# Working Under Cover: Investigating the Effect of Shade on Crop Yield in Agrivoltaics

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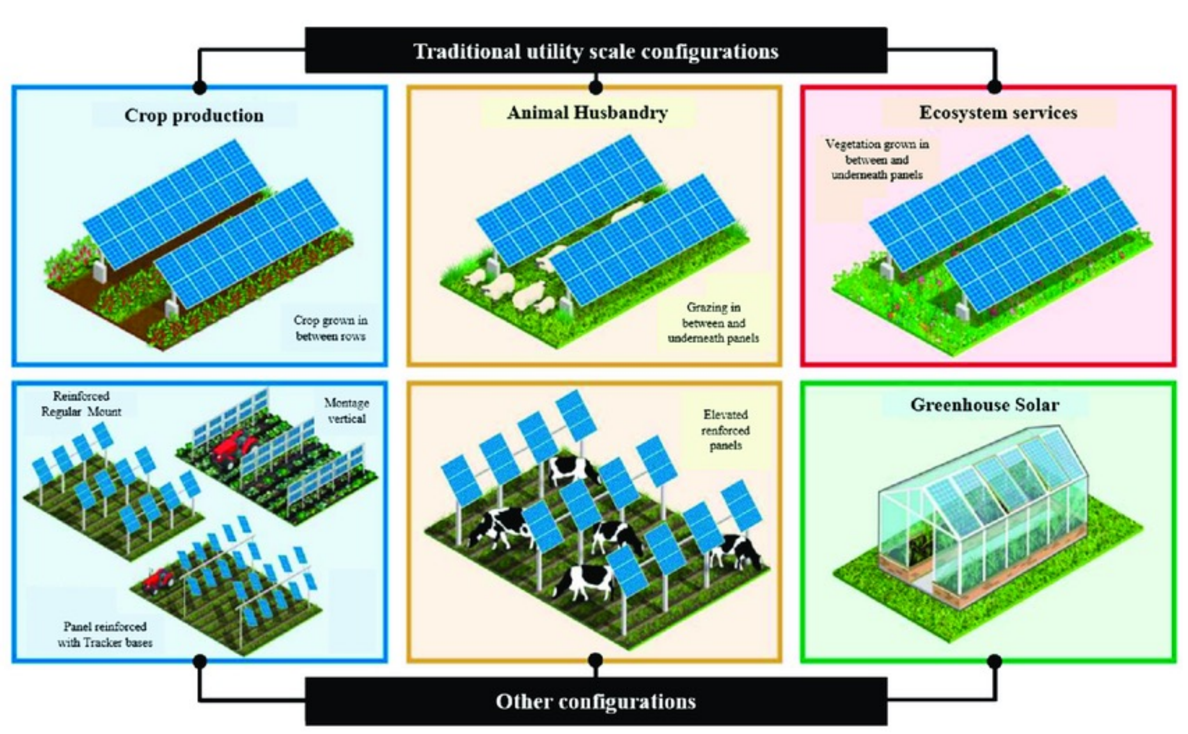
## Introduction

