Postharvest Quality: A Study in Risk Management

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The Post Harvest Quality Mantra

- Keep it Cool
- Keep it Damp
- Keep it Dark
What do I do in certain situations?

- Hot and Dry
- Hot and Wet
- Cool and Dry
- Cool and Wet
Hot and Dry

- Wait as long as possible to cut (dormancy)
- Cut, bale, and remove trees from field, daily
- Wind can severely dry trees out in these conditions (50% in one day)
- Trunk cracking can increase
- String burn is an issue
- Park trailers in shade if not immediately unloaded
- Store in fully shaded areas, preferably on wet material (increase humidity in load yard)
- Curing (heat of respiration)
- Maintain a first in, first out inventory
- Open trailers detrimental to post harvest quality
Hot and Wet

- Wait to cut as long as possible (dormancy and internal needle drop)
- Cut, bale, and remove trees from field, daily
- Field safety (work slower)
- Care should be taken to keep mud out of trees
- Unload trailers as soon as possible (especially if stacked horizontally)
- Store trees in shaded areas, preferably upright (releases heat)
- Mold on detritus in tree (dead needles, leaves, dead grass)
- Curing (heat of respiration increased with moisture, think compost pile)
- Should not be shipped in non-reefer box trailers.
Cold and Dry

- Dormancy not an issue
- Cut, bale, and remove trees from field, daily
- Wind can severely dry trees out in these conditions (50% in one day)
- Trunk cracking can increase
- String burn can be an issue if left in field
- Frozen trees become brittle and easily damaged, caution needed in bailing and anytime walking on them (loading trailers)
- Store in fully shaded areas, preferably on wet material (increase humidity in load yard)
- Open trailers could reduce tree moisture content
Cold and Wet

- Dormancy not an issue
- Cut, bale, and remove trees from field regularly
- Field safety (work slower)
- Care should be taken to keep mud out of trees
- Park trailers in shady area if unable to unload immediately
- Store trees in shaded areas
- Mold will not grow below 38F
- Should not be shipped in non-reefer box trailers to southeastern US.
Retail tree care

- Unload trees as soon as they arrive into constructed full shade areas (no gaps)
- Irrigate frequently if dry
- Wet sod or mulch under trees
- Burlap or shade cloth sides to keep wind out and humidity in
- Trees displayed in stands with full water bowls (fresh cut trunk)
- Multiple deliveries of trees if possible
- Tree shaking to remove loose needles
Home tree care

• Make a fresh cut (or have it done at the retailer)
• Use a stand that holds more than one gallon of water
  – Don’t let water level drop below base of tree
• Tree preservatives don’t work
• Home remedies don’t work
• Just clean fresh tap water
• Position tree away from heat sources (vents, heat sources, sunny windows)
• Use LED lights and don’t overload circuits
• Turn off lights before going to bed
• If tree does dry out, remove as soon after Christmas as possible
Recent PHQ Research

- Farm storage comparisons
- Strengths & weaknesses of pallet storage
  - Better moisture conservation than loose tree farm storage
  - Importance of initial heat of respiration & curing
  - Condition & duration of retail storage
- Forced air cooling
- Harvest timing & cold acclimation
- ID’d issues with “preservatives” & “remedies”
- ID’d issues with “fire retardants”
- 6 years of trunk crack treatments
- Using PGR’s to improve needle retention
2019 Multi-Species Needle Retention & PGR Amendment Study

- Fraser fir clonal selections from UMRS clone bank
- 4 species of spruce & 2 firs from Smokey Holler Christmas Tree Farm & Nursery
- Several treatments:
  - Abscisic acid
  - “Retain” ethylene inhibitor
  - “Smartfresh” 1-MCP ethylene blocker
  - Fraser fir genetics
Species Evaluated for Needle Retention (NR)

- Fraser fir (best NR)
- Fraser fir (worst NR)
- Canaan fir (a variety of Balsam fir)
- Concolor or white fir

- Norway spruce
- Colorado Blue spruce (CBS)
- Black Hills spruce (BH)
- Serbian spruce
Treatments

- Best Fraser NR clone check
- Untreated checks of all species
- High rate of Abscisic acid
- Low rate of Abscisic acid
- Retain applied to fresh cut boughs
- Retain applied 7 days prior to harvest
- Retain applied 1 day prior to harvest
- Retain applied 2X at 7 & 1 day prior to harvest
- 1-MCP gas treatment of 1 day old boughs
- 1-MCP gas treatment of fresh cut boughs
Study Design

