Abscission and Mechanical Harvesting

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SWEET ORANGE PRODUCTION IN FLORIDA

- Total production: 577,000 acres
- Mechanically harvested: 35,000 acres (7%)
- Hand harvested: 552,000 acres (93%)
REASONS FOR COMMERCIAL INTEREST IN MECHANICAL HARVESTING

- Labor availability
  - Traditionally difficult to obtain good labor
  - Especially late in harvest season (May and June) due to hot, humid weather

- Liability of hiring illegal labor

- Labor cost: H2A program

- Labor management
ABSCISSION AGENTS

- Improve efficiency of current harvester systems

  - Currently removing only about 75-85% of fruit with canopy shakers

- Best: CMNP (5-Chloro-3-Methyl-4-Nitro-1H-Pyrazole)

  - Experiment Use Permit (EUP)
    - Estimated submission by end 3Q 2009 with EPA
    - EPA review time: about 18 months

  - Section 3 (Full registration)
    - Estimated submission by end 3Q 2010
    - EPA review time: 24 months
CURRENT RESEARCH

- Limited to 10 acres
- Two major sets of field trials (Dec. through June)

Objectives:

1. Determine the relationship between CMNP concentration and mechanical harvester setting
2. Develop a predictive model for fruit loosening by CMNP
CMNP and Mechanical Harvester Setting Studies

APPROACH

1. Repeat same treatments on multiple dates
   - Hamlin: mid Dec., early Jan., late January
   - Valencia: mid March, mid April

2. Treatments
   - CMNP: 0, 200, and 300 ppm at 300 gal/acre
   - Pull behind canopy shaker settings: 180, 220, 260 cycles per minute (cpm)

3. Experimental design:
   - RCBD with 4 blocks, and 3 trees per block
   - Harvester setting as the main plot
   - CMNP treatment as the split plot
Fruit loosening requires direct contact with CMNP

Vertical, multi-fan sprayer

Height: no effect on FDF

Depth:
  • inside: 13.6 lbs
  • outside: 12.4 lbs
Data Collection

Fruit detachment force (FDF)

Preharvest Drop
Harvested with a “pull-behind” canopy shaker
Harvest data collection

Harvest weight

Glean weight
Fruit removal by CMNP ‘Hamlin’

Early January

Canopy shaker head speed (cpm) vs. Removal (%)

CMNP by canopy shaker head speed interaction significant
Drought effects on CMNP efficacy (2008)

**Hamlin**

- **Treatments**
  - Irrigation withheld 5, 12, 19 days in late Jan.
  - CMNP: 250 ppm, 300 gal/acre

- **Results**
  - Stem water potential (MPa): -1.3a, -1.7b, -1.6b
  - Interaction of CMNP x drought not significant

**Valencia**

- **Treatments**
  - Irrigation withheld 0, 4, 7 days in late April
  - CMNP: 250 ppm, 300 gal/acre

- **Results**
  - Stem water potential (MPa): -1.5c, -2.0b, -2.5a
  - Interaction of CMNP x drought not significant
Fruit removal by CMNP ‘Valencia’

Removal (%)

Canopy shaker head speed (cpm)

CMNP by canopy shaker head speed interaction significant
CONCLUSIONS

- The benefit of CMNP increases with slower mechanical harvester setting.
- Lower shake rate will help alleviate concerns on tree injury by grove managers.
- CMNP is beneficial throughout most of the harvest season.
CMNP Predictive Model

GOAL

To develop a predictive model for loosening sweet oranges by CMNP that would aid scheduling of CMNP and mechanical harvesting.
Factors that may affect CMNP

- CMNP concentration – assume complete coverage to drip
- Environmental factors
  - Rain – not within first 24 hrs after application
  - Air temperature – highly sensitive
  - Drought – possibly
  - Drying rate
- Tree factors
  - Cultivar and Rootstock
  - Tree health
- Timing
  - Time of year
  - Time of day
Effect of air temperature on fruit loosening
CURRENT STATUS OF THE MODEL

- Must assume complete coverage within the canopy
- Accurately predicts at 300 ppm CMNP
- Need to modify at lower concentrations of CMNP
- Is independent of short term drought stress
- Don’t know yet if varies by cultivar or rootstock.
- Other factors?
Studies planned for 2009

1. Determine the relationship between CMNP concentration and removal by days after application

2. Develop a predictive model for fruit drop by CMNP
GOAL: Put the models on FAWN as aids to CMNP and mechanical harvester scheduling
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