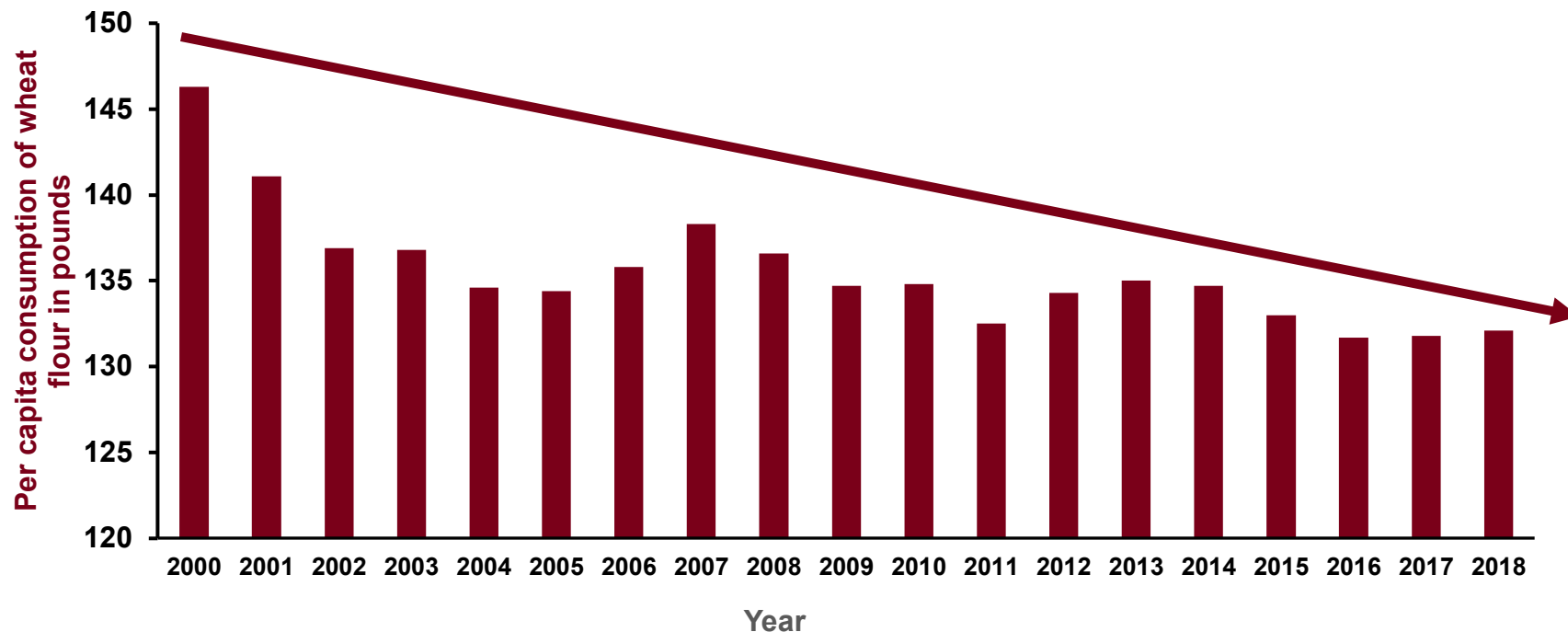


Tackling Wheat Digestibility: FODMAP Levels in Wheat Lines

George Annor, James Anderson, and Prabin Bajgain



Per Capita Wheat Consumption in the U.S.



Source: US Department of Agriculture; Economic Research Service: Conducted by the Economic Research Service; US Department of Agriculture Survey period: 2000 to 2018



Why the Decline?

Fad diets



- Promotion of Fad diets, resulting in an increasing percentage of the population to remove starches from their diet
- Avoidance of Gluten and/or Wheat

<https://www.uab.edu/news/youcanuse/item/9287-fad-diets-or-lifestyle-changes-where-do-three-popular-weight-reduction-plans-fit-in>



Why the Decline?

