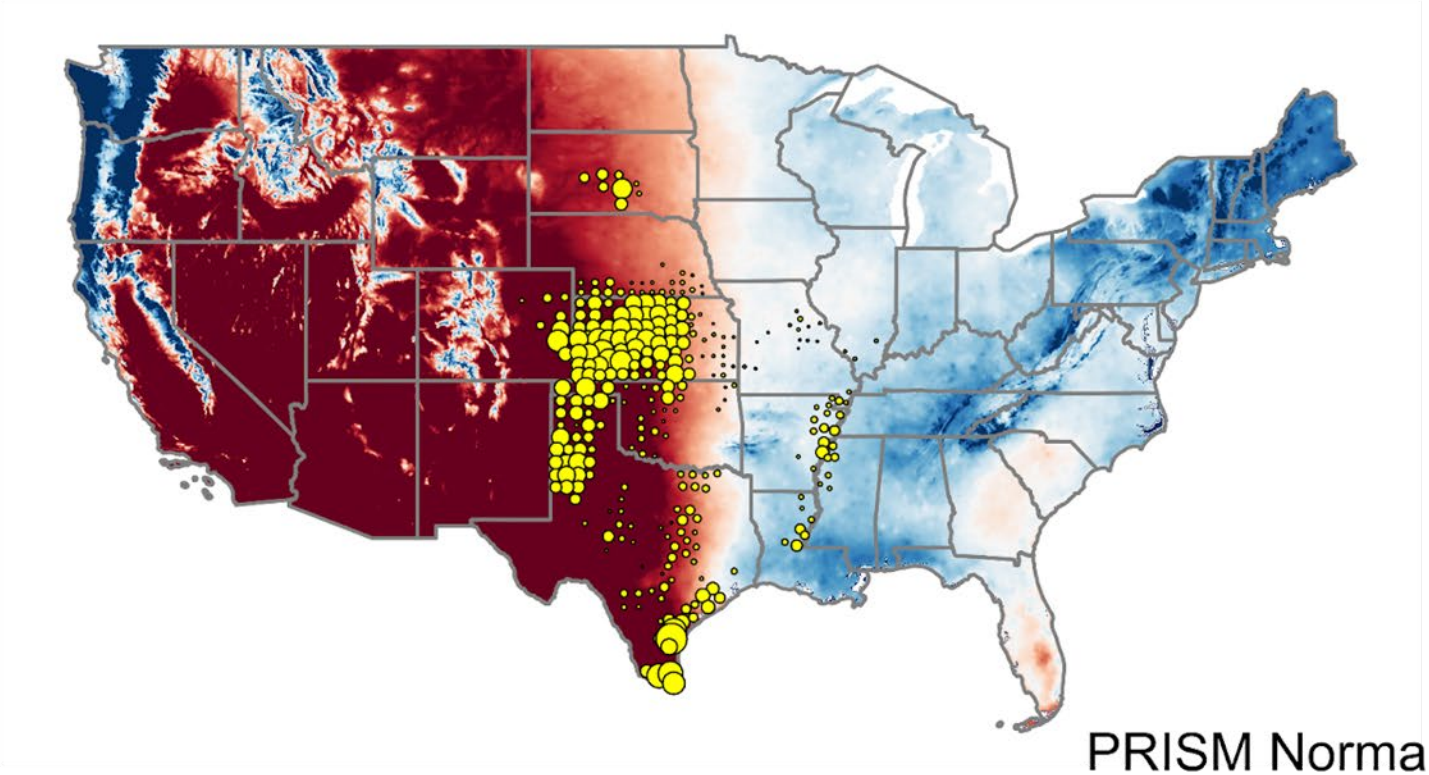
DropXL Sorghum

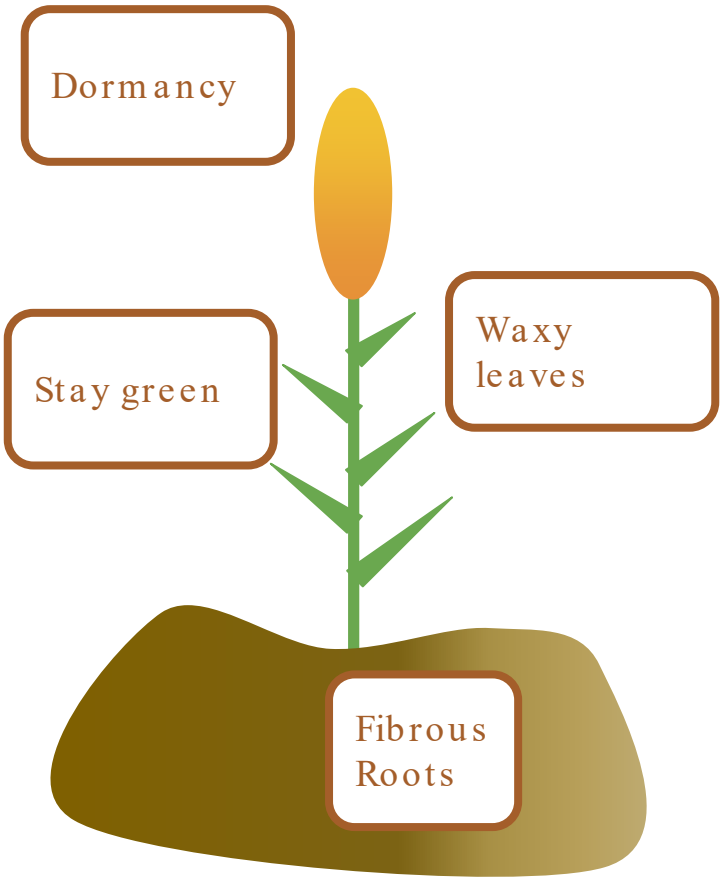
Developing **Water Optimized Sorghum** for Kansas using **Drone Imagery** and **Data Driven** Approaches.

