Trends, Drivers, and Experiences of Specialty Crop Producers in the Pursuit and Adoption of Mechanization and Automation in the Field

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**Definitions**

**Mechanization**
- Replacement of human power with mechanical power
- Saves the use of human muscles

**Automation**
- Complementing human thinking with computers and machines
- Saves the use of human judgement

Perennial specialty crops that uses some form of mechanization – especially for harvest

- Oranges
- Tart cherries
- Olives for canning
- Tree nuts
- Apples
- Blueberries
This presentation:

• U.S. apples: 67% to the fresh market
• US. blueberries: 55% to the fresh market.
• U.S. wine grapes: 85% to the processing market.

Photo: Washington Apple Commission
Photo: Gurneys Nursery
Photo: Great Northwest Wine
Drivers

- High dependence for seasonal labor

Monthly variable covered employment by select agricultural industries Washington state and selected agricultural reporting areas

January 2017-December 2017

Drivers

• The U.S. apple and blueberry industry identified labor availability and cost as the major challenge to ensure economic sustainability
  - 2017 survey of WA, NY, and MI apple growers (Gallardo et al., 2019)
  - 2017 survey of U.S. blueberry growers (Gallardo et al., 2018)
  - 2020 survey of CA vineyards owners (Gray, 2020)

• Other drivers are climate change, growing food demand, and increasing competition from other countries
Drivers

- Yearly increases in wages

H2A Adverse Effect Wage Rate in Washington State (nominal)

Source: U.S. Department of Labor, various sources
Drivers

- Labor represents 50%-57% of orchard variable costs for WA state apples

Source: Gallardo and Galinato 2020
Apples-Platforms

- 2010 survey WA - Platforms
  - 11% of survey respondents used platforms (N=316)
  - Platforms were mostly used for tree pruning, training, and green fruit thinning, only 1 respondent used for harvest (Gallardo and Brady, 2015).

- As of 2021
  - Platforms are used mostly for non-harvest activities
  - For harvest, ladders are preferred:
    - Workers: enables work at each individual picking rate speed
    - Employers: no return on the investment

Photo: Good Fruit Grower, 2016
Blueberries – Over the row harvesters

• 2017 survey of blueberry growers
  – 33% of respondents mechanically harvested fresh market blueberries
  – Advantage: Cost reduction
  – Disadvantage: Quality of the fruit
    • Bruised berries
    • Non-uniform ripen berries

• New varieties to improve harvester efficiency
  – Concentrated ripening
  – Upright habit
  – Resistance to bruising – thicker cell walls
Wine grapes – Mechanization is common

- Since 1960’s vines are almost exclusively mechanically picked.
- Mutual understanding with the winery if grapes must be manually picked.
- Other horticultural activities are mechanized, with the goal of improving productivity and quality.
  - Leafing
  - Under-vine cultivation
  - Pre-pruning
  - Pruning
  - Trunk suckering
  - Shoot thinning
• **Apples** – 2017 WA, NY, and MI apple growers
  - Precision soil mapping and nutrient management (39% of respondents used)
  - Sensor-based irrigation management (26% of respondents used)
  - Remote sensing for canopy mapping (5% of respondents used)

ECa preplanting soil map from EMI survey of Othello, WA orchard (left). SfM reconstructed 3-D fruit tree point clouds derived from UAV imagery (right). Photo: Brown, 2017.
• Other technologies
  – Automatic sprayers
    • Wireless/ultrasonic sensors to dispense precise chemical rate.
  – Automatic guided vehicles
    • Adaptability to carry a diverse array of implements: chemical sprayers, tree canopy shakers, weed elimination
  – Drones
    • To provide information on crops
    • Release sterilized codling moths
• Unprecedented number of research and development initiatives from academia, government, and private sector (start-ups).
  - From 2008-2018 AMS, ARS, and NIFA funded $287.7 million towards 213 projects.
  • Machinery automation, machine learning/data analysis, mechanical harvesting, precision agriculture, remote sensing/drones, sensors.

Source: Astill, 2020
Mechanization and Automation - Conclusions

• Digital agricultural revolution
  - Changes in population aspirations, aging population, and growing population
  - Ensure the economic sustainability of the specialty crop industry
  - Supply high quality products

• Effects on labor markets
  • Create better paid jobs with different sets of skills
  • Mitigate worker displacement-training

Photo: SwarmFarm robot – Australia. The Spokesman.
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