

Farmer-Friendly Vertical Agrivoltaics: A Field Simulation

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Introduction

- **Vertical bifacial** photovoltaic (PV) arrays, fence-like rows of solar panels, leave space for farming.
- To **support farmer success**, we need to know more about crop responses to PV shade.
- Our vegetable experiment in Vermont **will be one of the first** vertical PV installations in the US.
- It may benefit farmers and researchers to **field-test crop suitability** before PV installation.

Research Methods

- “**Shade fences**” simulate shade between PV rows.
- Shade treatments:
 - No shade Standard farming
 - **Morning** shade PV rows east of crops
 - **Afternoon** shade PV rows west of crops

Shade Fences & Sensors



Figure 1. A. Shade fences with wind vents, offset east or west for morning or afternoon shade. Larger panels intended for higher shade. **B.** Sensors to monitor microenvironment.

Preliminary Results (2023)

Data analysis is still in progress.

Crop Yield (Quantity)

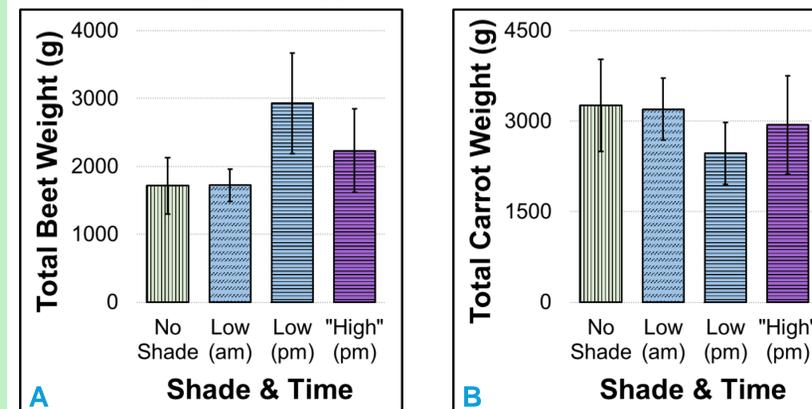


Figure 2. A. Beets. **B.** Carrots.

- Combined weight (average \pm standard error) of sampled vegetables from each type of shade (am = morning, pm = afternoon) from 6 feet of two adjacent crop rows; n=3 sampled sections per shade type.
- Vegetable counts: 17-38 per section for beets & 45-70 for carrots.

Crop Yield (Quality)

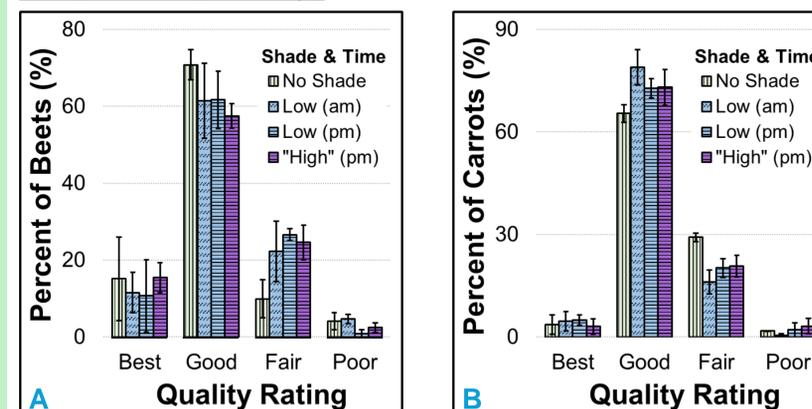


Figure 3. A. Beets. **B.** Carrots.

- Quality ratings (average \pm standard error) for vegetables sampled from each type of shade (am = morning, pm = afternoon); n=3.
- Best = High consumer market appeal, Good = Consumer acceptance, Fair = Not market saleable, Poor = Not saleable.

Microenvironment (Sunlight)

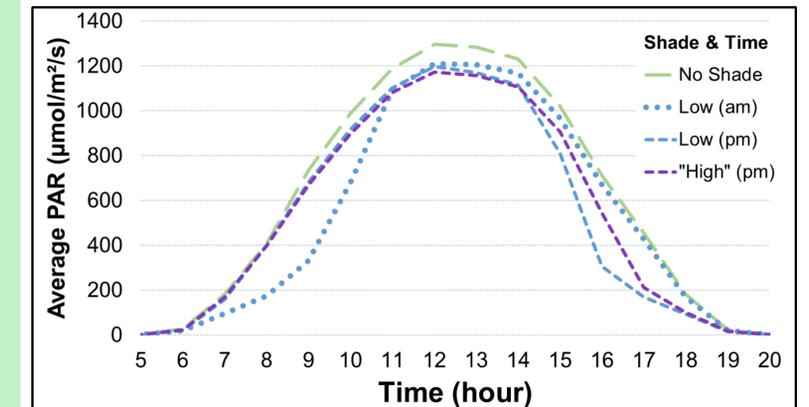


Figure 4.

- Photosynthetically active radiation (PAR) for each sunlit hour (05:00 to 20:00) in each type of shade (am = morning, pm = afternoon) from 08/12/23 to 09/20/23.
- It was unanticipated that sunlight would be lower in the Low (pm) shade treatment than the “High” (pm) shade.

Future Work

- We will **repeat** this in 2024 and compare to the vertical PV array in 2025, including statistical tests.
- If shade fences simulate vertical PV conditions, crops can be tested on site before installing PV.
- Results will **inform planting decisions** for beet and carrot crops in vertical agrivoltaic arrays.

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