Avoidance of Gluten and/or Wheat

- Gluten is a protein found in the grain of wheat, rye, and barley

- **Celiac disease**

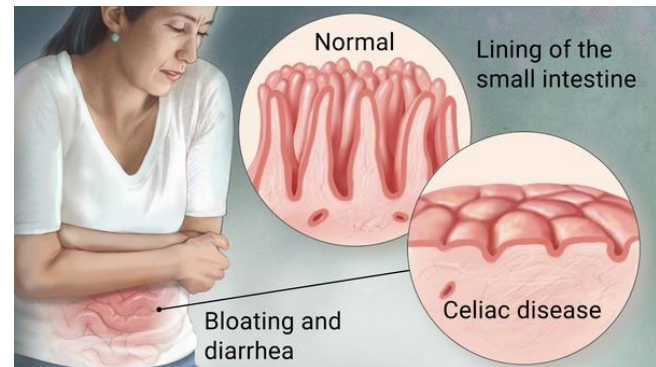
- Celiac disease is an immune disease in which people can't eat gluten because it will damage their small intestine
- ~1% of Americans have celiac.

- **Wheat Allergy**

- **Non allergy-non-celiac wheat sensitivity (NCWS)**



<https://www.drperlmutter.com/yes-gluten-sensitivity-is-very-real/>



https://support.google.com/websearch/answer/2364942?p=medical_conditions&hl=en



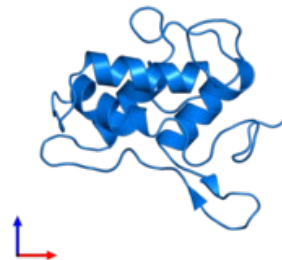
Why the Decline?

So, if it's not gluten per se, what are other possible causes of Non allergy-non-celiac wheat sensitivity (NCWS)?

- **FODMAPS** -Fermentable Oligo-, Di- and Monosaccharides and Polyols
 - Fructose, lactose, fructo- and galactooligosaccharides (fructans, and galactans)
 - Polyols (such as sorbitol, mannitol, xylitol and maltitol)
- **ATI** - Amylase Trypsin inhibitors

