



Update on breeding and quantitative genetics at USDA

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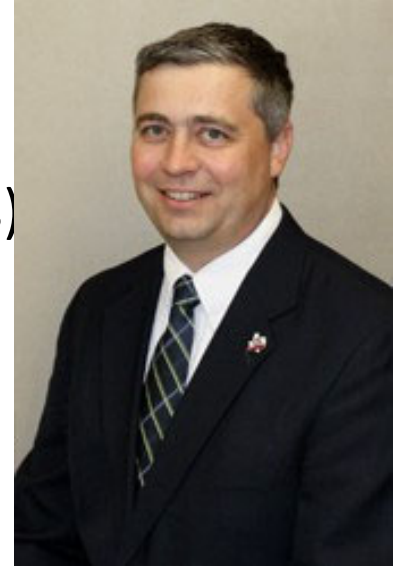
Dr. Nolan Kane, CU-Boulder

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Changes in USDA Leadership

Leadership change for Sunflower Unit

- My work responsibilities have changed, temporarily
 - November 2020 to April(?) 2021 – Acting Research Leader
 - A “permanent” hire resulted from a search last fall
 - Dr. Steve Hague, cotton breeder at Texas A&M, was selected
 - Onboarding takes a while for this high level position
- These days, Acting Research Leader work takes about 50% of my time (COVID and other objectives)



Leadership change for Sunflower Unit

- My objectives for leadership
 - Prepare the way for the new Research Leader
 - Repair stakeholder relations – thanks to many sunflower industry folks for participating in search!
 - Developing room for new research
 - He will also do breeding and genetics, so splitting breeding program into two programs in some way
 - Working with National Sunflower Association board for guidance on expanding scope
 - Solve some administrative “deferred maintenance” issues
 - Catch up on hiring – recruiting or revising 8 positions, including unit Program Support Analyst

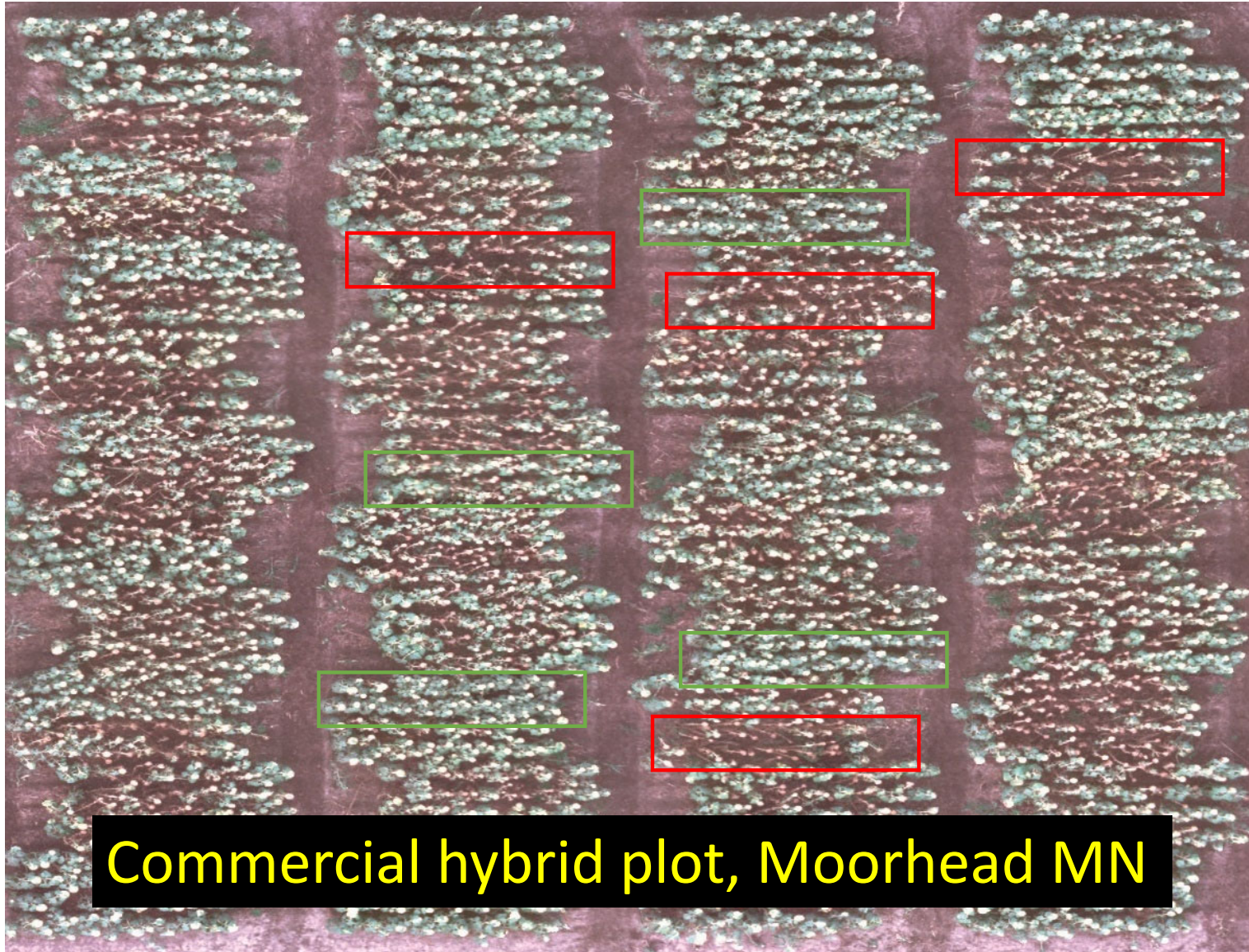
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Resistance to Phomopsis and
Sclerotinia Head Rot

