Physiological Mechanisms of Shade Avoidance Response in *Beta vulgaris*

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Introduction

- Light reflected from leaves of plants has a reduced red to far-red ratio (R:FR) (Figure 1)
- Plants respond to low R:FR by altering morphological and physiological characteristics to avoid the perceived impending competition (shade avoidance)
- Shade avoidance can therefore result in sink monopolization which affects photosynthate partitioning
- The economic yield of *B. vulgaris* is sucrose, which is a soluble carbohydrate (CHO)
- Understanding the effects of shade avoidance on CHO partitioning is therefore imperative

Objective

Evaluate effects of reflected R:FR from grass on non-structural carbohydrate (NSC) composition in roots of *B. vulgaris*

Methods

- *B. vulgaris* seeds were planted in 19 L plastic buckets in June 2014, and July & August 2015
- Grass roots were separated from *B. vulgaris* roots, clipped regularly to ensure there was no resource competition (Figure 2)
- Two treatments: grass (Kentucky bluegrass) and no grass (control)
- Randomized complete block with 15 replicates
- Adequate moisture and nutrients supplied
- Plants harvested at 90 days after planting (DAP) in 2014, and 59 and 73 DAP in 2015
- Roots chopped, freeze-dried, and ground
- NSC analysis conducted spectrophotometrically at 620 nm using anthrone reagent method (Yemm and Wills 1954)
- Statistical data analysis: Student's t-test

Results and Discussion

- No differences in root starch, soluble CHO, or total NSC were observed in two (59 and 73 DAP in 2015) out of 3 studies (Figure 3)
- There was more soluble CHO in roots compared to starch (Figure 3A, 3B, 3D)
- *B. vulgaris* store CHO almost exclusively as sucrose (a soluble CHO) in roots (Turesson et al. 2014) and as starch in leaves (Fondy and Geiger 1980)
- Soluble CHO in *B. vulgaris* roots increase as plants mature (Dunn et al. 1990)
- At 90 DAP in 2014, starch to soluble CHO ratio was higher in *B. vulgaris* exposed to the grass treatment compared to no grass control treatment
- This may be a strategy to store enough CHO for seed production in the second season

