NIFA CAP for Innovation in Genomic Technology to Accelerate Breeding

Leveraging high-throughput genotyping and phenotyping technologies to accelerate wheat improvement and mitigate the impacts of climate change

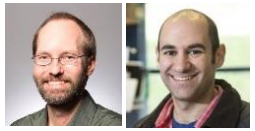
January 15, 2023

WHEAT CAP
Coordinated Agricultural Project

IWYP International Wheat Yield Partnership
Research to Deliver Wheat for the Future

USDA NIFA
United States Department of Agriculture
National Institute of Food and Agriculture

Organization of WheatCAP





Scientific Advisory Board
Coordinator: E. Akhunov

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Industry Liaison committee
Coordinator: M. Sorrells

Rotating representatives from:

* NAWG
* US Wheat Assoc.
* Syngenta
* Bayer
* NAMA
* ABA
* LimaGrain
* Corteva

Education Advisory Board
Coordinator: Amanda Peters

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Project Co-Director
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Executive Committee
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Amanda Peters
Rotating breeder

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Objective 3
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N. Santantonio

Objective 4
Team Leader
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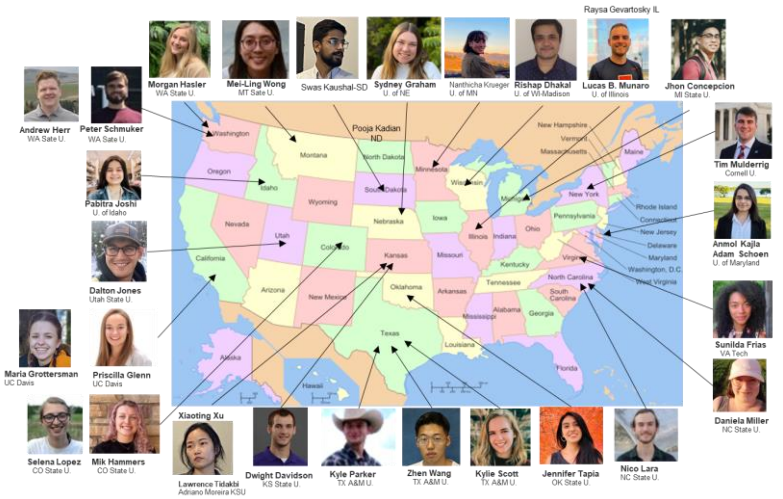
Objective 5
Team Leaders
Justin Faris
Amanda Peters

WheatCAP first year report

https://www.triticeaecap.org/meet-our-students/

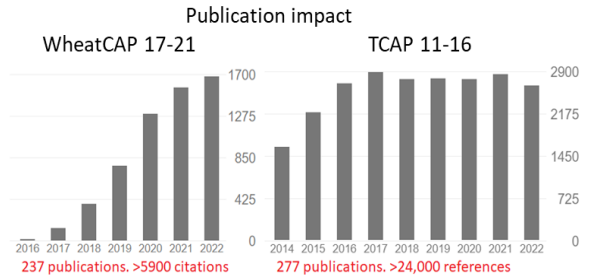
Education

- 7 students completed their PhD
- 42 graduate students participated in multiple educational activities
- 9/22 completed first educational survey https://www.triticeaecap.org/2022-graduate-student-suvey/
- Monthly meeting included discussion of WheatCAP objectives, and BreedBase use and data entry
- Writing groups were established (14 students participating)
- On Friday (1/13/2023) we had our first full day in person student workshop with 26 students!



Research

- WheatCAP breeders have released 33 commercial wheat varieties and 7 improved germplasm.
- The WheatCAP team published 47 new peer-reviewed papers. Remember to explicitly acknowledge: "This project was supported by AFRI Competitive Grant 2022-68013-36439 (WheatCAP) from the USDA NIFA"
- Data was collected from 173 UAS flights over 23.8 acres.
- 25,400 samples were sent for genotyping (mostly with medium throughput genotyping platforms).
- 55,000 plots from 175 trials were entered into T3, with data already incorporated for 167 trials
- Several breeding programs started to use BreedBase and adding data for the first time.



National Program Leader Christian Tobias 12/02/2022: I just now read your full report and I see that there's a good number interactions with the Spring Wheat Hub and KS Winter Wheat Hub. It's nice to see that yield traits are being incorporated into CIMMYT pre-breeding pipelines and Wheat Yield Consortium Yield Trials. I also appreciate the activities and resources available to the WheatCAP's students. Please tell everyone who helped prepare the report that their efforts are impressive, and that effective management of all the UAV data and incorporation of the PHG are really nice outcomes already. What people can do when they come together like this is really incredible.