Phomopsis harms yield and oil content

| | Oil % | Lodging | Phomopsis |
|---------|-------|---------|-----------|
| Yield | 0.37 | -0.41 | -0.39 |
| Oil | | 0.05 | -0.29 |
| Lodging | | | 0.17 |

Lodging and pre-mature ripening damage depend on severity of disease and earliness of onset



Commercial hybrid plot, Moorhead MN

| 8 | 7 | 6 | 5 |
|------|------|------|------|
| 6.03 | 3.85 | 4.59 | 5.18 |
| 3.23 | 5.63 | 5.06 | 4.44 |
| 5.68 | 5.18 | 5.43 | 5.49 |
| 5.35 | 4.49 | 5.36 | 4.96 |
| 4.94 | 4.3 | 4.47 | 4.12 |
| 4.67 | 4.2 | 4.77 | 3.67 |
| 5.45 | 4.03 | 5.17 | 5.64 |
| 4.02 | 3.7 | 4.97 | 3.45 |
| 4.18 | 4.58 | 3.15 | 3.97 |
| 6.13 | 4.28 | 4.22 | 5.17 |
| 4.79 | 5.32 | 5.13 | 5.41 |
| 4.74 | 5.01 | 6.27 | 5.87 |
| 5.29 | 4.45 | 4.81 | 5 |
| 5.2 | 5.45 | 3.54 | 4.13 |
| 5.53 | 4.03 | 5.18 | 6.1 |
| 4.6 | 4.47 | 6.43 | 4.61 |

Plot yield in lbs.

