



Update on breeding and quantitative genetics at USDA

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Breeding projects

Trial results - Early maturing sunflowers

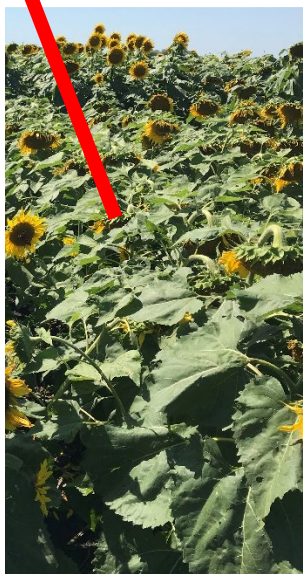
- Lines in process for release
- HA 493 – short stature, early, high yield!
- HA 494 – alternative to CM 595, better yield and oil content than 595
- HA 495 – IMI/HO version of CM 595
- RHA 496 – IMI/HO version of RHA 476
- RHA 503 and RHA 504 – IMI/HO/Plarg DM – high yield and oil potential

Honeycomb NS	CM595A/RHA_477	Myc_8 N270CLDM	Pioneer_63A21	Honeycomb NS	CM595A/RHA_477	Myc_8 N270CLDM	Pioneer_63A21
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Moorhead Yield

Hutchinson, KS Yield

CM595A/19_1847	2,393 *	*	*	*	2,468		
CMS493/19_1847	2,553 *	*	*	*	2,771 *	*	
Myc_8N270CLDM	1,841				2,582 *	*	
Pioneer_63A21	1,711				2,022		
Honeycomb NS	1,779				1,738		
CM595A/RHA_477	1,636				1,890		



Hybrid is 4 feet tall!
 Better head shape than similar hybrids on the market

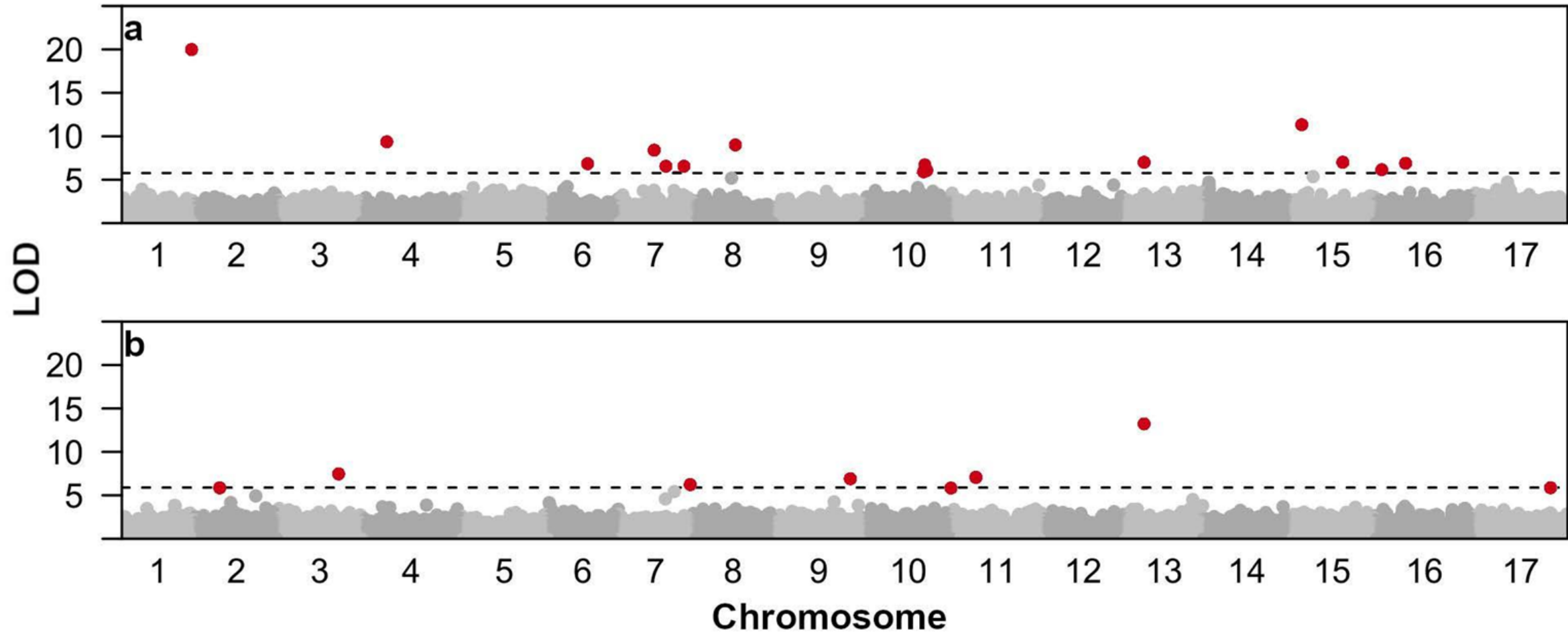


Look for releases in the mid- to late-maturity range!