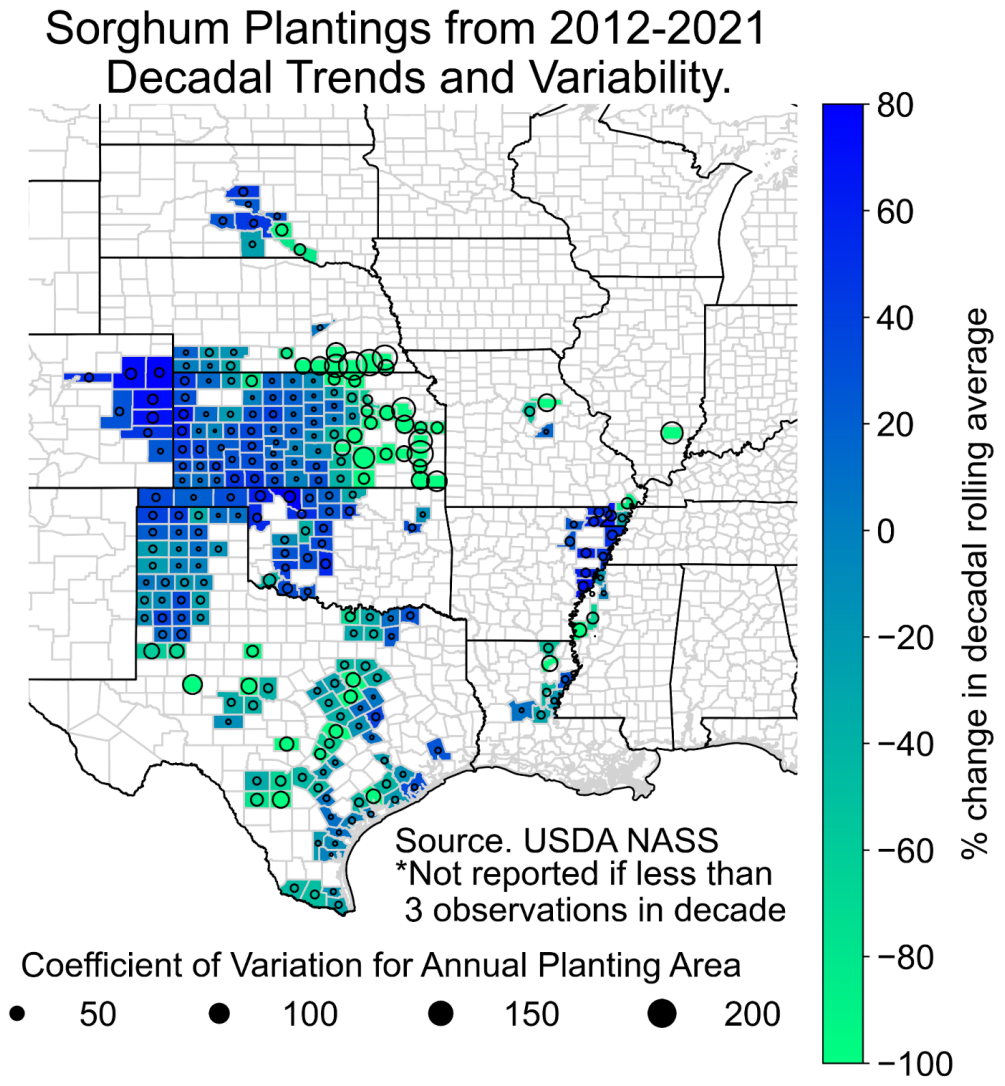
Presenter:
Sarah Sexton-Bowser, CSIP Managing Director, KSU
Md. Abdullah Al Bari, Postdoc Research Fellow, KSU