Phomopsis incidence

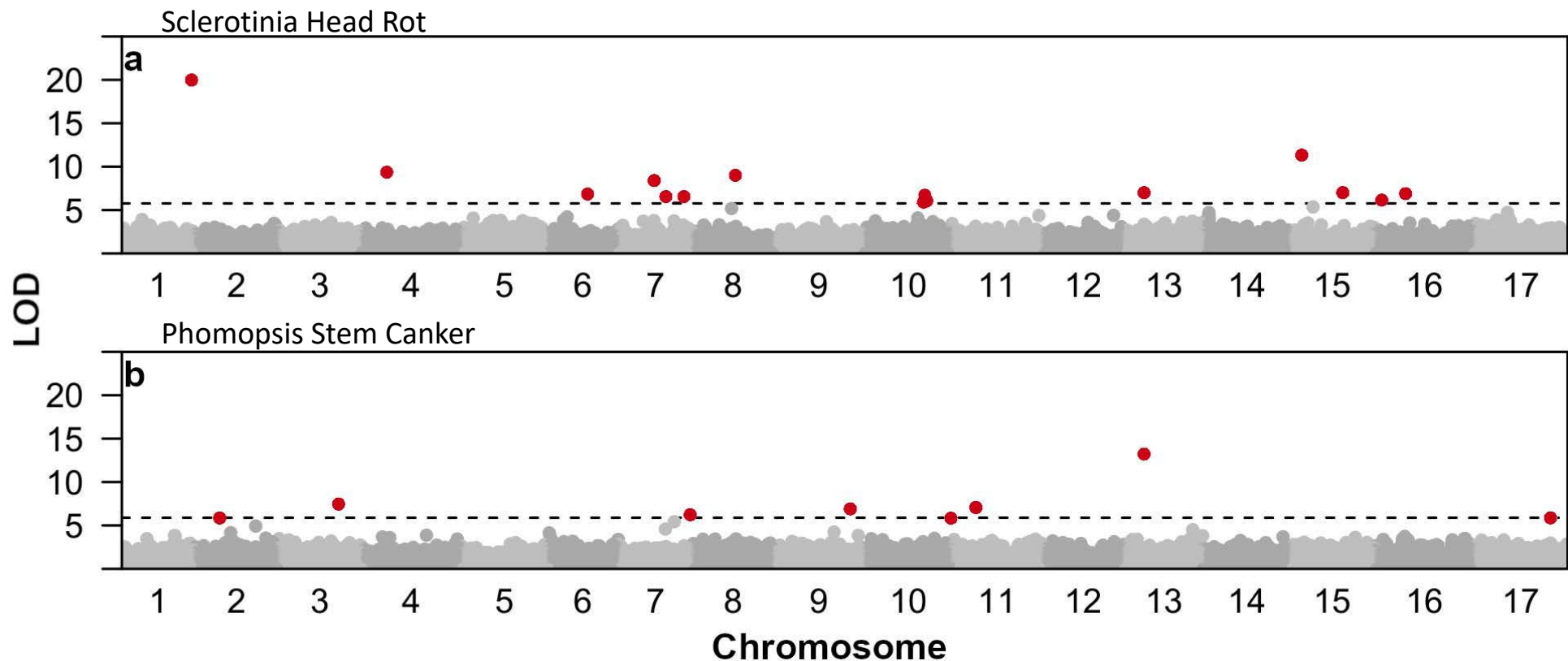
Versus Yield:

$r = -0.27$

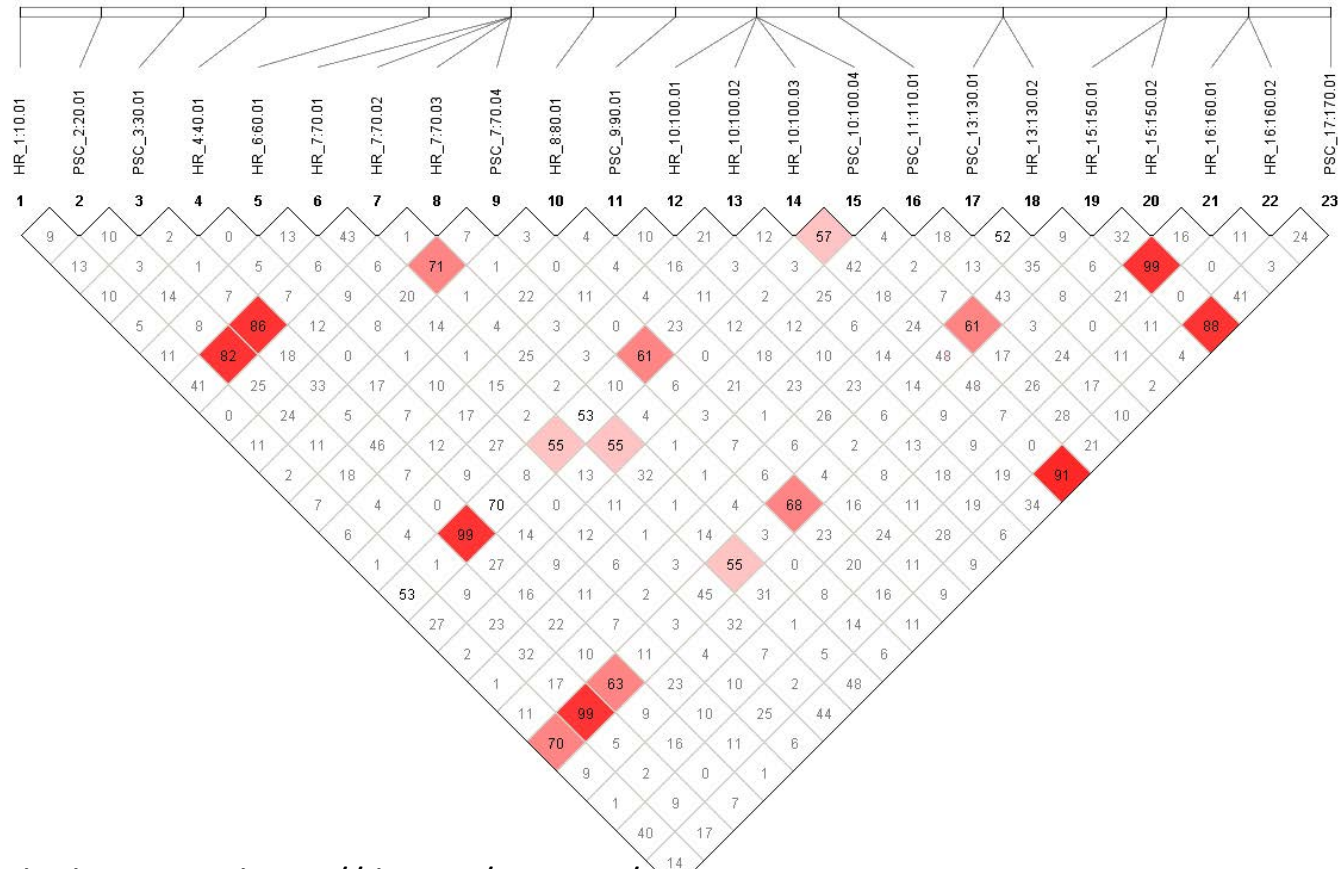
HOWEVER

All hybrids with yield
>3,000 lbs had Phomopsis
Incidence below 35%

Sclerotinia and Phomopsis resistance is not an impossible breeding goal...



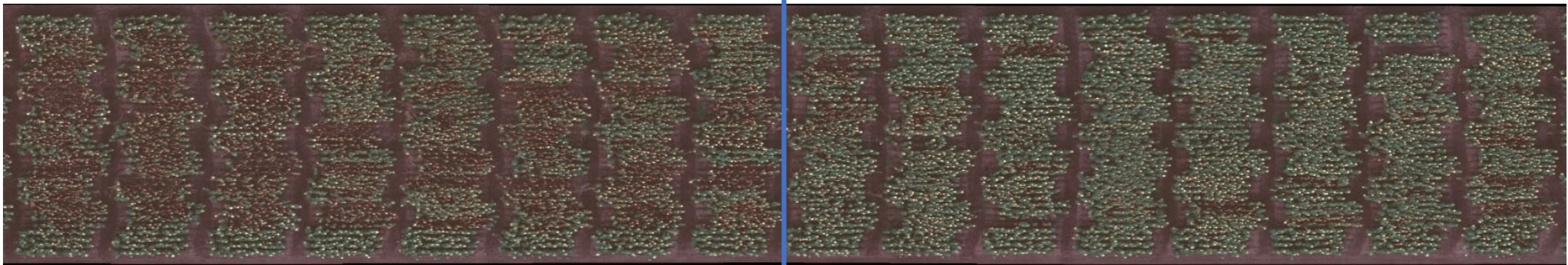
... and some of the loci are selected together by breeders or function in resistance to both!