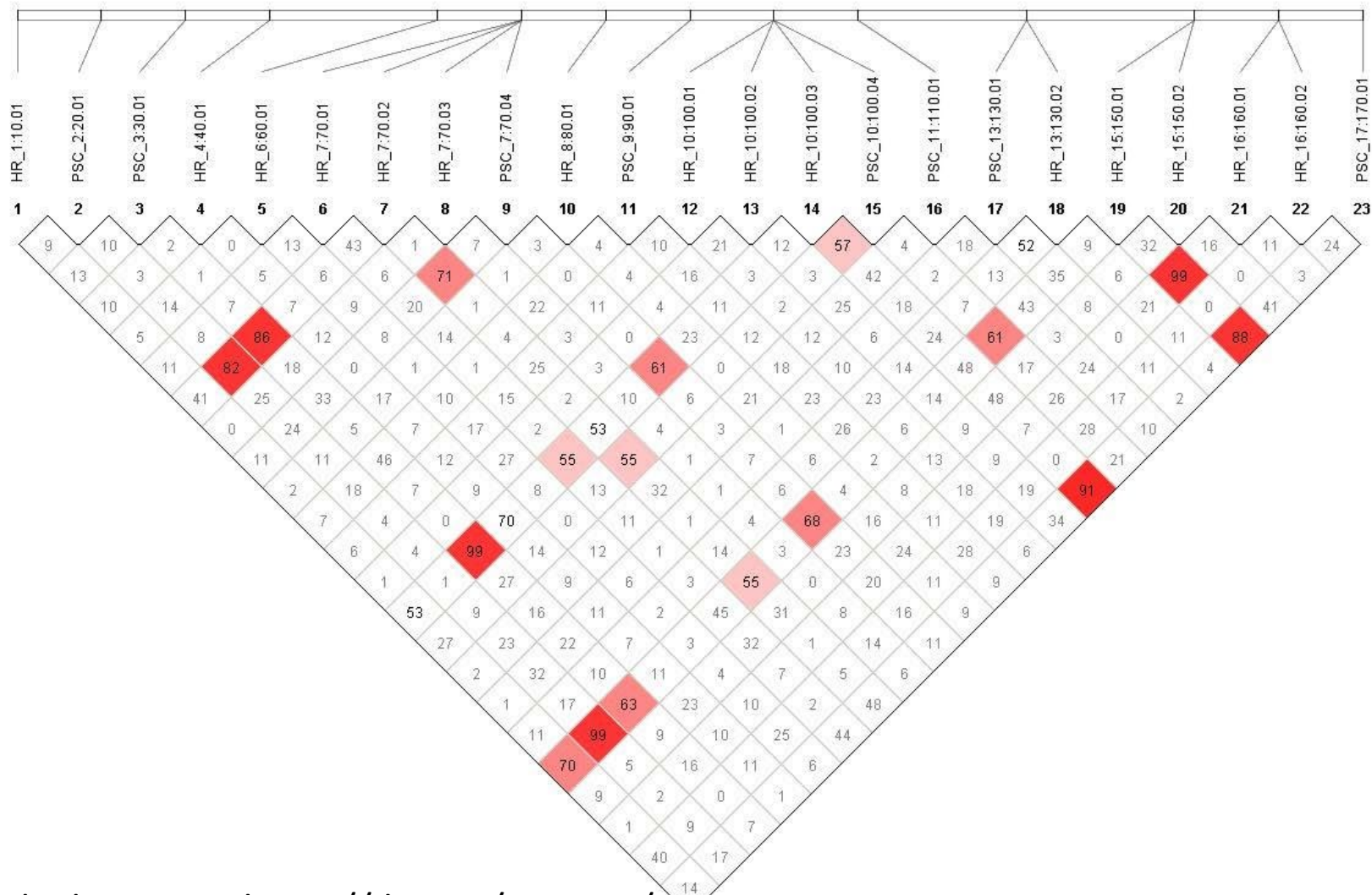
- RHA 491 and RHA 492
 - Trialed at Clark Coleman's farm in Bismarck, terrible drought
 - Hybrids with these lines looked very good and yielded very well – contain PI15
- RHA 499 -- Clearfield, PIArg for DM, high yielding, disease resistant
- RHA 500 – Clearfield, excellent disease resistance, esp. Phomopsis
- RHA 501 -- HO, high yield, excellent disease resistance
- RHA 502 – HO, high oil, high yield, excellent disease resistance

Resistance to Sclerotinia Basal Stalk Rot and Sunflower Rhizospheres

Sclerotinia Head Rot and Phomopsis resistance are governed by several key genes



... and some of the loci are selected together by breeders or function in resistance to both!



Sclerotinia and Phomopsis disease resistance

Phenotypic correlations

	HR	PSC
SR	-0.16*	NS
HR		0.52***

Genetic correlations (Broad Sense)