WheatCAP power of the combined data

Public wheat breeding programs across the US generate a huge amount of information each year, but until now this information was confined within each program and could not be analyzed jointly.

Some problems are too big to be solved by a single breeding program but can be tackled but combining data from all public breeding programs, operating as a coordinate effort.

In the previous WheatCAP we identified multiple genes affecting yield, but we are now know that those genes are part of interconnected regulatory networks resulting in strong interactions among genes, genetic background and environment.

The number of combinations is too high to explore in single experiments, but if we can generate large high-quality integrated genotypic and phenotypic datasets, we would be able to explore these complex questions *in silico.*

This is the rationale for us to request that participating breeding programs enter their yearly trials and results into BreedBase. Integration of BreedBase into the daily breeding activities can help reduce the burden of data entry into BreedBase.

The combined genotypic and phenotypic datasets are an invaluable resource to investigate the effects of different alleles and their epistatic interactions with US environments and US germplasm.

Agenda meeting January 15, 2023

WHEAT CAP
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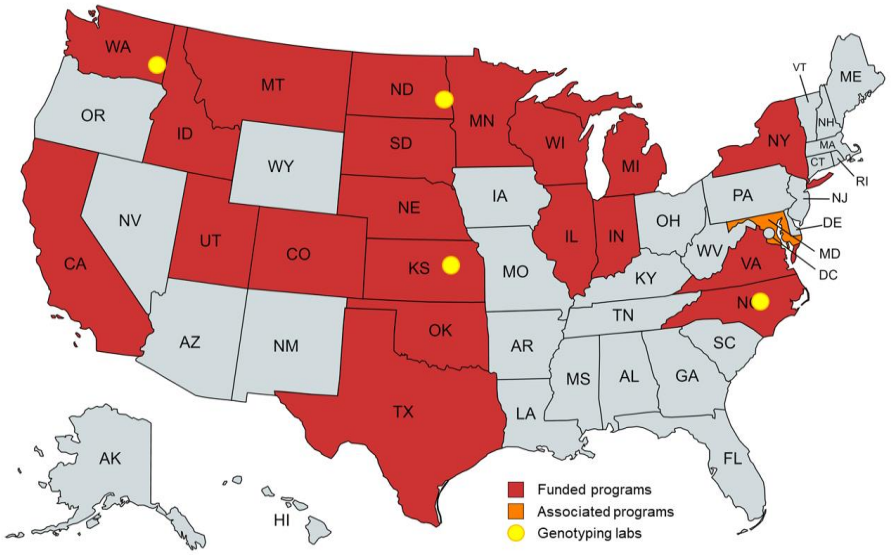


Introduction and project overview.

8:30 – 8:45 am. **J Dubcovsky**. 1st year report, overall vision and areas that require work.

Educational activities

8:45 – 9:05 am. **A. Peters Haugrud & K. Running.** Overview educational activities & priorities Y2.

Applications UAV high-throughput phenotyping to wheat breeding

9:05 – 9:20 am. **S. Baker** 'Six Years of Wheat UAS Phenotyping at TAMU'

9:20 – 9:35 am. **A. Carter** 'The Ups and Downs of UAS in WA wheat breeding'

9:35 – 9:50 am. Open discussion UAS implementation in plant breeding.

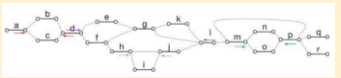
Genotyping tools and resources

9:35 – 9:50 am **G. Brown-Guedira** & **J. Fiedler**. Medium density genotyping platforms for wheat breeding

Coffee break. 10:05 – 10:30 am 

Genotyping tools and resources

10:30 – 10:45 am. **K. Jordan**. Genotype imputation using Wheat PHG

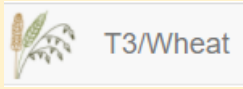


10:45 – 11:00 am. Open discussion of genotyping activities in WheatCAP

T3 database and its implementation in breeding programs

11:00 – 11:15 am - Update on T3 database (Clay Birkett, USDA ARS)

11:15 – 11:30 am - How Breedbase Helps Our Breeding Program (Jessica Rutkoski, UIUC)



11:30 – 11:45 pm - Open discussion on integration of T3 into breeding programs

Lunch on your own. 11.45 – 1.15 pm

Genomic resources and their utilization in plant breeding

1:15 – 1.30 pm. **E. Akhunov**. Genomic resources for identifying functional variants associated with agronomic traits

1:30 – 1:45 pm. **J. Dubcovsky**. Characterization of cis-regulatory diversity

1:45 – 2.00 pm. Open discussion on development and utilization of WheatCAP genomic resources

Allele mining for improving grain yield potential in optimum environments

2:00 – 2:15 pm. **L. Yan**. Cloning of *TaCol-B5* and its applications in wheat breeding

2:15 – 2:30 pm. **N. DeWitt**. A network modeling approach for environment-specific yield architecture of wheat

2:30 – 2:45 pm. **M. Nyine**. Introgression and characterization of climate-adaptive alleles from wild relatives.