- PGR treatments were made 1 week, 1 day before, and day-of branch harvest
- October 10 harvest
- 12 Branches placed in tobacco seedling trays to hold in order by treatment
- Appropriate trays placed in 1-MCP gas chamber
- Branches were stored in a dark barn
- Weekly, then biweekly evaluation of needle retention
- Twig weights for moisture content
Needle Loss Rating - Simplified

- 0-1 = no gaps, scant mess
- 2-3 = no gaps, some mess
- 4-5 = visible gaps, lots of mess, marginal quality
- 6-7 = unacceptable needle loss from branches
Oct. 10 Needle Retention Treatments
Picture taken on December 19, 2019

- Best NR Fraser clones are in the right tray
- Worst NR Fraser clones in the far left row
- Canaan fir on right of the left-hand tray
- Bare branches in the center of the left-hand tray are Concolor fir
Needle Retention of Conifer Species Tested

- BH Spruce
- CB Spruce
- Canaan Fir
- Worst Fraser
- Best Fraser
- Norway Spruce
- Serbian Spruce
- Concolor Fir
Fraser Fir vs. Canaan Fir
Fraser Fir vs. Canaan Fir

- Canaan Fir
- Worst Fraser
- Best Fraser
- Ave. Fraser

Date: 10-Oct, 17-Oct, 24-Oct, 31-Oct, 7-Nov, 14-Nov, 21-Nov, 28-Nov, 5-Dec, 12-Dec, 19-Dec, 26-Dec, 2-Jan
Fraser Fir Needle Retention by Treatment

Fraser Fir Needle Retention

- Poor NR CK
- Retain 1
- Retain 7
- ABA Low
- ABA High
- Retain FC
- Retain 1+7
- 1 MCP 1
- 1 MCP FC
- Good NR CK
Implications of the 1 MCP Treatments

- 1 MCP can take the Fraser fir with the worst needle retention and make it perform like the best!

- Ck vs. 1-MCP 1 day
Smartfresh by Agrofresh

• 1-MCP was invented at NCSU initially for Apples
• Manufactured by Agrofresh
• About to go off-patent

• Different formulations are in development to spray, pack and ship, etc.

• May not need to use a gas treatment in the future

• Opportunities for testing new formulations
• Maybe lower cost treatments!
Genetically Improved Fraser Fir Seed

Needle Loss by family
Mean = 5.1%
Best = 0.2%
Worst = 21.9%
Other Species Responded to PGR’s Differently

Norway   Serbian   Norway   Serbian Spruces

Picture taken on December 19, 2019

Retain 1 day prior to harvest  vs. Untreated Check
Norway and Serbian Spruces

Norway Spruce Needle Retention

- Check
- Retain 1
- Retain 7
- ABA Low
- ABA High
- Retain FC
- Retain 1+7
- 1 MCP 1
- 1 MCP FC

Serbian Spruce Needle Retention

NC STATE EXTENSION
Black Hills & Colorado Blue Spruces

Black Hills Spruce Needle Retention

- Check
- Retain 1
- Retain 7
- ABA Low
- ABA High
- Retain FC
- Retain 1+7
- 1 MCP 1
- 1 MCP FC

Colorado Blue Spruce Needle Retention

- Check
- Retain 1
- Retain 7
- ABA Low
- ABA High
- Retain FC
- Retain 1+7
- 1 MCP 1
- 1 MCP FC
Ethylene Interruption on Spruces

• Both 1-MCP and Retain generally improved needle retention over the untreated checks.
• Ultimately, spruces failed to retain needles past Christmas given the extremely early harvest date.
• Could explore later / normal harvest window with these treatments.
• Serbian & CBS looked better than BH & Norway.
• Individual high performers suggest room for genetic improvement (but why bother?)
Concolor Fir Should NEVER be Harvested Early!
(it performed so badly, it was funny)
Canaan Fir vs. Fraser Fir

Canaan Fir Needle Retention

- Check
- Retain 1
- Retain 7
- ABA Low
- ABA High
- Retain FC

Fraser Fir Needle Retention

- Check
- Retain 1
- Retain 7
- ABA Low
- ABA High
- Retain FC
Ethylene Interrupters & Firs

• Canaan Fir & Fraser Fir responded similarly, but Fraser still has better NR
• Fraser fir is uniquely adapted to southern stress, ie warm fall weather
• There are numerous sources of Concolor fir that might be better than this one…
• If you are going to buy and sell Canaan or Balsam fir, consider these treatments
So What Can You Do?

• Watch the weather and harvest dormant trees
• Get cut trees out of field as quickly as possible
• Make your storage area as cool, dark, and damp as possible.
• Use shipping methods with tree freshness in mind
• Make sure retailers are caring for trees properly and have educational tree care material for consumers
• Balanced Genetics (Economic heritability and needle retention)
Questions?