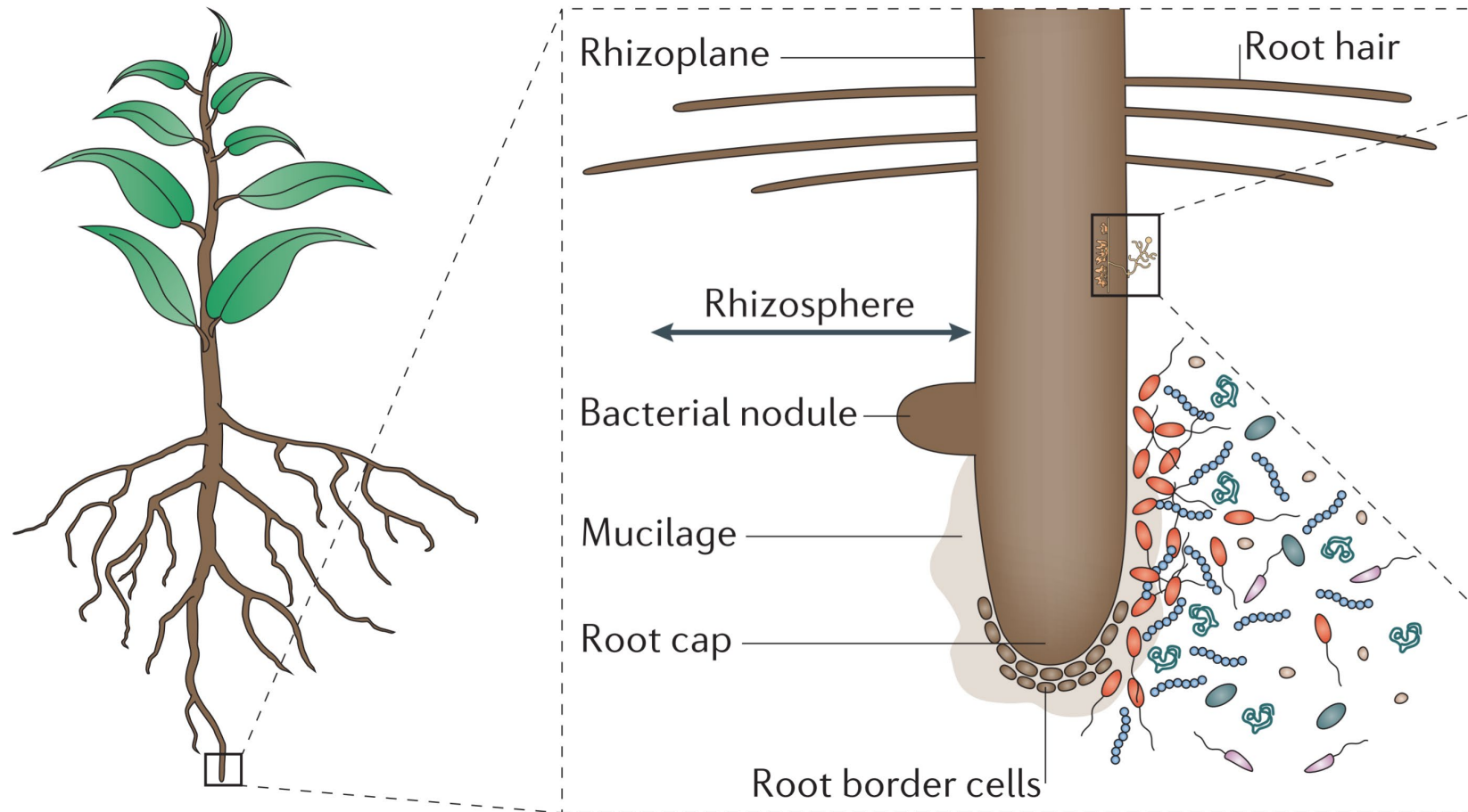
	HR	PSC
SR	-0.16*	NS
HR		0.45***

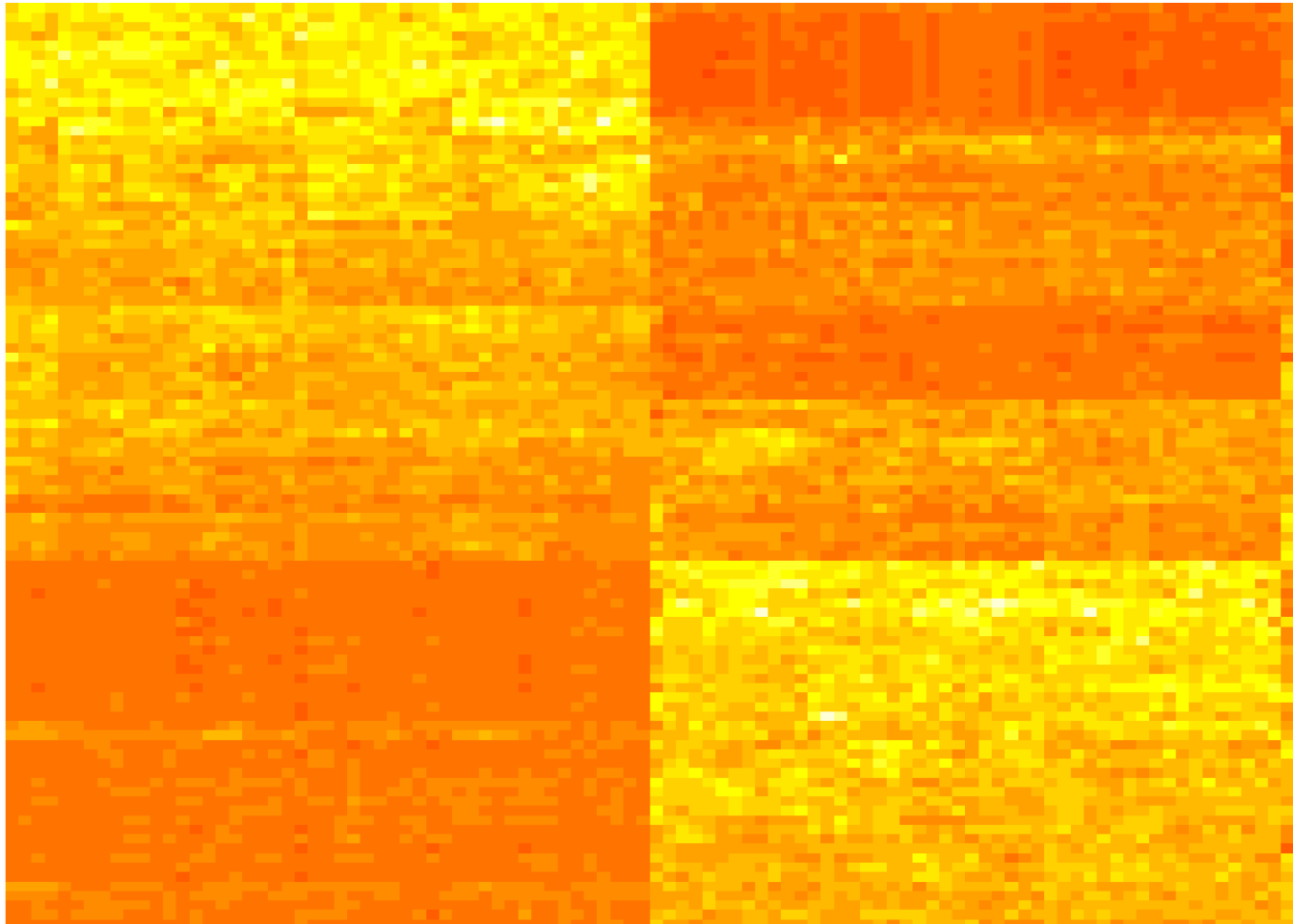
