005 harvest
- Thermo-fogged DPA in two commercial rooms
- Empire (spaced) and Delicious (tight-stacked) - need 72 cm minimum top height void
- In combination with SmartFresh to investigate effects on CO_2 injury as well as superficial scald
- Dr. Peter Sanderson, Pace International, LLC
- Apples must be treated when dry!

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DeEll, 2005

Results

- Fruit samples measured for residue
  ~2 weeks after application
  - no major differences compared to DPA drench
  - tighter stacked room made no difference
- Fruit evaluations after standard CA storage
- Delicious room opened early (3 months)
  - no damage observed due to fogging
  - very little superficial scald

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DPA Injury on Empire

Can occur in the "line of fire" or along specific air flow patterns

DeEll
May 2006

DECCO Aerosol DPA

- Dry formulation, weighed according to weight of apples in room
- Fast application (about 500 bins/ 15 min)
- No loss of storage space
- No high voltage requirements
- No container disposal
- No drench water disposal
- Patent Pending
  - different process than "Fogging"

John Holowid, DECCO

John Holowid, DECCO

DECCO Aerosol DPA

- No problems with high residues
- Scald control has been excellent
- No CO_2 injury
- Good distribution of DPA within room and within bins

John Holowid, DECCO

Commercial Trials - 2009

- Research permit from PMRA for 2009 harvest
- Decco DPA aerosol in two commercial rooms in ON and one room in QC
- ON = Empire and Delicious
- QC = McIntosh, with some Spartan
- DPA injury found on Empire in top bins, back corner
- Delicious, McIntosh and Spartan all clean
- Very few disorders found in non-DPA-treated apples, so difficult to compare efficacy
- No excessive DPA residue anywhere

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Stored in CA (2.5% O_2 + 2-2.5% CO_2) at 3.3ºC for 7 months plus 12 days in cold air storage at 0-1ºC

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Commercial Trials - 2010

- Research permits from PMRA for 2010 harvest
- Decco DPA aerosol in 14 storage rooms
  - 1 in BC, 6 in ON, 5 in QC, 2 in NS
- Pace DPA EcoFog in 3 storage rooms
  - 1 in BC, 1 in ON, 1 in QC
- Results to follow…

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Thank You!