Soybean Production in an Agrivoltaics System in New Jersey

First Year Results – 2024 Growing Season

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Introduction

- The Rutgers Agrivoltaics Program (RAP) has three different agrivoltaic systems to study some of the most important agronomic crops produced in New Jersey.
- This effort supports New Jersey's commitment to produce 100% renewable energy by 2035, while simultaneously maintaining agricultural production.
- Research must be conducted to determine the potential impacts of agrivoltaic systems on the yield and quality of agronomic crops.
- This poster presents preliminary results of a trial on soybeans grown under a single-axis tracker system located at the Rutgers Agricultural Research and Extension Center (RAREC), in Upper Deerfield, New Jersey.

Rutgers Agrivoltaic Systems:
1. *Animal Farm in New Brunswick*
2. *RAREC in Upper Deerfield*
3. *Snyder Farm in Pittstown*

Agrivoltaics at the Rutgers Agricultural Research and Extension Center

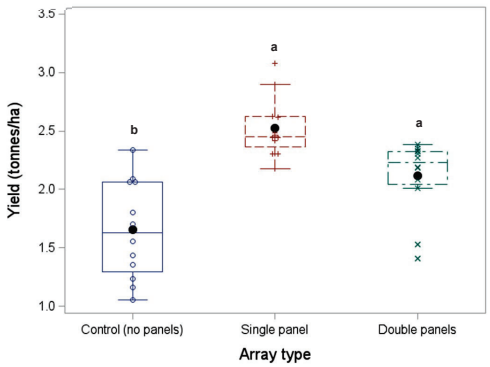
Agrivoltaics System Design

- Single-axis trackers with single and double rows of panels, North-South oriented.
- Bifacial panels (450 W; 70% bifaciality).
- 21 or 42 panels per row.
- Pivot point 2.4 m (8 feet) above ground level.
- Row spacing: 10.4 m (34 feet).
- 255 kW_{DC} installed capacity (567 panels).
- Three randomized experimental blocks, each with a control area, three array rows with single rows of panels, and three array rows with double rows of panels.

Sowing and Harvesting

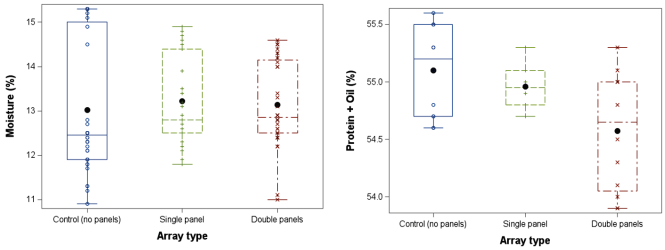
- Working around solar panels requires adjustments and planning when using big machinery.

Soybean Yield



- Significant differences ($P = 0.0114$) in yield were observed among array treatment types (including control area, without panels).
- Soybeans growing under both single and double panels produced significantly higher yields, 2.52 tonnes/ha and 2.11 tonnes/ha respectively, compared to the control area at 1.65 tonnes/ha.
- Analysis of the effects of East-West position and distance from the center array row detected no significant main effects or interactions.

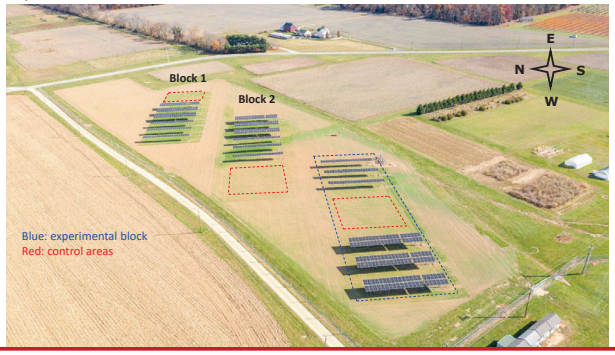
Soybean Quality



- Soybean moisture content and protein plus oil content were not significantly different among treatments or any of the interactions tested.

Experimental Design

- Soybeans were sown at ~395,400 seeds/ha in Block 1 and Block 2.
- Crop management was consistent with conventional agricultural practices in the area, providing irrigation as needed through an overhead sprinkler system.
- Soybean moisture and protein plus oil contents was assessed using a mixed-effects ANOVA that tested for the main effects and interactions of array type, plant position relative to the center array row (East or West), and plant distance from the center array row in each treatment area.



Summary and Preliminary Conclusions

- Soybean yield increased when produced in a single-axis tracker agrivoltaic system while its quality was unaffected.
- Yields produced under the two different tracking systems were not significantly different from each other, but both of their yields were significantly higher than the yield in the control area (area without panels).
- These results were obtained during our first growing season (2024), which included the driest September and October in recorded history and may therefore not be representative of future yields.
- Results of additional growing seasons are needed to draw more definitive conclusions and produce recommendations for the impacts of a single-axis tracker agrivoltaic system on the production of soybeans.

Acknowledgements

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Agrivoltaics (AV) has gained popularity globally as part of the efforts to produce clean energy while protecting high value productive land. Important research must be conducted to determine the potential agricultural impacts of AV panels on the yield and quality of agronomic crops. In this work, we show soybean yield and moisture results of the first year under a single axis tracker, mounted with the axis of rotation at 8 feet above ground level and two configurations, single or double-wide bifacial modules compared to a no-panel control plot. All activities were consistent with regular agricultural practices in the area. For grain yield, protein content, and moisture content, a mixed-effects ANOVA was used to test for main effects and interactions of array type, East-West position, and distance from the center array row of the whole plot. Significant differences ($P = 0.0114$) on yield were found only on the array type, where soybean growing under both single and double panels presented significantly higher yields than the control, 37.5 bu/acre and 31.4 bu/acre, respectively, compared to the control area 24.6 bu/acre. We detected no significant main effects nor any interactions with East-West position or distance from the center array row. No significant main effects or interactions were detected for grain protein or moisture. It is important to note that this year was the driest recorded September and October of all history for New Jersey.