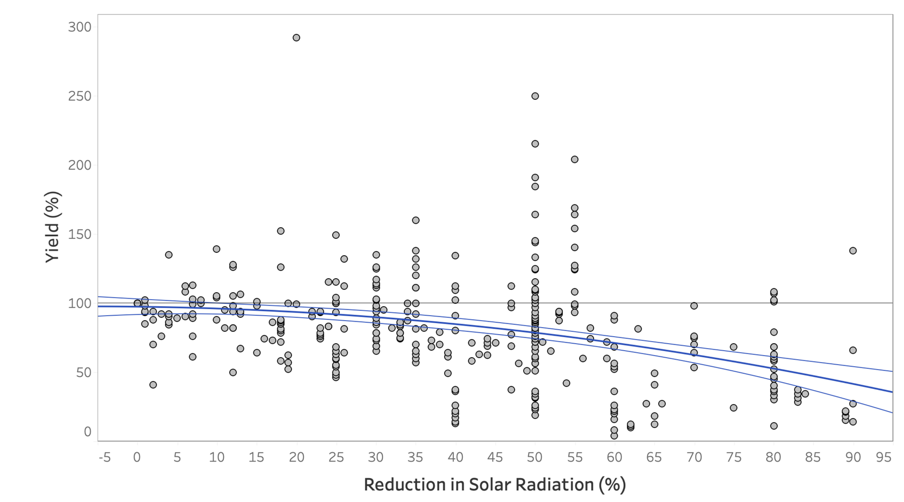
Agrivoltaics (AV) is the simultaneous use of land for solar energy and agricultural production. The shade provided in AV systems can affect crop yield, with the nature and extent of this effect varying by crop type and environmental conditions. This study investigates the impact of shade on crop yield across different crop types and climatic zones, focusing on how varying levels of reduction in solar radiation (RSR) influence agricultural productivity in AV systems.

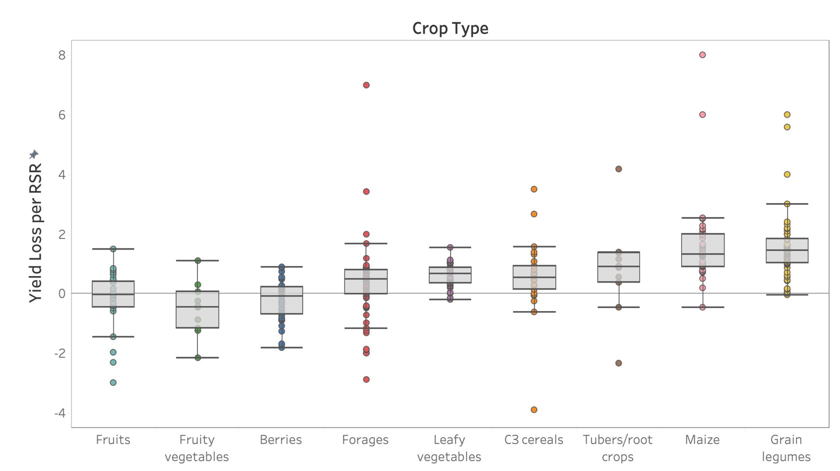
**Research question:** How does shade impact crop yield in agrivoltaic systems across various crop types and climatic conditions?

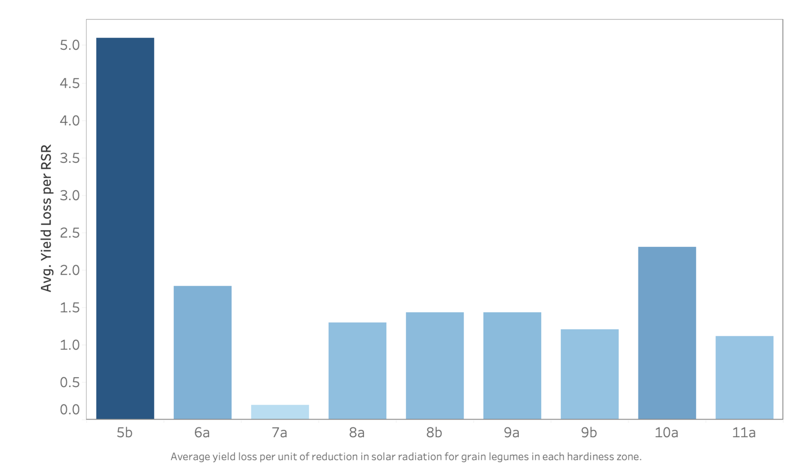



## Exploratory Data Analysis

- Yield, the response variable, exhibits a non-linear relationship with reduction in solar radiation.
- Shade type and experiment type do not significantly influence yield response to RSR.
- Crop type significantly affects how yield responds to RSR.
  - Some crops show increased yield under moderate shade
  - Others experience yield declines from any shade
- Yield responses to RSR differ across climate zones and plant hardiness zones.
  - Although differences were observed, clear patterns were not evident