Atmospheric Water Deficit and Sorghum Planted Area

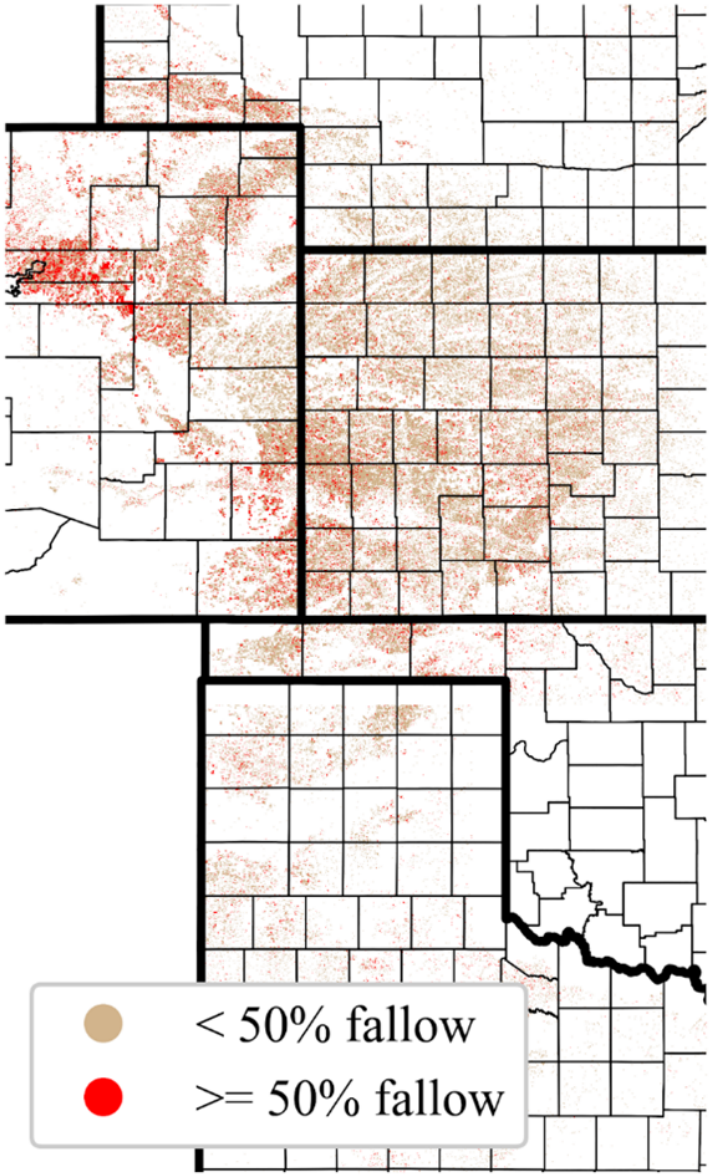


PRISM Normals 1991-2020
TerraClimate Normals 1981-2010
USDA NASS 2012-2021

