Precision Orchard Management: Research update

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Overview

• Definitions and examples
• GIS-based applications
• Weather-based decision support tools

Precision management

• Components
  — Sensors and remote sensing
  — Precision positioning
  — Integrated communication
  — Geomapping
  — Auto-steering
  — Variable rate technology

Precision management

• Mapping components
  — Soil properties map
  — Grid soil testing (nutrients)
  — Yield history
  — Pest distribution
• Variable management
  — Variety
  — Seeding rate
  — Fertilizer rate
  — Pesticide rate
Orchard examples

- TRAPs app

Precision Crop Load Management

- Determine target crop load
  - Bushels per acre to maximize “crop value” (target size class)
  - Fruit # per acre → Fruit # per tree → Fruit # per branch
- Precision pruning
  - Determine flower buds per tree (5 trees per block)
  - Factor this into pruning strategies to reduce flower buds
- Precise thinning program
  - Fruit Growth Model
  - Carbohydrate Thinning Model
  - “Window” hand thinning

Applications for Utah

- Appropriate for tart cherry?
- Research locations
  - Three farms
  - Two orchard blocks per farm
  - Orchard blocks differ in soil uniformity (based on NRCS maps)

Orchard examples

- TRAPs app features
- Precision crop load management
- Variable rate management
  - Fertilizer
  - Based on what?
    - Soil variability
    - Yield history?
Mapping parameters - Soil

• Soil properties
  – Electromagnetic probe
    • Texture
    • pH
    • Salinity

Mapping parameters - Canopy

• Aerial imaging
• Light interception mapping
  – Light sensors 5-cm spacing
  – GPS and data logger
Mapping parameters - Canopy
• Aerial imaging
• Light interception mapping

Mapping parameters - Yield
• Yield variability
• Technology?
• Mapping Parameters:
  - Canopy
  - Soil
  - Yield

• Next steps?
  - Correlations among these and yield, tree health
  - Changes in leaf area over time?

• Leaf area changes
  - Proportional to water needs

• Improved crop coefficients
  \[ \text{ET}_{\text{crop}} = \text{ET}_{\text{ref}} \times K_{\text{crop}} \]
• Variable rate management
  – Fertility
  – Irrigation
  – Pruning

• Pruning
  – Canopy density threshold
    • Fruit color
    • Powdery mildew

Overview
• Definitions and examples
• GIS-based applications for tart cherry
• Weather-based decision support tools

Weather Based Decision Support
• TRAPs app
  – 10 Insect pests
  – 1 disease
• Crop growth models
Apple Carbohydrate Model

• Carbon balance affects thinning response
• Surplus = difficult to thin
• Deficit = easy to thin

Pollen Tube Growth Model

• Predicts time to pollination
• Used to time bloom thinners

Improved ET estimates

$$ET_{crop} = ET_{ref} \times K_{crop}$$

• Orchard-specific $$ET_{ref}$$ calculations
• Projected ET from weather forecasts

Crop Phenology

• Growing Degree Days (GDD) from 1-Jan to crop growth stages – apple (by cultivar: Cripps Pink, Gala, Red Delicious)

• GDD to bloom for peach and cherry
Fruit Growth Model - Apple
• Uses GDD, fruit measurements and date to estimate harvest fruit size distribution. (Cripps Pink, Gala, Red Delicious)

Honey Bee Foraging Activity
• Bee activity based on weather
  – (rain, wind, temperature, sunlight)
• Past three days,
• Forecast of next three days
• Limiting factor

Peach fruit development
• California model
  – GDH for first 30 days after bloom
  – Predicts fruit size potential
  – Used to determine thinning timing and severity

Weather-based tools
UDAF Specialty Crop grant (2019-2021)
• Integrate new heat unit models into Climate Center Website
• Validate these models under Utah Conditions
• Refine/Improve the models where appropriate
• Integrate validated models into Utah TRAPs app.
Which weather-based tools

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- Priority: High, Medium, Low, No Interest