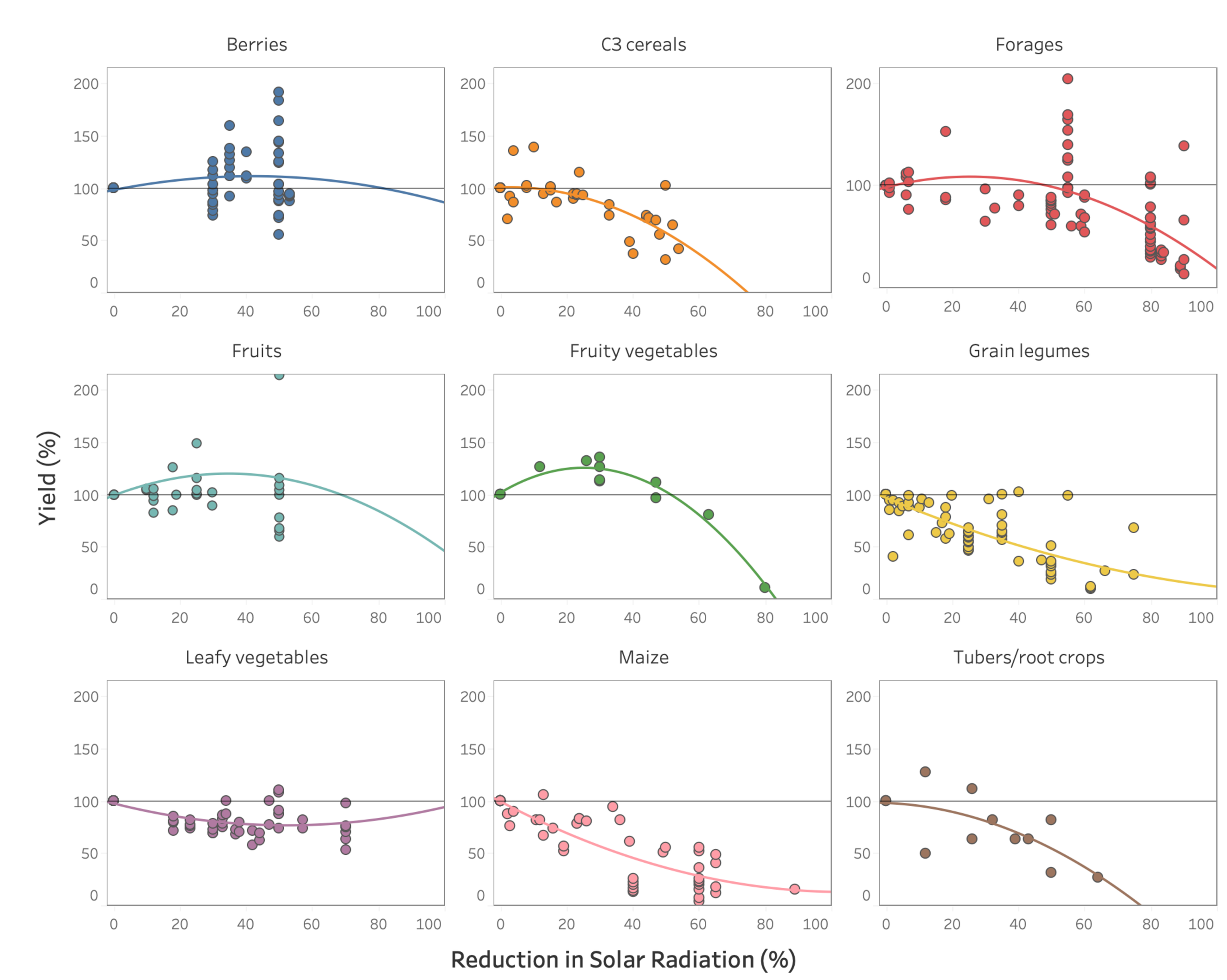




## Methods

Multiple linear regression was used to identify predictors of yield response to shade.

