Sorghum Carotenoid Variation

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Introduction

- Carotenoids are precursors to vitamin A.
- Vit A deficiency increases the risk of blindness and childbirth complications.
- Sorghum is a highly consumed crop in areas of Africa where vitamin A deficiency is prevalent.
- Biofortification of sorghum grain carotenoids could decrease incidence of vitamin A deficiency.
  (Fernandez *et al*., 2008, *Crop Sci* 48:5)

Purpose

The purpose of this research is to understand the heritability and genetic controls of sorghum grain carotenoids in order to develop a biofortification plan.

Hypothesis and Predictions

- Hypothesis 1: Carotenoids in a genetically diverse sorghum association panel grown in a temperate humid environment are highly heritable.
  - Prediction 1: There will be a significant correlation in carotenoid content between sorghum grown in 2015 and 2016 measured by high-performance liquid chromatography (HPLC).
  - Prediction 2: Genome-wide association studies (GWAS) will identify some of the same quantitative trait loci (QTL) in each year, in particular *zeaxanthin epoxidase (ZEP).*

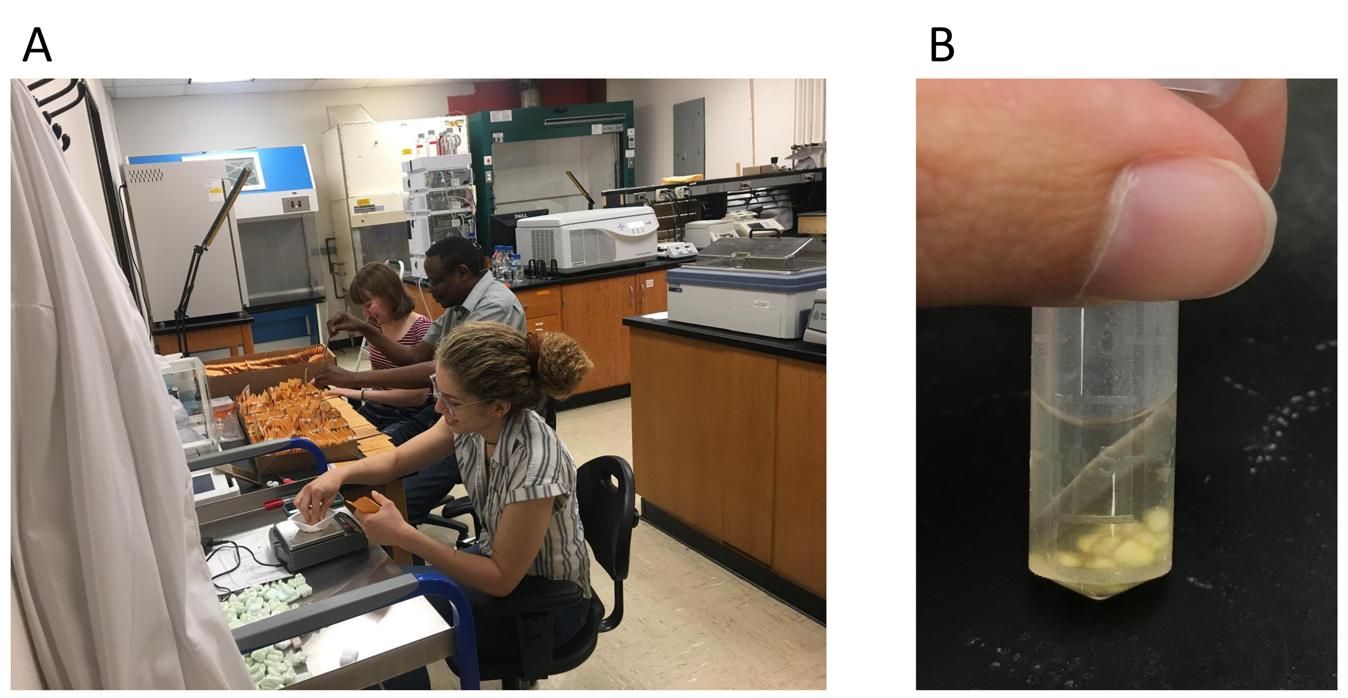

Figure 1. A) Counting samples to prepare them to be planted in the field. B) Part of the extraction process; after centrifugation and before the organic layer is removed from the sample.

Methods and Experimental Design

- The 2015 panel was previously quantified with a different method of extraction and HPLC.
- High-throughput extraction of 2016 panel (*n* = 64)
  - 5 seeds per accession were ground and extracted with methanol/chloroform (2:1)
- High-throughput phenotyping of 2016 panel (*n* = 64)
  - extracts were run through the HPLC and their lutein, zeaxanthin, and β-carotene concentrations were measured
- Analysis
  - Pearson's correlations were conducted between compounds and between years
  - GWAS were conducted to identify SNP-trait associations between lutein and zeaxanthin