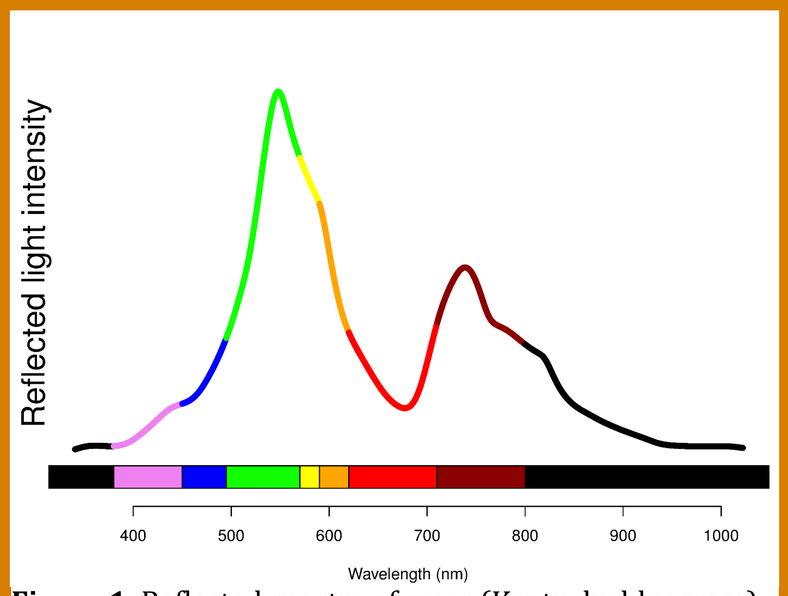

Figure 1. Reflected spectra of grass (Kentucky bluegrass) used in the study

Figure 2. Study setup ensuring no resource competition

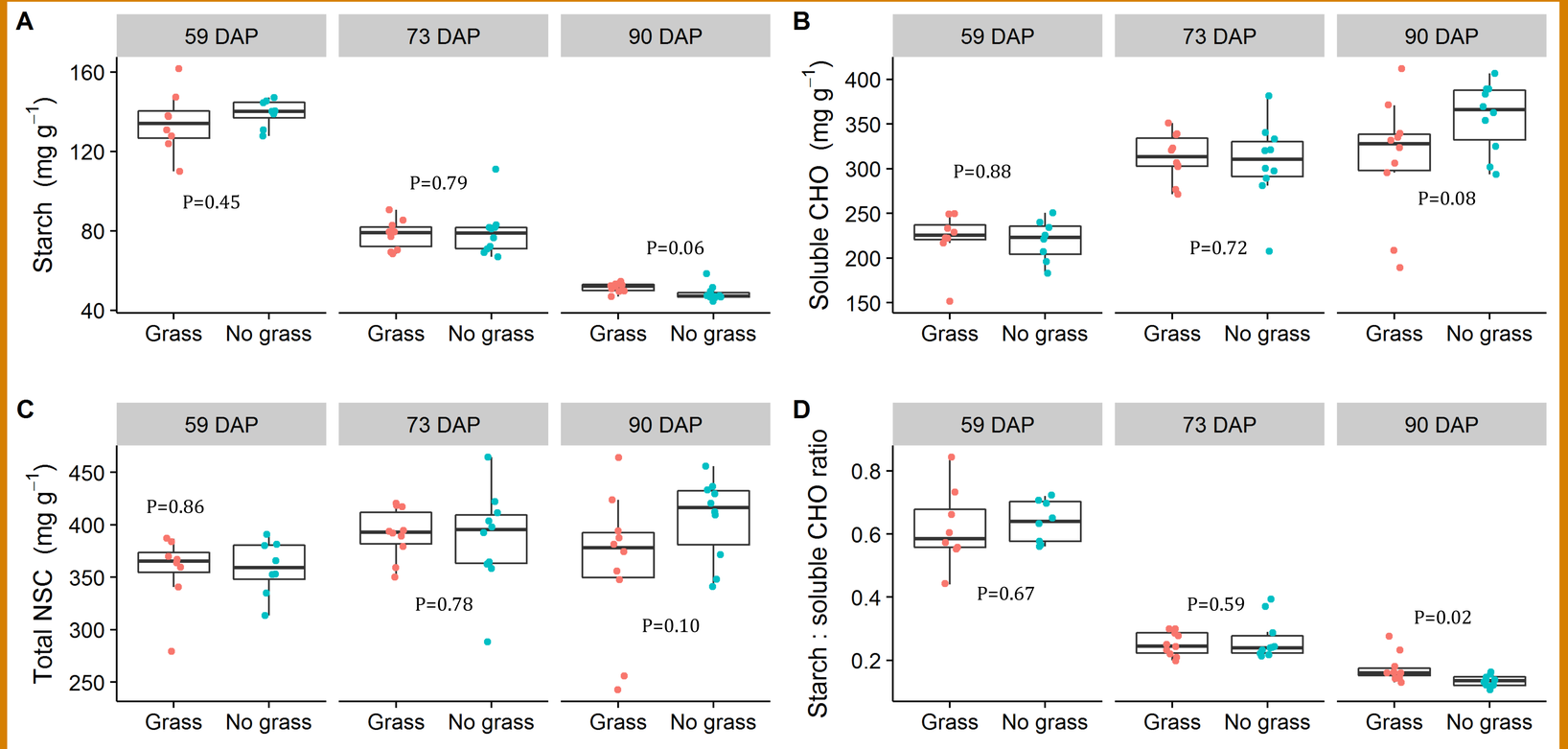

Figure 3. Effects of grass presence on starch (A), soluble carbohydrate (CHO) (B), total non structural CHO (NSC) (C), and starch to soluble CHO ratio (D)concentrations in roots of *B. vulgaris*

Future Research

- Evaluate the critical period of irreversible shade avoidance response
- Shade avoidance versus resource competition
- Assimilate partitioning into roots and leaves

References

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