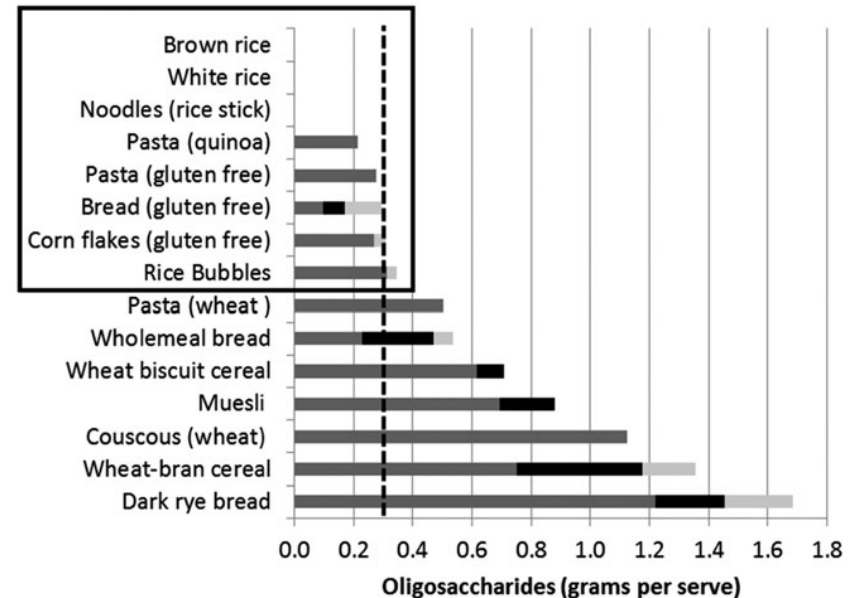
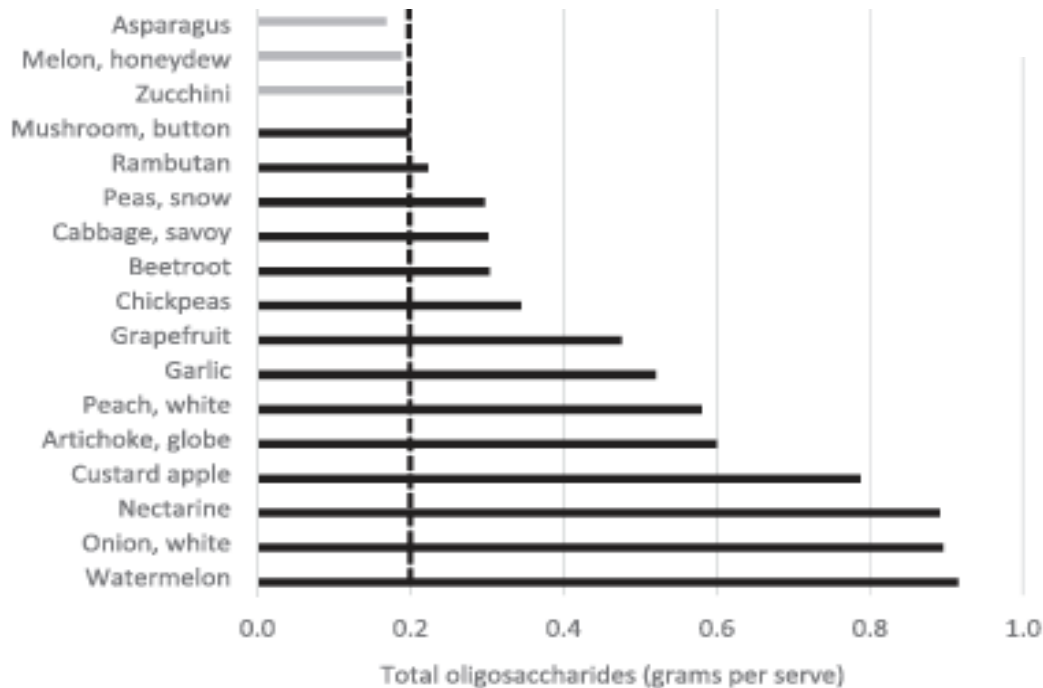


<https://enjoylifefoods.com/blogs/content/about-fodmap-friendly-living-enjoy-life-products>

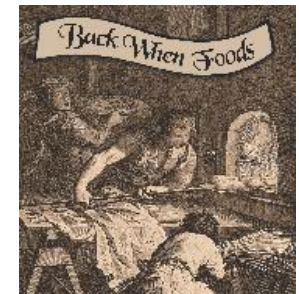


FODMAP Levels in some common foods

- Best tolerated if < 0.3 g/serving



Project Partners agreed to tackle issue





- Reduce the discomforts resulting from the consumption of wheat-based products
- Improve the health of consumers
- Increase the profitability of wheat farmers

Specific Objectives

- Characterize variation and identify genetic markers for FODMAPs and ATI activity in ancient, heritage and modern wheat varieties from different growing environments in Minnesota
- Explore the use of fermentation as a technique to reduce FODMAPs and ATI activity in wheat food products
- Establish a pathway to implement research outcomes to industry.



Materials & Methods

- A panel of 220 ancient, heritage and modern wheat varieties were grown at U of MN field sites at Crookston and St. Paul, MN in 2019
- The panel represented heritage and hard red spring wheat diversity going back to the origins of the U of MN wheat breeding program (~1895) and regional breeding programs
- Genetic markers were determined by extracting DNA from the panel of 200 wheat varieties and genotyped using Genotyping-By-Sequencing.
- FODMAPs and ATI activity determined
- Association mapping was used to identify DNA markers associated with FODMAPs and ATI activity