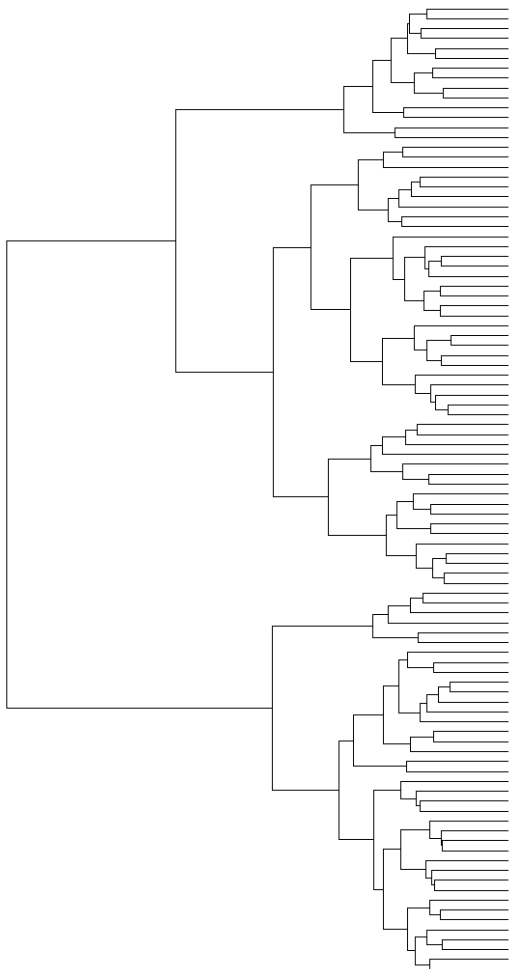
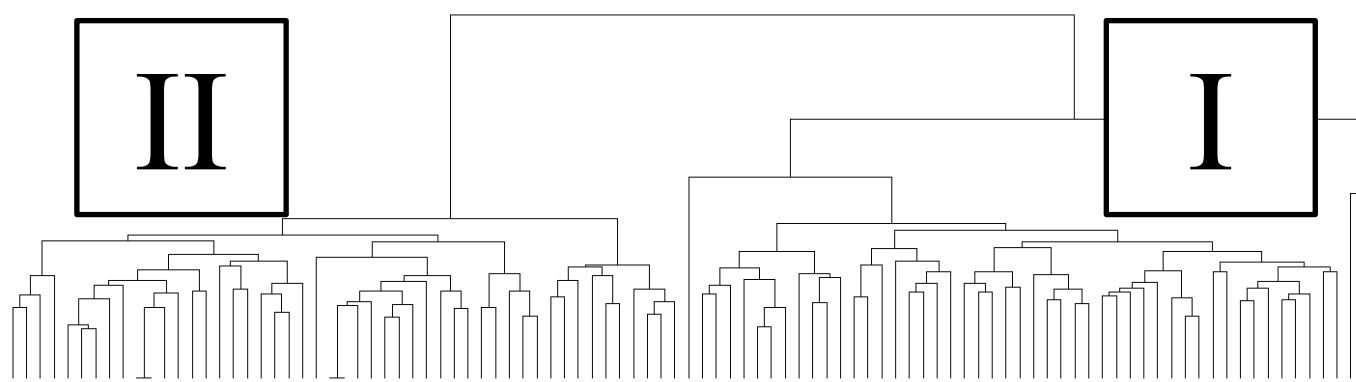
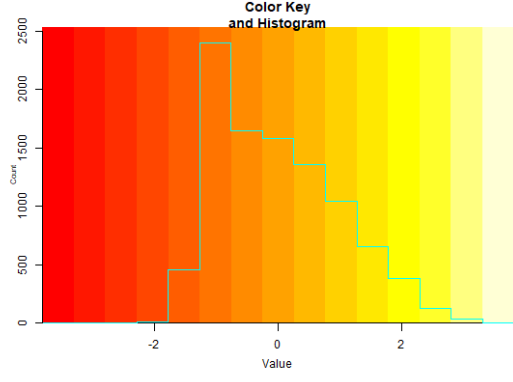
SR: Sclerotinia Basal Stalk Rot

