GREEN ROOFS: INFLUENCE OF PHOTO-INHIBITION ON FOOD CROP GROWTH FRONT RANGE

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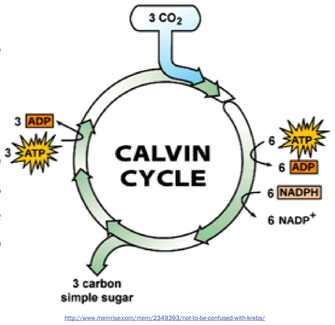
PROJECT INTRODUCTION

Growing food crops on green roofs can provide urban settings with fresh, highly nutritious, and short shelf-life produce while also providing general green roof benefits such as urban heat island mitigation, building insulation, storm water capture, and provide animal/pollinator habitat (1).

Harsh rooftop conditions such as high winds and solar exposure provide challenges for green roof environments. Excessive solar irradiance and high temperatures can trigger photoinhibition in plants where O_2 is mistakenly pulled into the Calvin Cycle instead of CO_2. This leads to inefficient carbon uptake in plants: while energy is still consumed for the cycle, no new biomass is generated, so plant growth is stunted.

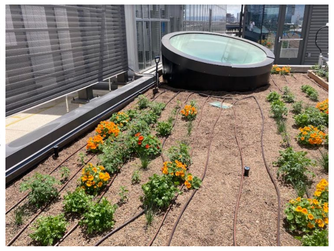


http://www.memrise.com/mem/2349393/not-to-be-confused-with-krebs/

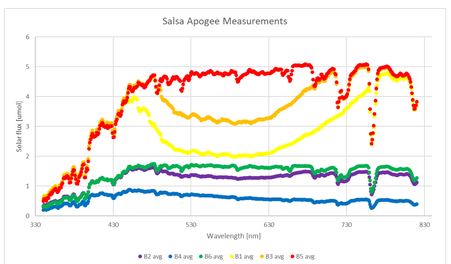
Providing morning shade in addition to consistent afternoon Colorado cloud cover could shield plants enough to avoid the photo-inhibition threshold, thus increasing the yield of food crops on green roofs.

METHODS

Five different species of food crop plants (chives, jalapenos, cilantro, tomatoes, and nasturtiums) were randomly assigned positions in each of six blocks on the 18-inch intensive green roof on the 4th floor of the Terra building of the CSU Spur Campus. Each block had 24 plants in five columns and four rows with three of the blocks receiving partial shade in the morning from a wall adjacent to the garden.



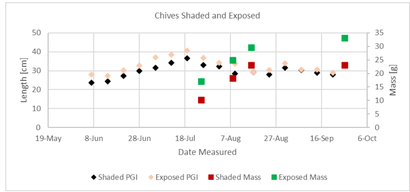
Relative success of the plants were quantified with additive fresh weight and by measurements of width and height. Weekly harvest masses for each species were averaged for each block and the three shaded and exposed blocks were averaged together. For length measurements, the longest width of a plant as well as the perpendicular width and height were measured with a tape measure and averaged per block and per treatment. Both widths and heights were averaged together to indicate the Plant Growth Index (PGI) of each species. Both additive fresh mass and PGI for the shaded and exposed blocks were plotted over time. Solar exposure for the blocks were quantified using a spectroradiometer.