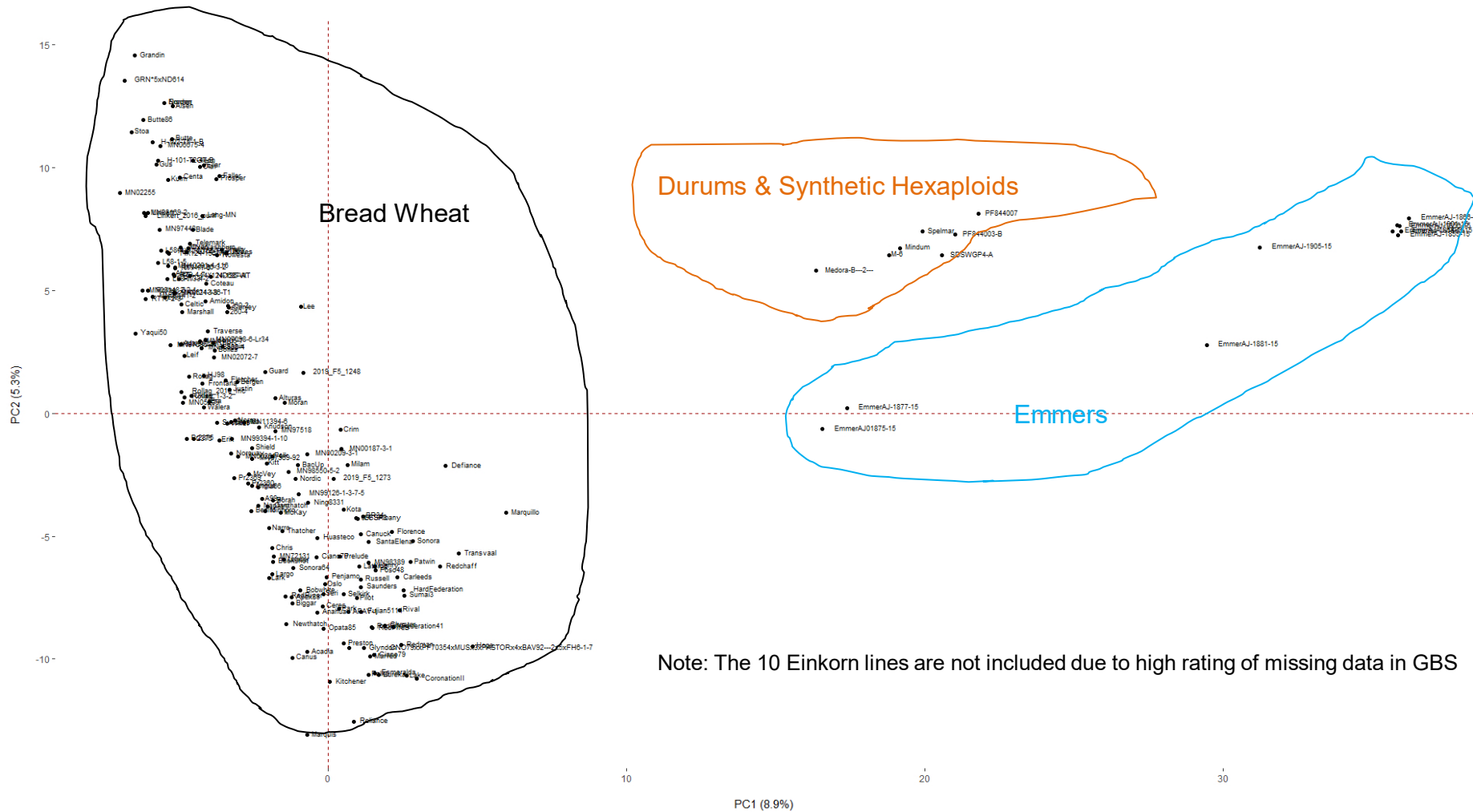
Wheat Materials for FODMAP Evaluation

Material	No. lines
Heritage wheats:	46
Modern wheats:	142
Durum:	5
Einkorn:	10
Emmer:	11
Synthetic hexaploids:	16
Total:	230

