Exploring Carbon Accounting Models and the Promising Impacts of Melatonin on Drought-Stressed Turfgrass

Annabella Williams, 2026

The scope of my summer fellowship covered two distinct research projects, the first of which involved improving the accuracy of New Forests' current carbon accounting model. New Forests is an Australian-based company that contracts with institutions worldwide to find and manage sources of carbon offset credits. Through this initiative, they hope to amplify the monetary benefits of investing in sustainable agricultural and arboreal markets. This summer, I answered three questions posed by their research team and offered my insight into ways they can more accurately measure and report their carbon sequestration and emissions. These questions were: how much carbon is emitted from plantation fires at different levels of severity; how much carbon is sequestered in the roots compared to the above-ground shoot of various tree species; and lastly, how can we better model the expansion of carbon sequestration in arboreal species as they age and grow?

Through synthesizing peer-reviewed scientific articles, I learned that carbon accounting is a continuously improving field. Although age-old practices of drying plant matter and measuring masses still endure, newer and more advanced methods are coming to the forefront - such as employing satellite imaging to define fire intensities and using atmospheric carbon modeling to estimate tree growth patterns in a changing environment.

I coupled my time reviewing scientific articles with getting involved in the melatonin research conducted in the Logan Lab. Specifically, we looked at how different applications of melatonin impact the chlorophyll content and photosynthetic properties of turfgrass flats subjected to different drought severities. We did this by precisely droughting 63 turfgrass flats over two weeks. For our experimental flats, we either exposed them to a melatonin spray applied to the leaves of the grass or soaked the soil with a melatonin-nutrient solution before the onset of the drought treatment. We then took measurements of their photosynthetic rates and chlorophyll content to make inferences about how melatonin may impact the productivity of turfgrass. While melatonin does not appear to impact photosynthetic rates of turfgrass, our findings suggest that melatonin may reduce the need for turfgrass to rely on higher chlorophyll B concentrations to decrease the production of reactive oxygen species at higher light intensities. This reduction may be due to melatonin's ability to enhance antioxidant capacity, as cited in previous literature. Further analysis of our data will continue through the fall semester.

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