2:45 – 3:00 pm - Open discussion on allele mining and deployment in breeding programs

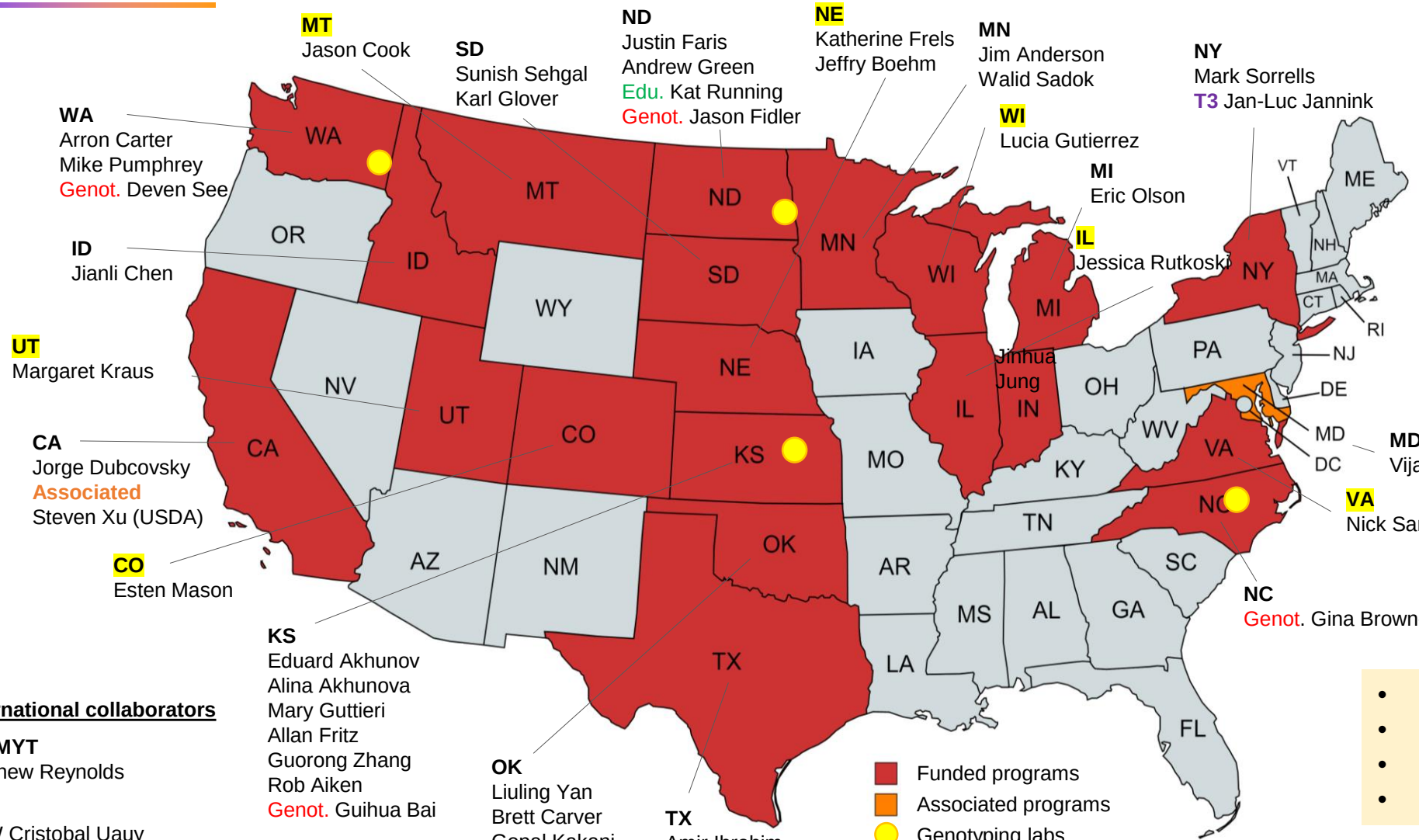
Coffee break. 3:00 – 3:25 pm 

Student poster session 1. 3:25 – 4:10 pm

SAB feedback and discussion 4:10 – 4:30 pm

Student poster session 1. 4:30 – 5:15 pm. Wrap up meeting 5:.15 – 5:30 pm

WheatCAP 22-26



MT
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Andrew Green
Edu. Kat Running
Genot. Jason Fidler

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Jeffry Boehm

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Allan Fritz
Guorong Zhang
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Juan Landivar
Anjin Chang

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Jinhua, Jung

MD Associated
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VA
Nick Santantonio