HR: Sclerotinia Head Rot

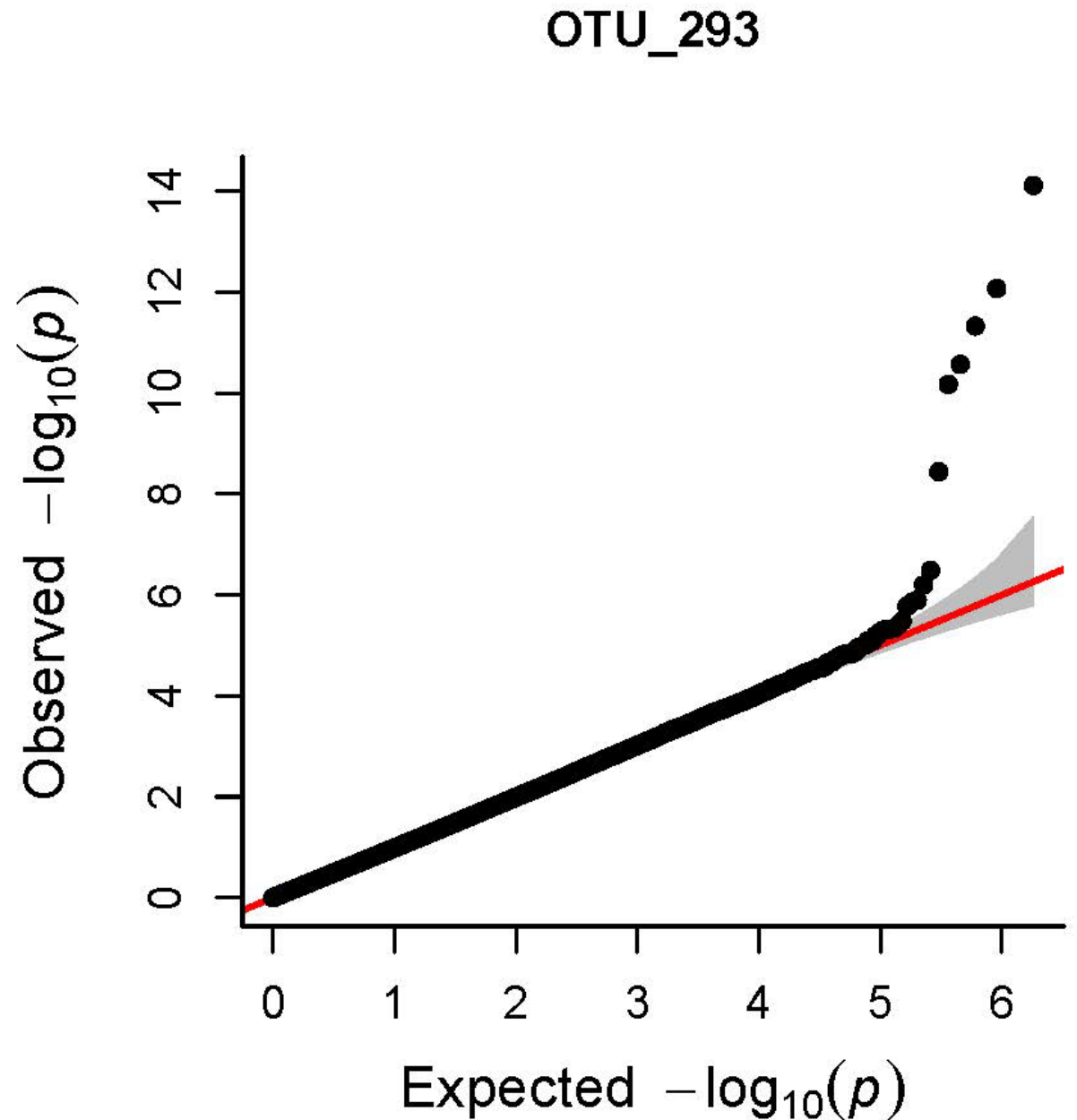
PSC: Phomopsis Stalk Canker

Getting to the 'root' of basal stalk rot





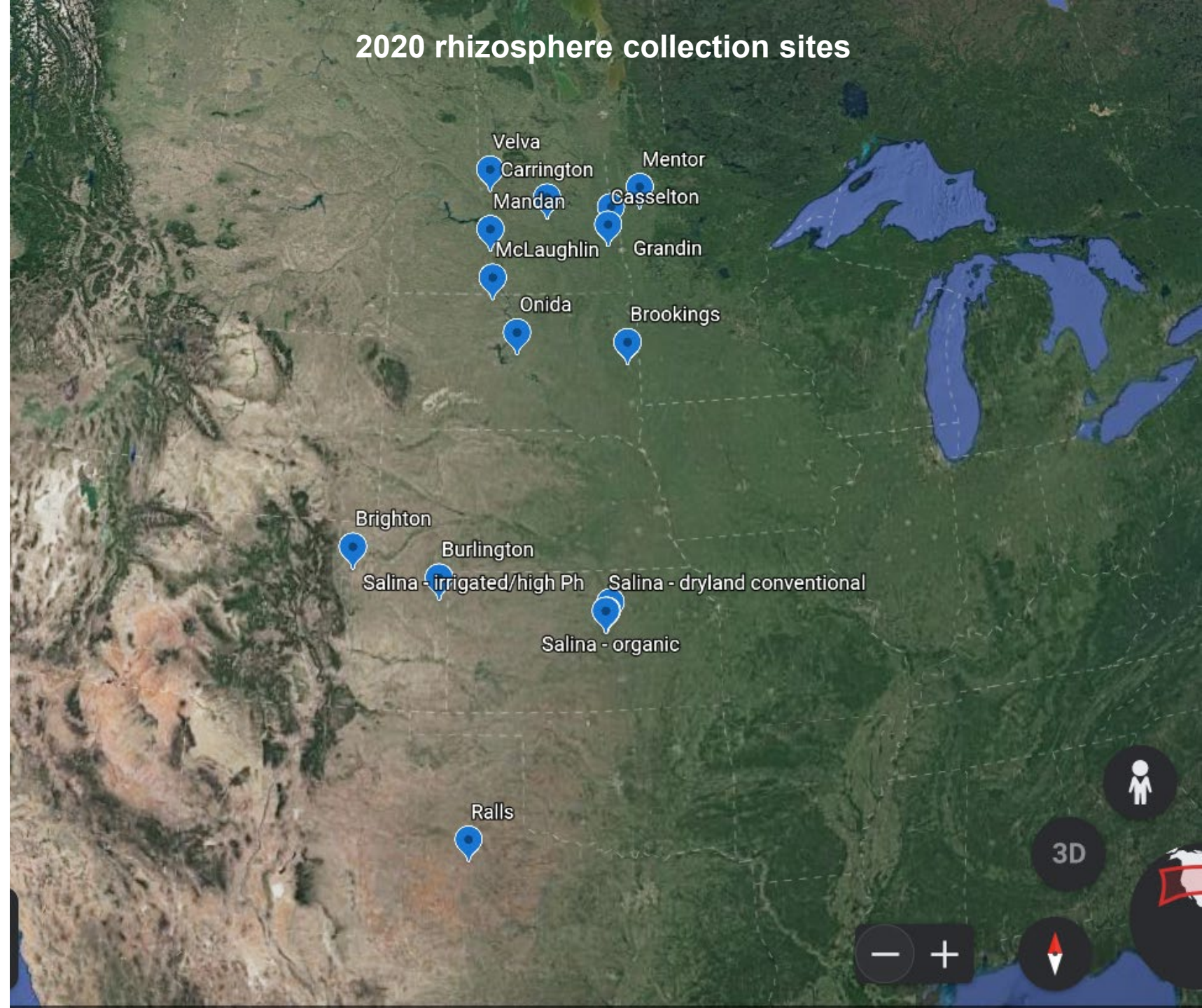
- Around 1000 root-associated microbes
- Moderate to high heritability
- GWAS mapping analysis shows that specific sunflower genes are associated with microbial composition



Next steps...