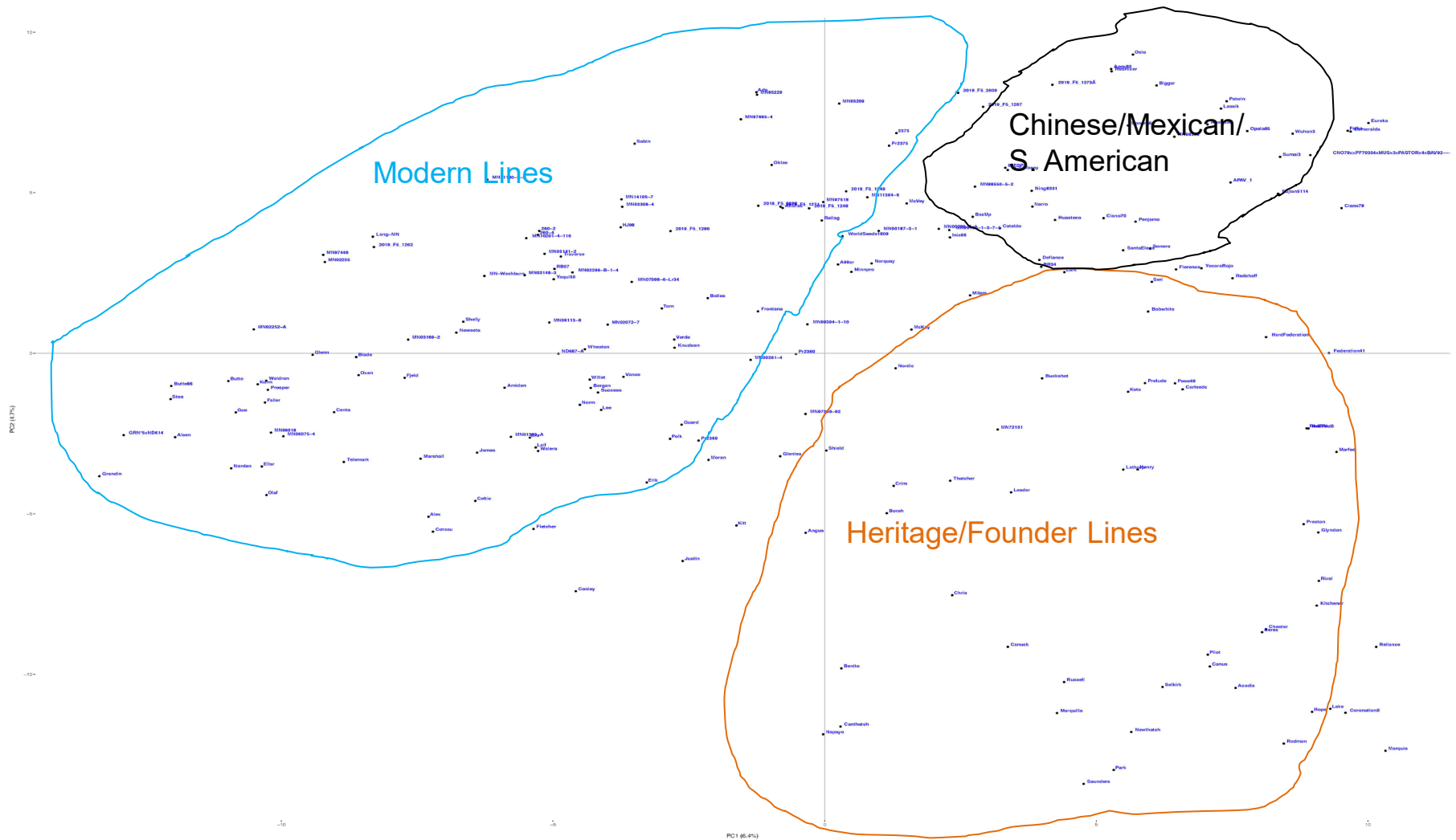
Lots of variation observed for heading date, height, yield