NC
Genot. Gina Brown-Guedira

International collaborators

CIMMYT
Matthew Reynolds

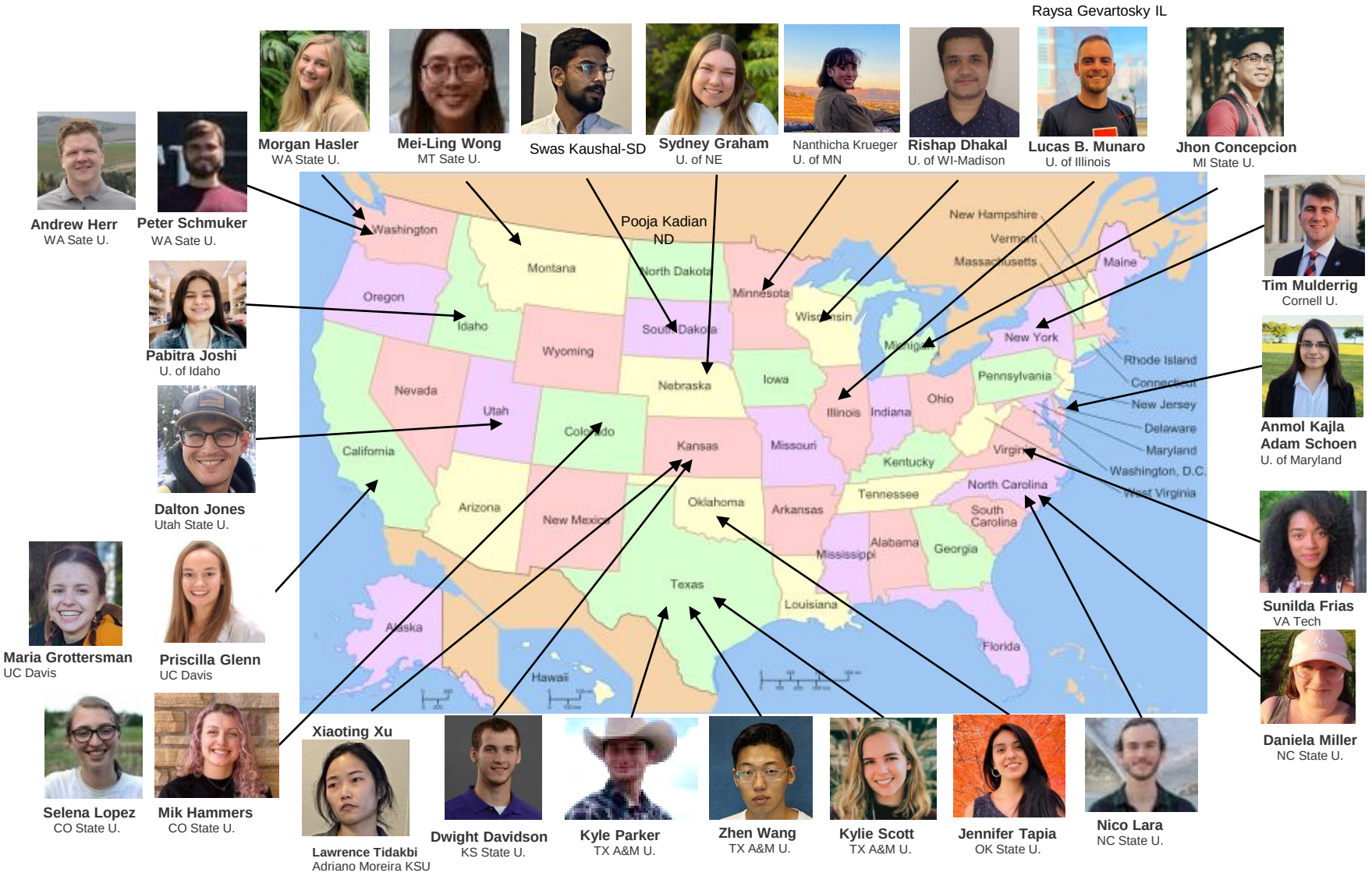
UK
DFW Cristobal Uauy

CANADA
Curtis Pozniak

- 5 years (1/22 to 12/26)
- $15 M
- 40 collaborators
- 20 states

The WheatCAP participating states represent
~90 % of the wheat acreage in the USA and produce
60-70% of the wheat varieties

WheatCAP graduate students



2022: **34** students + 6 graduated. Since 2001 WheatCAP projects trained **>200 graduate students**

Amanda Peters Haugrud
Educational Coordinator
WheatCAP

Kat Running
Educational Coordinator
WheatCAP

Student profiles can be found at:
https://www.triticeaecap.org/meet-our-students/