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2020 Update Mtg: Cranberry Production and Solar

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Cranberry production and solar: What have we found so far?

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January 30, 2020
Rosebrook Event Center, Wareham, MA
SMART Program

• The Massachusetts Department of Energy Resources launched the Solar Massachusetts Renewable Target (SMART) program in 2018

• Renewable energy and agriculture are incentivized to work together

• Agrivoltaic systems designed to promote the continuation of productive agricultural activities are eligible for additional financial incentives under SMART
Agrivoltaic systems

• Agrivoltaic systems modify light conditions by reducing the amount of photosynthetically active radiation

• Forms the basis of current regulations in terms of shading requirements

• Maximum sunlight reduction should not be more than 50% per square foot under an agrivoltaic system
Objectives

• Preliminary study on cranberry production under solar photovoltaic installation

• Provide research-based information for Massachusetts cranberry growers and all interested stakeholders

• Data collected will also be used to adapt and promote the use of effective production practices for cranberry production under solar panels
Study Site

• Wainio Bog, Carver, MA
• ‘Stevens’ cranberry cultivar
• Uncovered control area and an agrivoltaic system with three replica plywood solar arrays
Study site

• Plywood ‘solar arrays’ were spaced 12 feet apart, 20 feet in length, and feet wide at 10 feet above the plant canopy

• Microclimatic sensors were installed under solar arrays, between solar arrays, and in the uncovered control
Sensor placement

Array 1
Array 2
Array 3

North
Control

West
East

Photosynthetically Active Radiation (PAR) sensors
Canopy temperature, soil moisture & leaf wetness sensors
Microclimatic sensors
PAR beneath a solar panel on a sunny day (07-23)

- 40.07% shading beneath solar panel
- ≈ 3¼ hours at noon, ≈ 30mins early morning and late afternoon from adjacent solar arrays (21 feet spacing)

Light saturation for maximal photosynthesis in cranberry
PAR between solar arrays on a sunny day (07-23)

- 27.52% shading between solar arrays
- ≈ 2.5 hours shading midmorning and midafternoon from adjacent solar arrays (21 feet spacing)

Light saturation for maximal photosynthesis in cranberry
Seasonal PAR trend

- 41.51% shading beneath solar panel
- 29.31% shading between solar arrays
How does the reduction in PAR affect leaf gas exchange?

- Leaf gas exchange at midmorning (9:46), solar noon (12:46) & midafternoon (15:46) on 09-20-19
Leaf gas exchange midmorning

- Mid-morning
- Solar noon
- Mid-afternoon
Leaf gas exchange

- **Mid-morning**

- **Solar noon**

- **Mid-afternoon**
Ambient temperature (hot day)

- Canopy temperature reduced ≈7°F beneath solar panels and ≈6°F between solar arrays
- Potential implications for sunscald and consequently fruit rot
Canopy temperature

- Higher minimum temperature under solar
- Effect on frost tolerance?
Effect of solar panels on soil moisture

- Increased soil moisture content after rain even could be from ‘funneling’ effect
Data still being analyzed

• Yield and land use efficiency, fruit quality, fruit rot

• Physiological responses: leaf area index, leaf chlorophyll index & nutrient analysis
Summary

• Agrivoltaic systems modify the microclimate

• Reduction in PAR

• Reduction in maximum temperature and increase in minimum temperature

• Increased soil moisture content
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