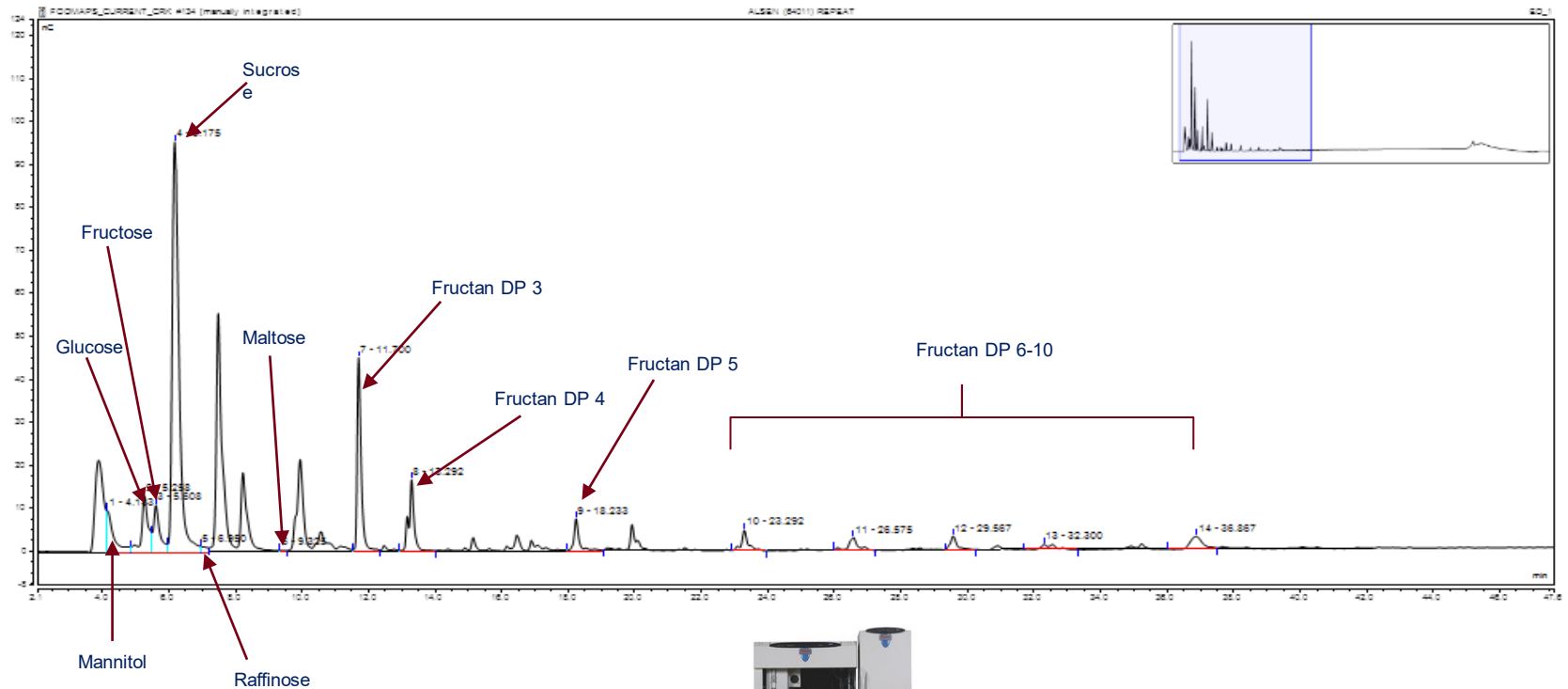
Genetic Diversity of 220 FODMAP panel lines