...But Yield and Disease Resistance needs to be optimized by breeders

Primarily selection on Yield

Selection on Phomopsis + Yield using careful phenotyping



***Due to COVID delays, I don't have the newest release data ready yet, but high yielding, Phomopsis resistant lines are going to be released this year.

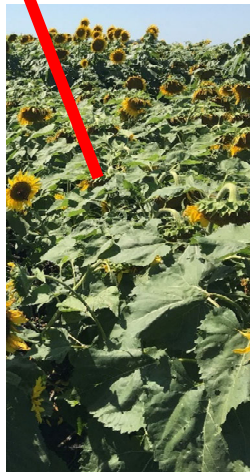
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Short Stature and Early Maturing Sunflowers

Trial results 2020 - Early maturing sunflowers

- Four lines to be released
- 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
- More forthcoming!

| | Moorhead Yield | Honeycomb NS | CM595A/RHA_477 | Myc_8N270CLDM | Pioneer_63A21 | Hutchinson, KS Yield | Honeycomb NS | CM595A/RHA_477 | Myc_8N270CLDM | Pioneer_63A21 |
|----------------|----------------|--------------|----------------|---------------|---------------|----------------------|--------------|----------------|---------------|---------------|
| 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

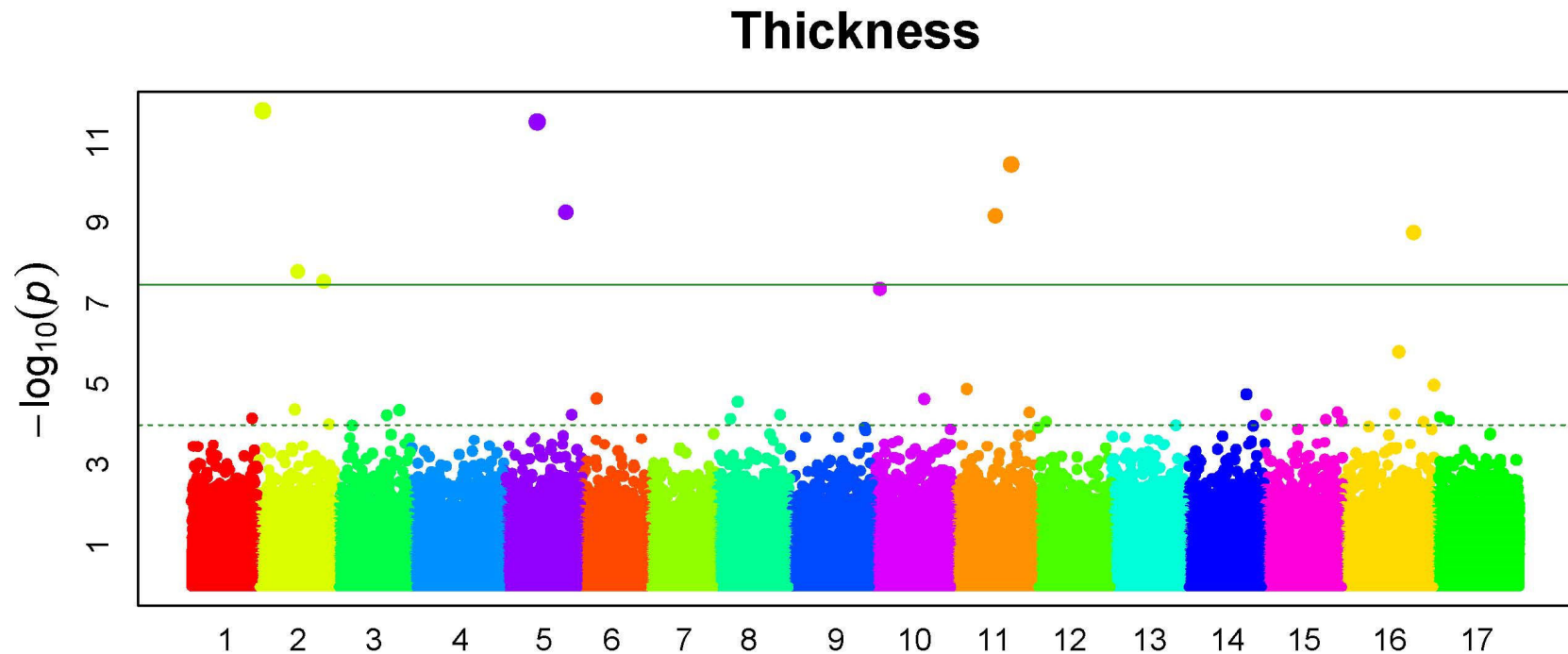


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Hull Thickness and
Seed Composition

Hull thickness = sunflower head moth resistance

- Previous results from Jarrad Prasifka – USDA entomologist
 - Hull hardness in the early stages has been linked to resistance to head moth larval invasion
 - Hull hardness is part thickness of the hull, and part cell structure of the hull
 - We are interested in the genetics of hull hardness in developing seeds
 - The thickness part is nearly finished, with the cell structure part planned for the next two years

Thickness of hulls leading to insect resistance is controlled by a few major loci



Fatty acid genetics

- Funded through NSA
- We have two subprojects
 - Hybrid fatty acid prediction from previously mapped loci in inbred lines
 - Instability of oleic acid composition in some inbred lines
- All populations have been made and grown in field to obtain samples
- Remaining lab work on this project has been slowed down due to COVID
 - At this point, our genetics lab is still operating at limited capacity in Boulder
 - Gas chromatograph died, recently replaced, should finish analysis this spring