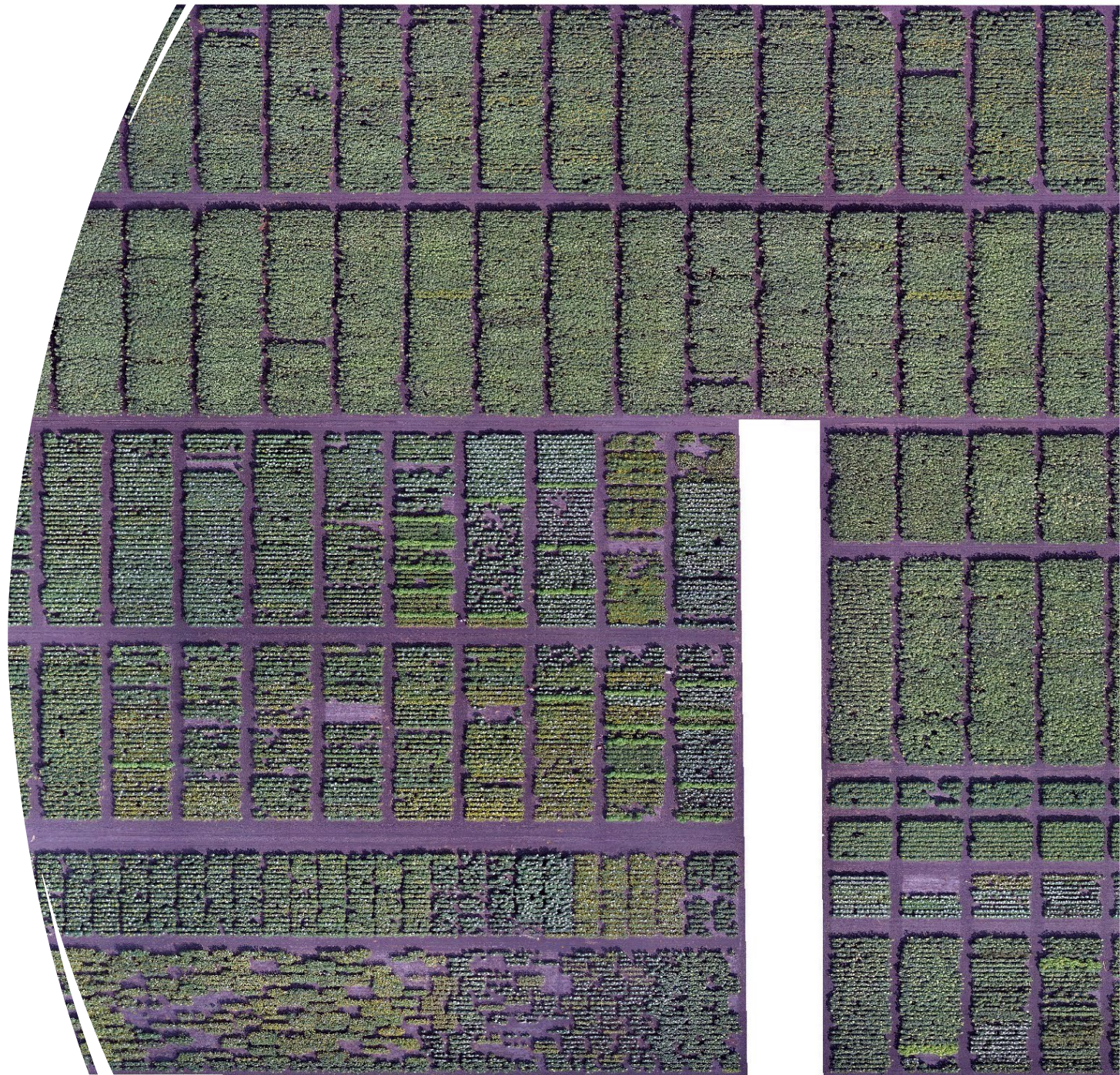
GxE analysis of rhizospheres

- Sites contrasting in soil
- Sites contrasting in management
- Sites contrasting in geography
- **Will better understand the variability in rhizosphere communities on a common set of genetics**
- Meta-genomics is complete!
- Currently analyzing data



