Impacts of Melatonin Application on the Drought Tolerance of Turfgrass

Elisabeth Chan, 2025

When a college like Bowdoin pledges to be "carbon-neutral," it commits to offsetting its carbon dioxide (CO_2) emissions by facilitating the absorption of an equivalent amount of CO_2. Since plants absorb carbon dioxide (CO2) during photosynthesis, it is crucial to measure their photosynthetic efficiency to accurately calculate CO2 fluxes. A promising method of measuring global photosynthetic output is solar-induced fluorescence (SIF), which is recorded via satellite. When chlorophyll absorbs light in plant leaves, it releases energy through photosynthetic processes, heat, or SIF (Jones et al., 2023). While SIF effectively tracks global photosynthesis at grand scales (Magney et al., 2019), recent research suggests that it may not accurately correlate with photosynthetic capacity at the plant scale (Jones et al., 2023). The Logan Lab aims to understand photosynthetic pathways at the plant level, complementing research conducted by the National Institute of Standards and Technology to confirm measurement accuracy.

This summer, the Logan Lab investigated the effects of melatonin, a hormone reported to enhance photosynthesis (Antoniou et al., 2017; Chen et al., 2018; Xie et al., 2019). We applied melatonin through irrigation and spray to assess its impact on photosynthesis. Our study included key measurements such as plant water status, chlorophyll content, grass-blade height, greenness, and various measures of photosynthesis. Through these comprehensive measurements, we aimed to understand how melatonin affects photosynthesis. However, contrary to expectations from the literature, our melatonin treatments did not significantly impact the grass.

Our findings question the reported benefits of melatonin on photosynthesis, suggesting that melatonin will not be useful in future studies. The data shows that the chemical – across various drought conditions and using various application methods – did not significantly increase drought tolerance in turfgrass.

This summer's research experience was incredibly rewarding, providing valuable hands-on experience in a research laboratory and exposing me to various career opportunities. I will continue this research during the academic year through an Honors Project, aiming to delve deeper into the complexities of photosynthesis and CO_2 measurement.

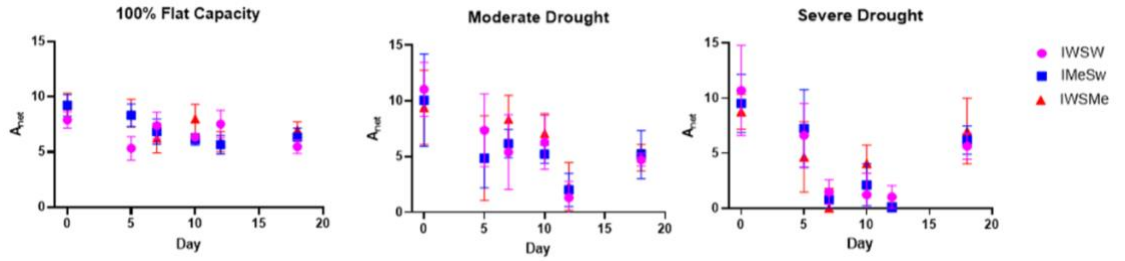

Figure: CO2 assimilation rates of Festuca *arundinacea* under varying drought conditions. Figure 1: 100% pot capacity, Figure 2: moderate drought (35-45% pot capacity), Figure 3: severe drought (20-30% pot capacity). Symbols: pink circles (water irrigated and sprayed), blue squares (melatonin irrigated and water sprayed), red triangles (water irrigated and melatonin sprayed). No significant differences were observed in melatonin treatments across all conditions.

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References: Marrs et al., 2020; Magney et al., 2019; Jones et al., 2023; Antoniou et al., 2017; Chen et al., 2018; Xie et al., 2019.