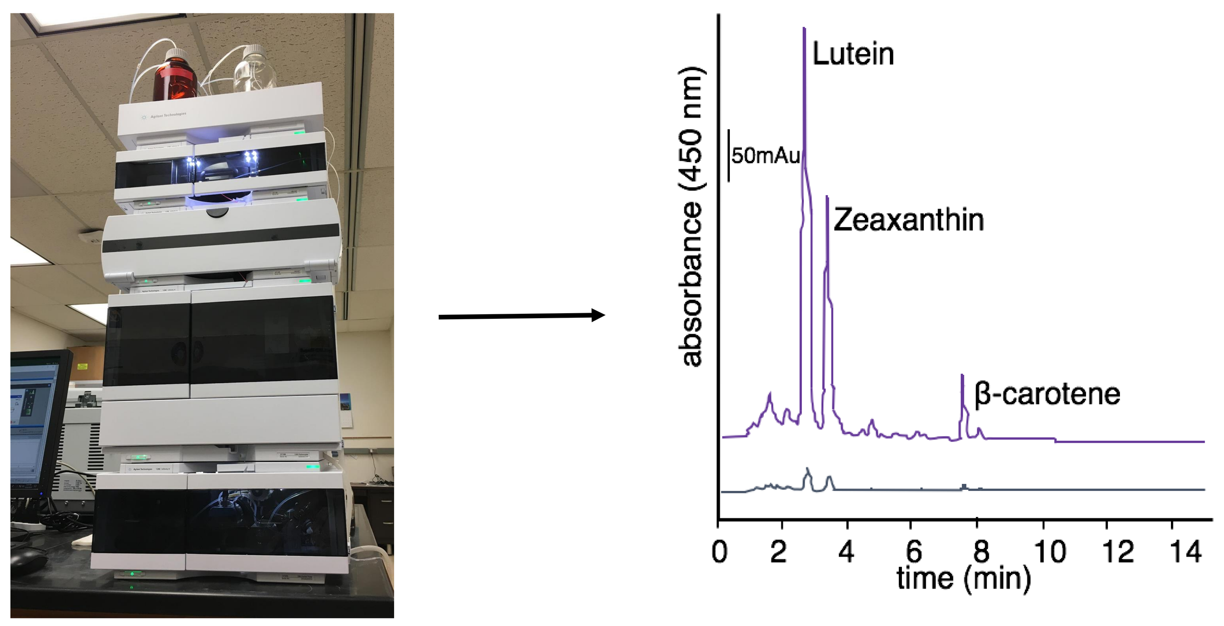

Figure 2. High-Performance Liquid Chromatography. HPLC Graph showing concentrations of carotenoids.

Results

1. There was a significant correlation between the samples from 2015 and 2016, but concentrations in 2016 measured significantly lower than the 2015 concentrations (Figure 3).