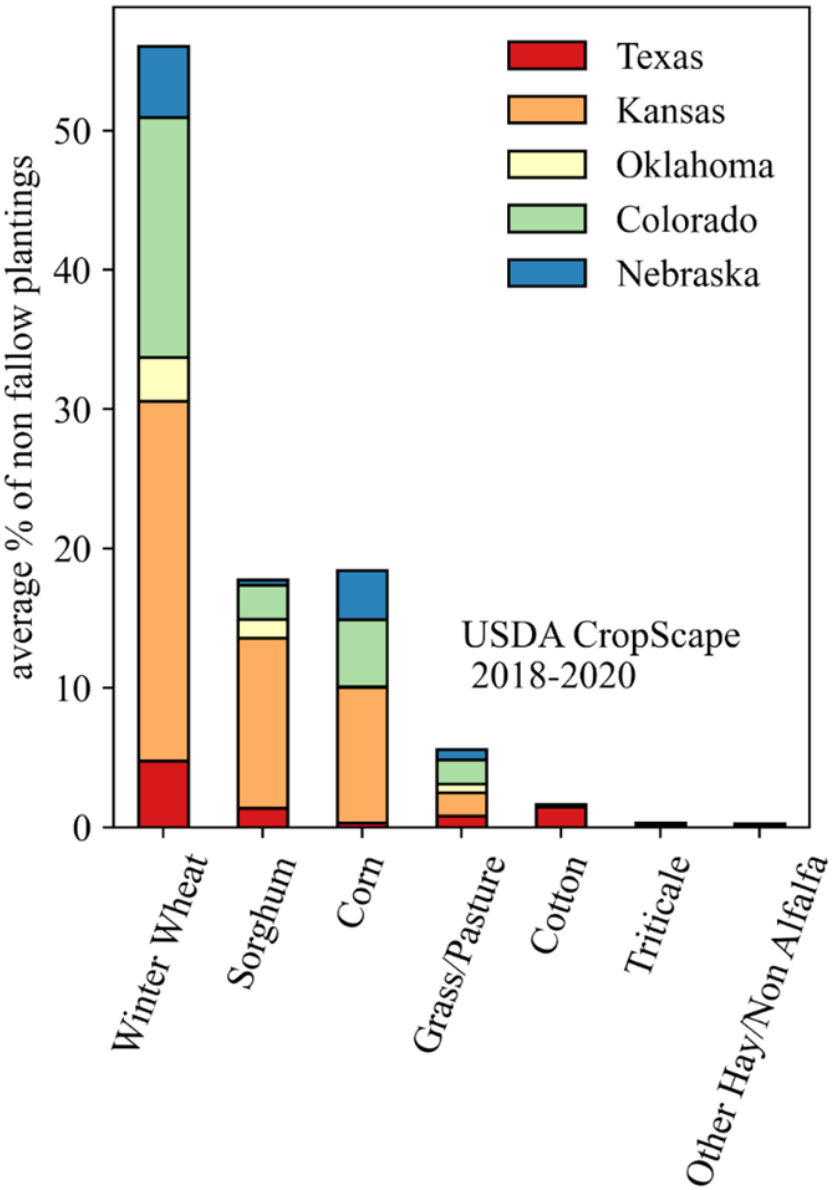

Dormancy
Stay green
Waxy leaves
Fibrous Roots

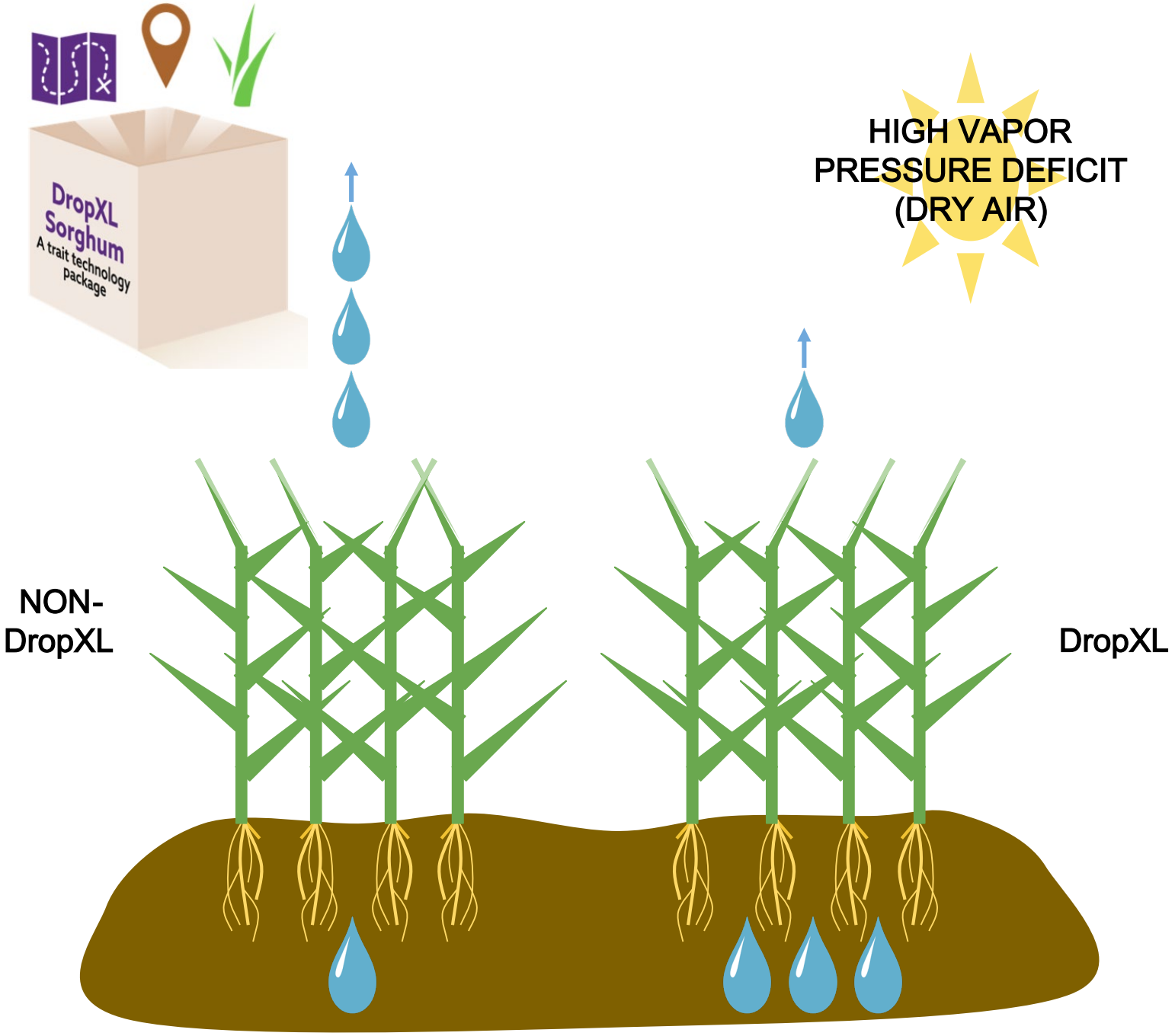

Sorghum Plantings from 2012-2021
Decadal Trends and Variability.
Source. USDA NASS
*Not reported if less than
3 observations in decade
Coefficient of Variation for Annual Planting Area
50
100
150
200
80
60
40
20
0
−20
−40
−60
−80
−100
% change in decadal rolling average