Breeding implications

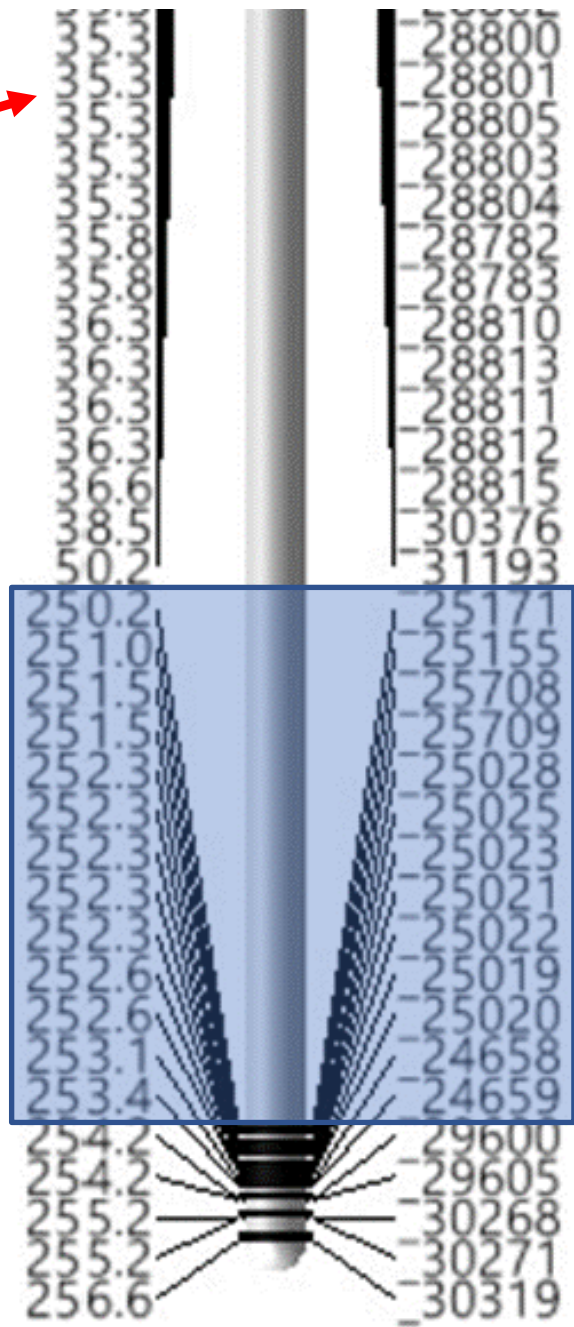
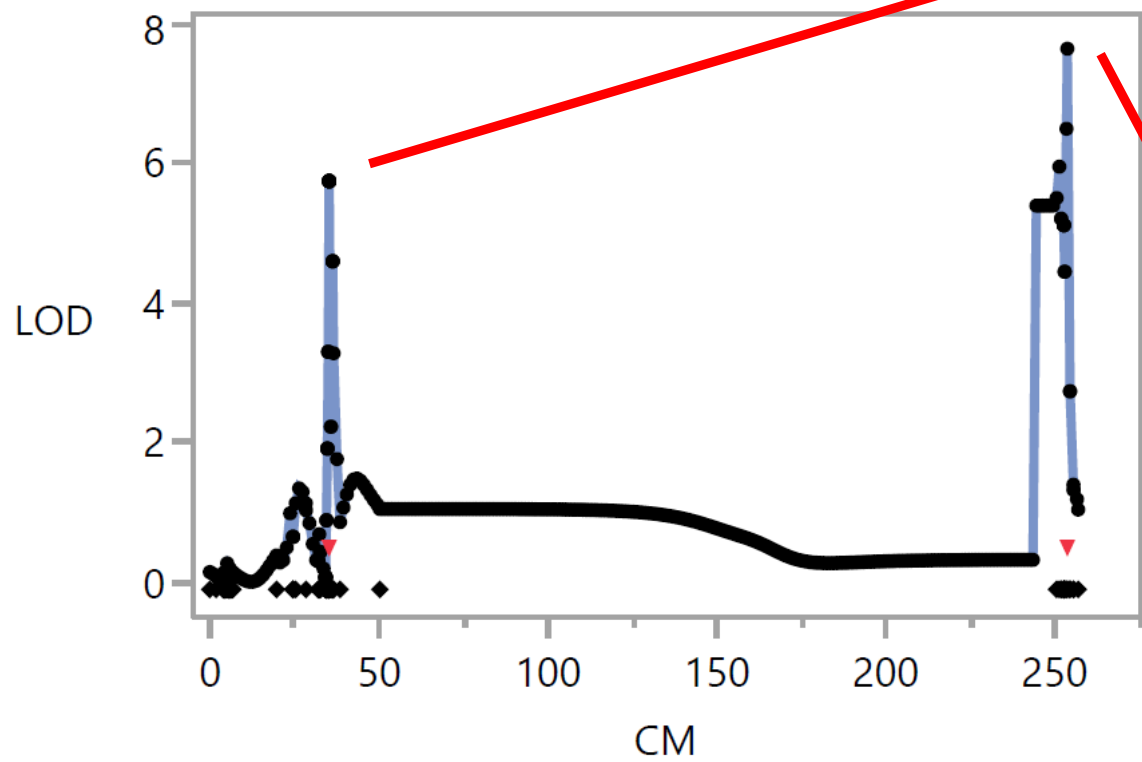
- Development of markers for microbial partners associated with Sclerotinia resistance could provide a path to improving root health, reducing basal stalk rot
- A unique mechanism for resistance that is distinct from defense related genes (Phomopsis and Scl HR)