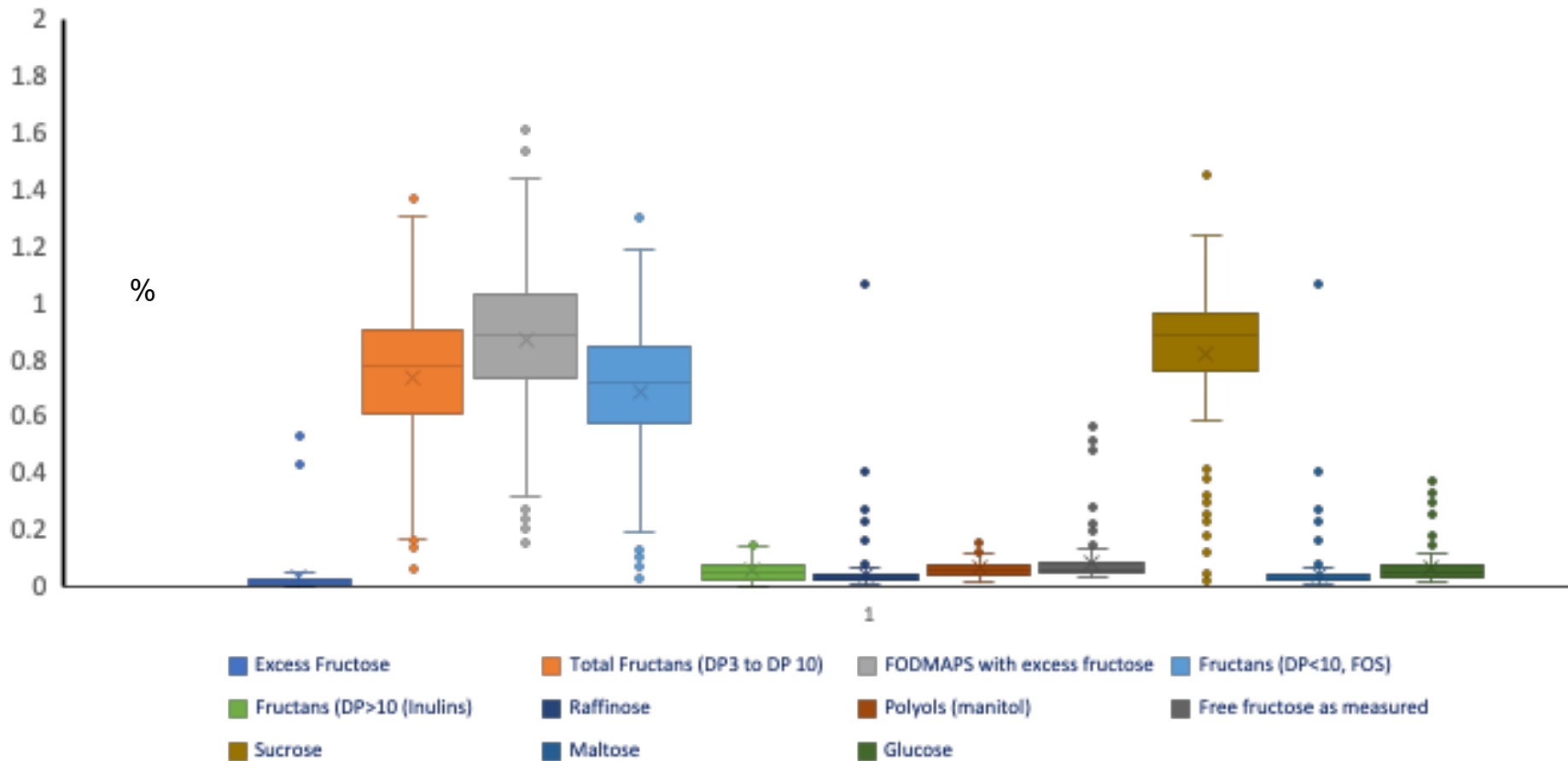
- Excludes durums, emmers, and synthetic hexaploids