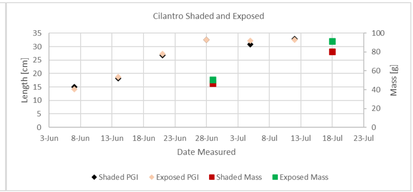


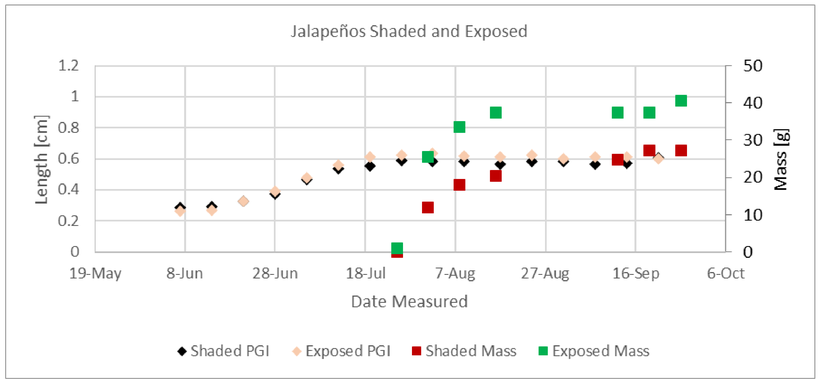
Block notation

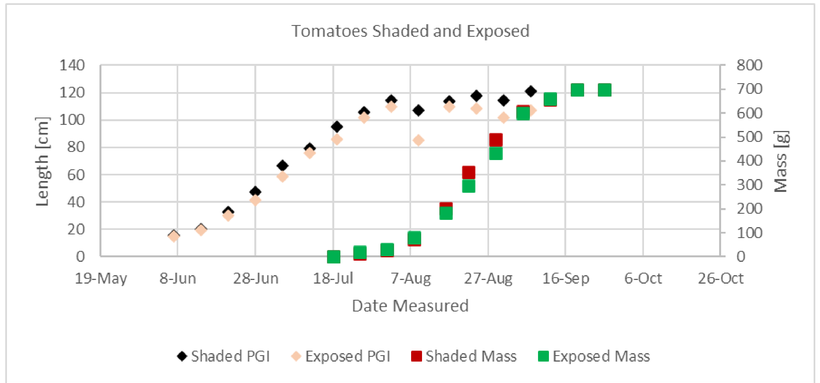
Skylight		
1	2	
3	4	Shade wall
5	6	
Skylight		

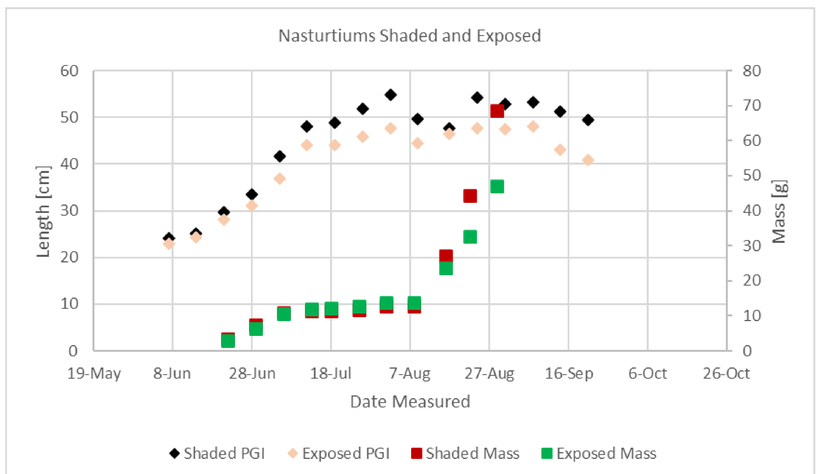
RESULTS











DISCUSSION

While tomatoes and nasturtiums had improved growth under morning shade, chives, jalapenos, and cilantro benefitted from greater solar exposure. This could be a result of variations of optimal growing conditions between species and suggests that tomatoes and nasturtiums may benefit from being positioned where they receive partial morning shade while the other plants would have more success in more exposed orientations.

Environmental factors may have interrupted standard growth for the plants, complicating the data. Hail on August 8th led to significant plant damage which contributed to future disease penetration and frailty of branches.

Further challenges were faced with the overgrowth of plants out of their assigned areas. Tomato and nasturtium plants expanded throughout the blocks, providing shade for the plants they grew adjacent to. This overgrowth also may have prompted human error in length measurements, as the determination of where the plants ended became difficult as they became intertwined with each other.

CONCLUSION

Solar exposure reduction seemed to have a positive effect on the growth rate of tomatoes and nasturtiums, indicating that photo-inhibition may play a role in limiting their growth on green roofs (though data collection and statistical analysis are incomplete at the time of this poster's completion).

Further studies spanning multiple growing seasons could reduce the impact of adverse environmental effects, and further examination on how blocks within each treatment fared relative to each other could indicate an edge effect acting on outside blocks.

REFERENCES

1. Getter, K.L. and D.B. Rowe. 2006. The role of extensive green roofs in sustainable development. HortScience 41:1276–1285.