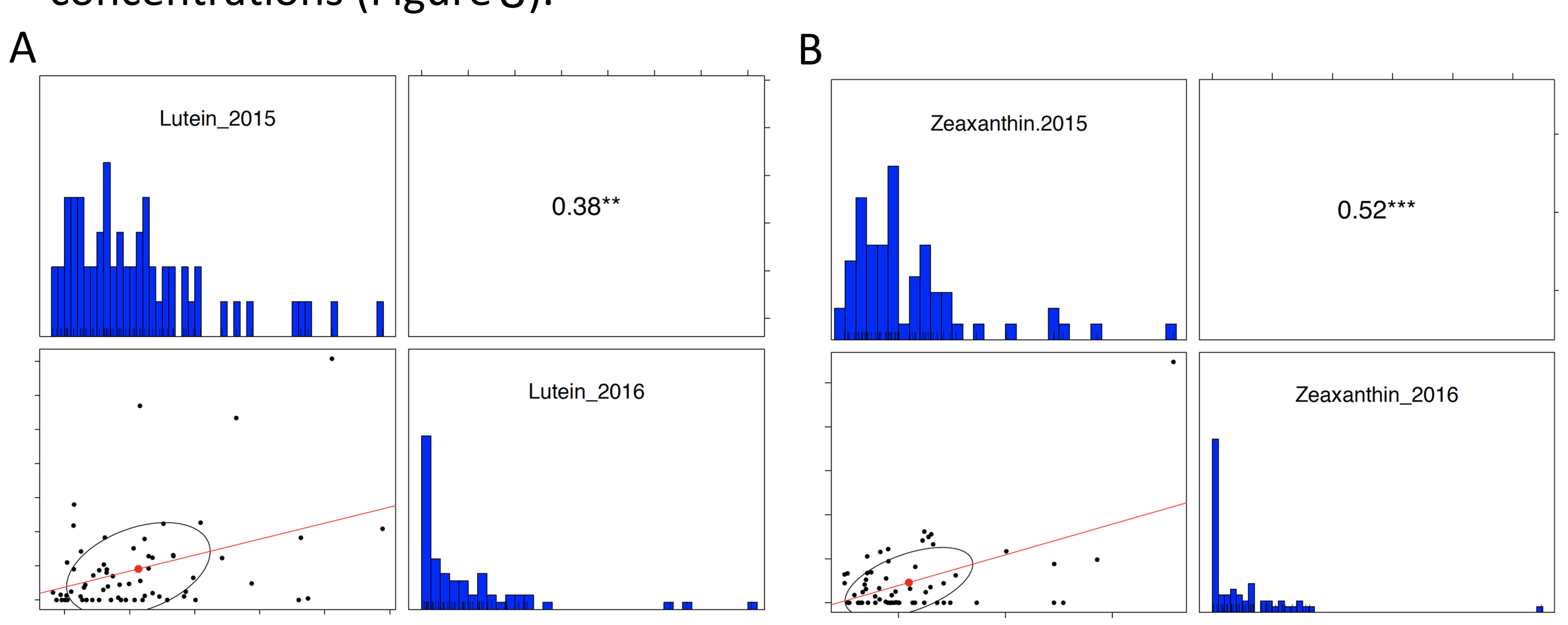

Figure 3. Relationship of grain carotenoid traits in a sorghum panel. 64 carotenoid samples for A) lutein and B) zeaxanthin were plotted and measured to show the significance of the correlation between years.

2. Significant SNPs between the 2015 and 2016 panels did not overlap. ZEP was not identified by GWAS in the 2016 panel (Figure 4).

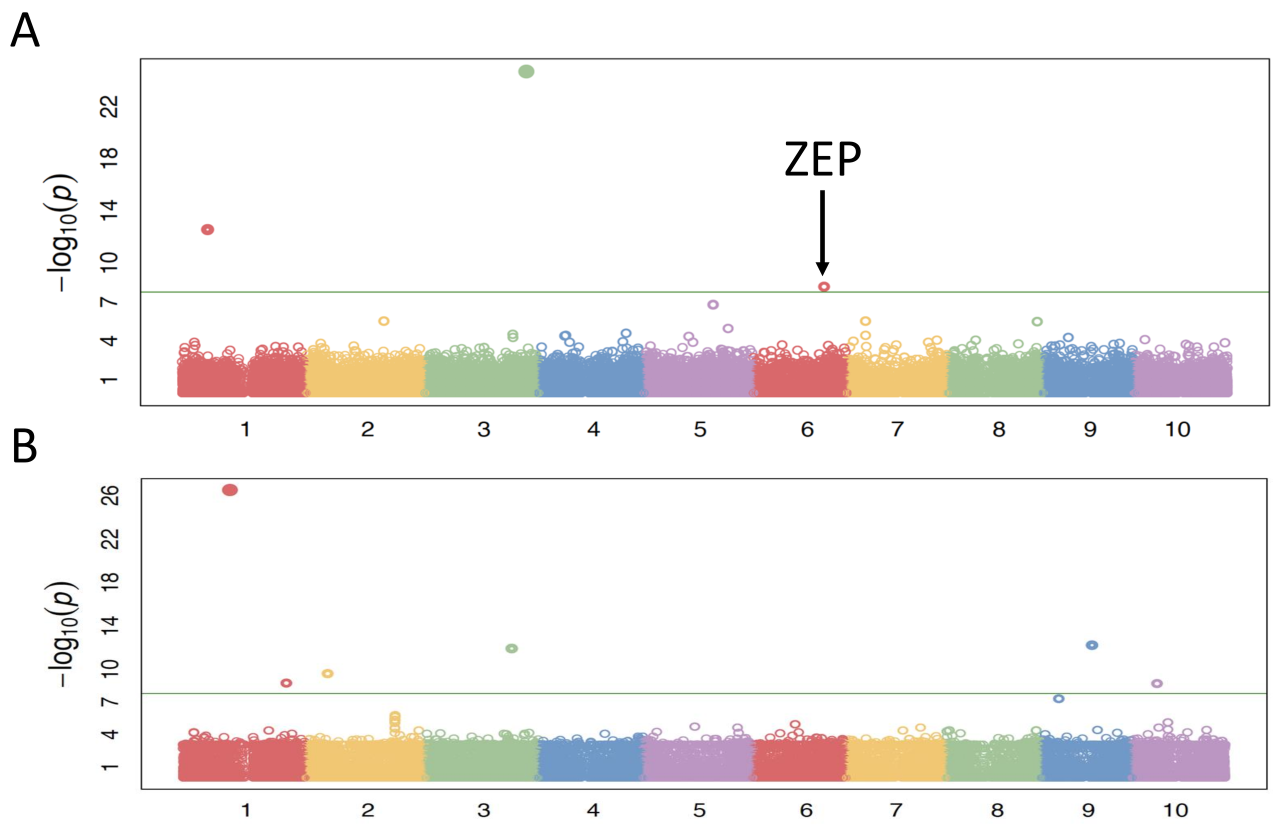

Figure 4. GWAS for carotenoid content in sorghum grain grown in 2015 and 2016. Manhattan plot of association using 64 accessions. A) 2015 panel and B) 2016 panel. Each circle represents a single nucleotide polymorphism (SNP).

Conclusions

- Carotenoid levels from 2016 read by the HPLC were not as high as expected
- The extraction method currently being used needs to be altered

Future Directions

Some aspects to be further considered about this project in the future would be trouble shooting the extraction process to further improve the accuracy and to decrease the amount of degradation that occurs during the process.

Acknowledgements

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