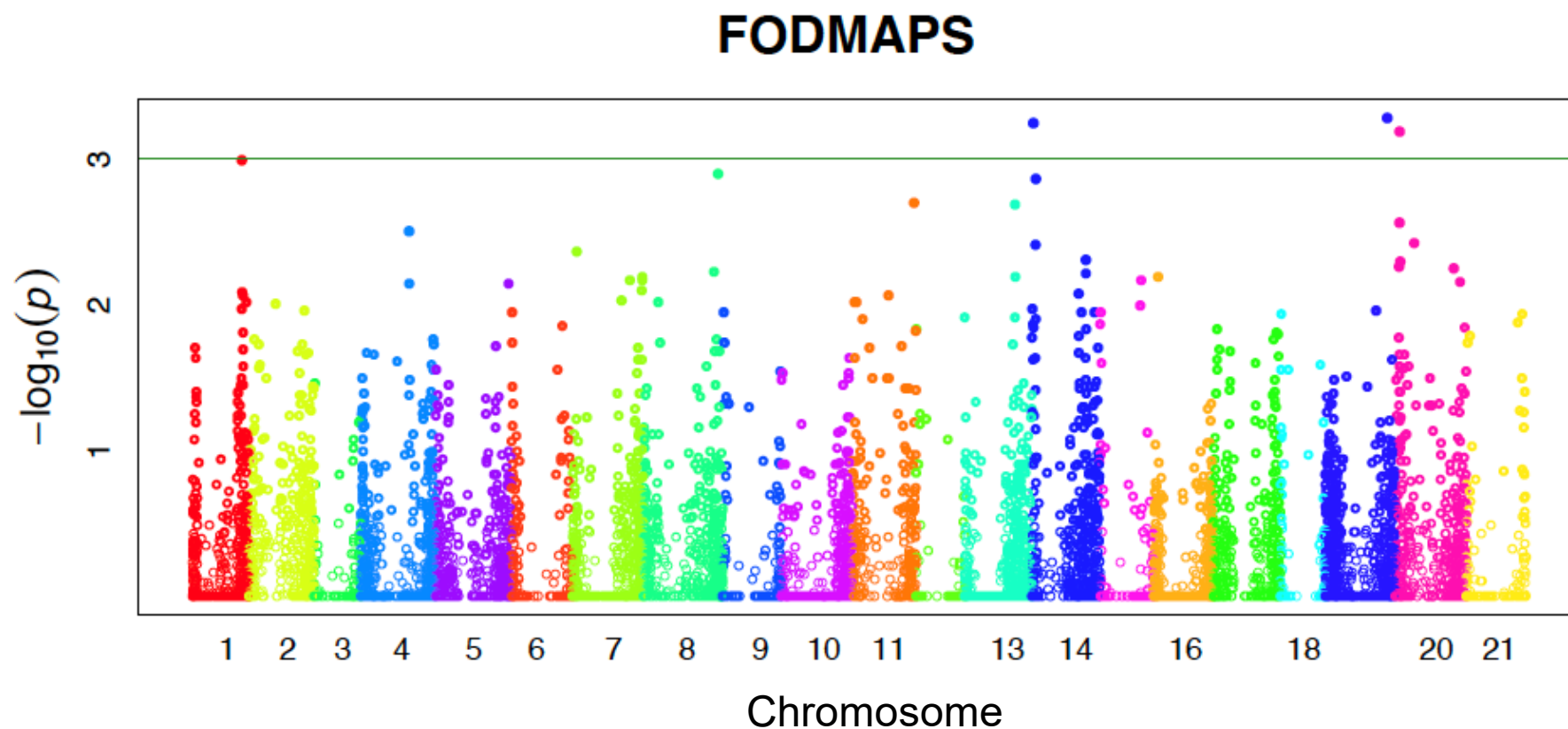
FODMAP Evaluation



FODMAP Results (196 samples from Crookston MN)



Association of Genetic markers along the 21 wheat chromosomes with FODMAP content



Preliminary findings summary

- Genetically diverse set of wheat lines being analyzed
- Wide differences in FODMAPs and Fructans with DP<10
- No identifiable patterns regarding FODMAP and Total Fructan concentrations vs. year of release or wheat species
- No genomic region is responsible for a large portion of the genetic variation for these traits



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