Genetics of Nectar Volume in Sunflower

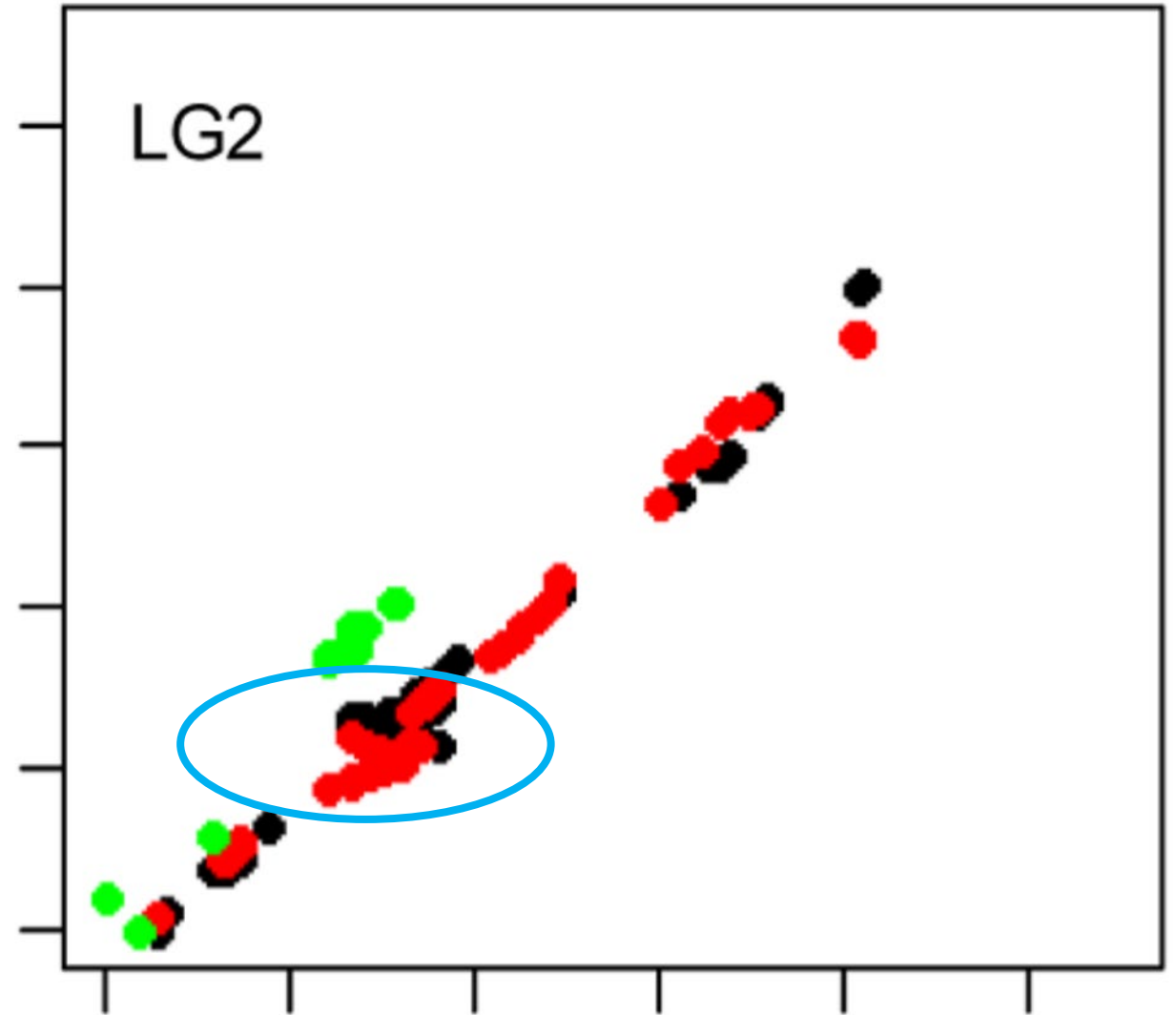
Nectar rewards and bee visitation

- Previous results from Jarrad Prasifka – USDA entomologist
 - Access to nectar is important to bee visitation of sunflowers, particularly smaller bodied bees
 - Many native bees are small bodied and are important for enhancing pollination in producer fields
 - Even with self pollination in hybrids, bee pollination significantly enhances yield under stressful conditions
 - Understanding the genetics of nectar and **using it in breeding is simple insurance breeders can use to augment yield under stress.**
 - The high nectar **trait is already in some recently released inbred lines**



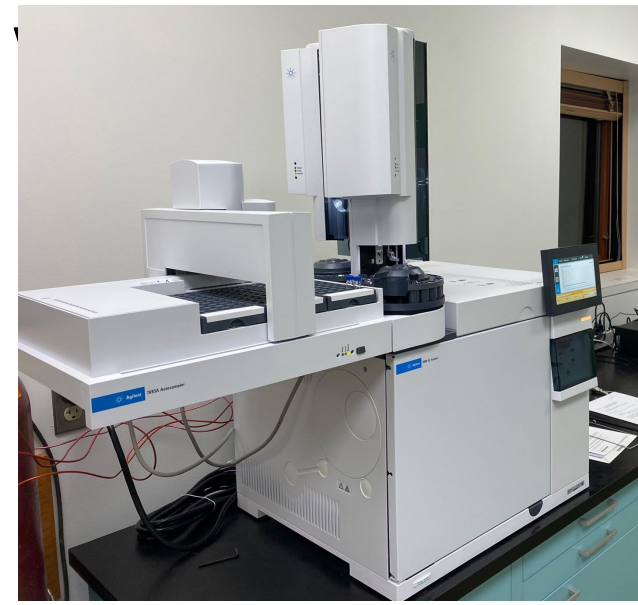
Two major loci on Chromosome 2

- Interaction exists between the markers
- **May be functionally a single locus because of chromosomal inversion**
- **Simple inheritance makes enhanced nectar reward for pollinators a relatively easy breeding goal!**
- Quality of nectar (amount of sucrose) is single gene HaCWINV2 on Chromosome 1.



Fatty acid, other seed composition traits

- Funded through NSA
- Completing gas chromatography for fatty acid work
 - Gas chromatograph died, recently replaced and new machine tuned for sunflower oil, should finish analysis this spring
- Protein and carbohydrate analyses are underway
 - Delayed due to work capacity limits at USDA – collaborations
 - Plan to find associations with markers/genes through GWAS



PUBLICATIONS

See below for the variety of research topics our lab has completed work on. Feel free to contact Brent Hulke if you would like a reprint of any publications.

Journal Publications

Registration of oilseed sunflower maintainer germplasm HA 489 with resistance to the banded sunflower moth

May 15, 2020

Registration of oilseed sunflower maintainer germplasm HA 488, with resistance to the red sunflower seed weevil

May 7, 2020


Gene banks for wild and cultivated sunflower genetic resources

March 6, 2020

- BIOLOGICAL RESEARCH
- TECHNICIAN
- INTERNSHIP

winter camelina

SPECIES WE WORK WITH





Thanks!

Hulke and Kane Lab Staff

- Brady Koehler, Technician
- Hailee Meiners, Technician
- Zach Tarble, Technician
- Brian Smart, NDSU bioinformatician
- Neil Olson, Grad. Student (NDSU)
- André Gossweiler, Grad. Student (NDSU)
- Numerous undergrad interns!
- Collaborators in many states!

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