Other Seed Composition Traits

- Beyond the fatty acid traits, we have started a newly funded project on other seed components that may have value
- New seed samples were increased in summer 2020, for purposes of study
- Working to thresh samples with limited staff, then will proceed to do lab analyses
- Not asking for new funding for this project this year, as it has been delayed by COVID

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

Capitate Glandular Trichomes Fail to Provide Significant Resistance to Banded Sunflower Moth (Lepidoptera: Tortricidae)
January 21, 2020

Field evaluation of early maturing oilseed sunflower double-cropped after winter camelina
January 9, 2020

Seed and floret size parameters of sunflower are determined by partially overlapping sets of quantitative trait loci with epistatic interactions
September 26, 2019

Assessment of the biogeographical variation of seed size and seed oil traits in wild *Silphium integrifolium* Michx. genotypes
September 10, 2019

Registration of oilseed sunflower germplasms RHA 478, RHA 479, RHA 480, and HA 481,

Field evaluation of early maturing oilseed sunflower double-cropped after winter camelina

Search ...

SPECIES WE WORK WITH



Silphium perfoliatum



Linum lewisii



Now Hiring!

Join the only public sector sunflower breeding program in North America! Our lab conducts genetics and genomics studies on sunflower and perennial oilseeds. We collaborate extensively with North Dakota State University, University of Colorado-Boulder, The Land Institute, and several seed and food companies that have interest in our work.

Apply Here



Thanks!

Hulke and Kane Lab Staff

- Dr. Cloe Pogoda, Postdoc (CU)
- Dr. Ziv Attia (CU)
- Brady Koehler, Technician
- Mike Grove, Technician
- Brian Smart, Grad. Student (NDSU)
- Neil Olson, Grad. Student (NDSU)
- André Gossweiler, Grad. Student (NDSU)
- Numerous undergrad interns!
- Collaborators in many states!

Funding sponsors

- National Sunflower Association
- National Sclerotinia Initiative
- Genome Canada / Genome BC
- The Malone Family Foundation
- North Central Region SARE
- US-Israel Agricultural R&D Fund