- Stepwise selection was applied to determine the optimal model
- A climatic variable was included due to the research focus; plant hardiness zone proved a better predictor of $\sqrt{\text{Yield}}$ than climate zone

Clustering analysis was used to group crops based on their yield responses to shade.




## Results

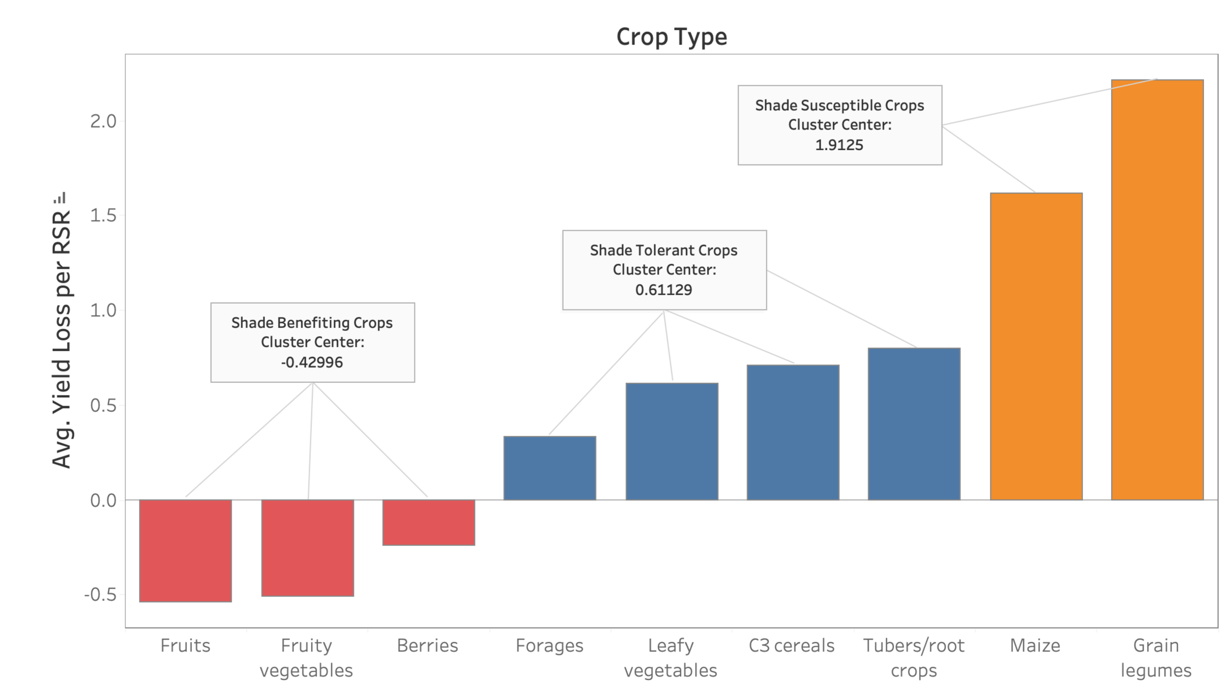
Final model:

$$\sqrt{\text{Yield}} \sim \text{RSR}^2 + \text{Crop Type} + \text{RSR}^2 : \text{Crop Type} + \text{Hardiness Zone}$$

- 60% of the variance in $\sqrt{\text{Yield}}$ can be explained by the predictors ($R^2 = 0.6004$)

Clustering categorized crops into 3 shade response groups:

- Shade benefitting: Fruits, Fruity vegetables, Berries
- Shade tolerant: Forages, Leafy vegetables, C3 cereals, Tubers/root crops
- Shade susceptible: Maize, Grain legumes




## Conclusion & Future Work

- Crop yield responses to shade vary by crop type and environmental conditions.
- Limitations include a lack of detail on shading sources and underrepresentation of certain crop types.
- Future work should expand field studies with solar panels and incorporate more environmental variables.

## References

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