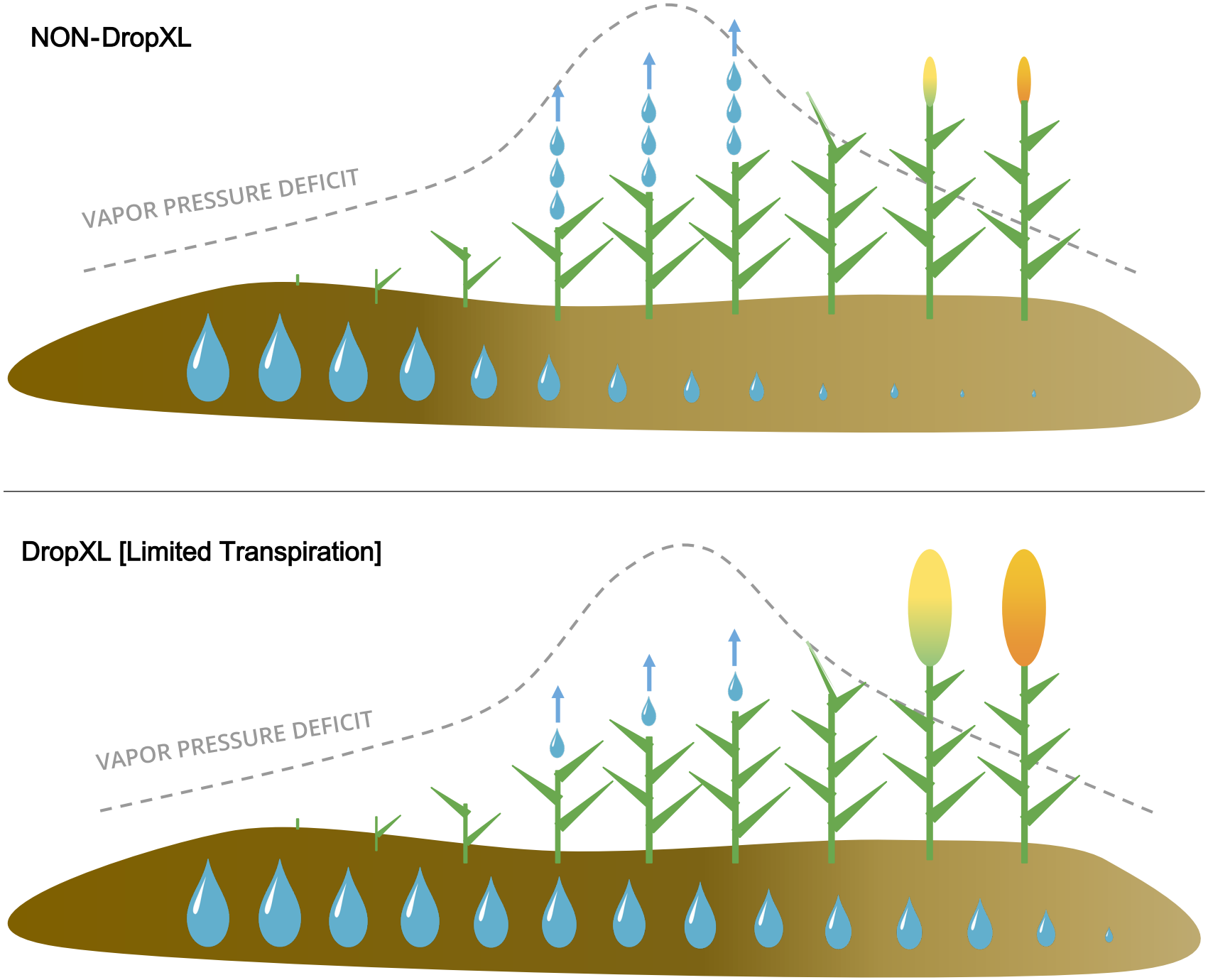
Fallow cropping in a 3-yr rotation.
USDA Cropscape (2018-2020)



Crops planted in target region
on field with fallow period




DropXL Sorghum
A trait technology package
HIGH VAPOR PRESSURE DEFICIT (DRY AIR)
NON-DropXL
DropXL


NON-DropXL
VAPOR PRESSURE DEFICIT
DropXL [Limited Transpiration]
VAPOR PRESSURE DEFICIT

TRAIT
MAP

TRAIT
MAP

TRAIT
MARKER

TRAIT
DONOR

TRAIT
MAP

+5 bu/ac

~¾ inch

TRAIT MAP

TRAIT MARKER

+5 bu/ac

~¾ inch

TRAIT MAP

TRAIT MARKER

TRAIT DONOR

+5 bu/ac

~¾ inch

TRAIT MAP

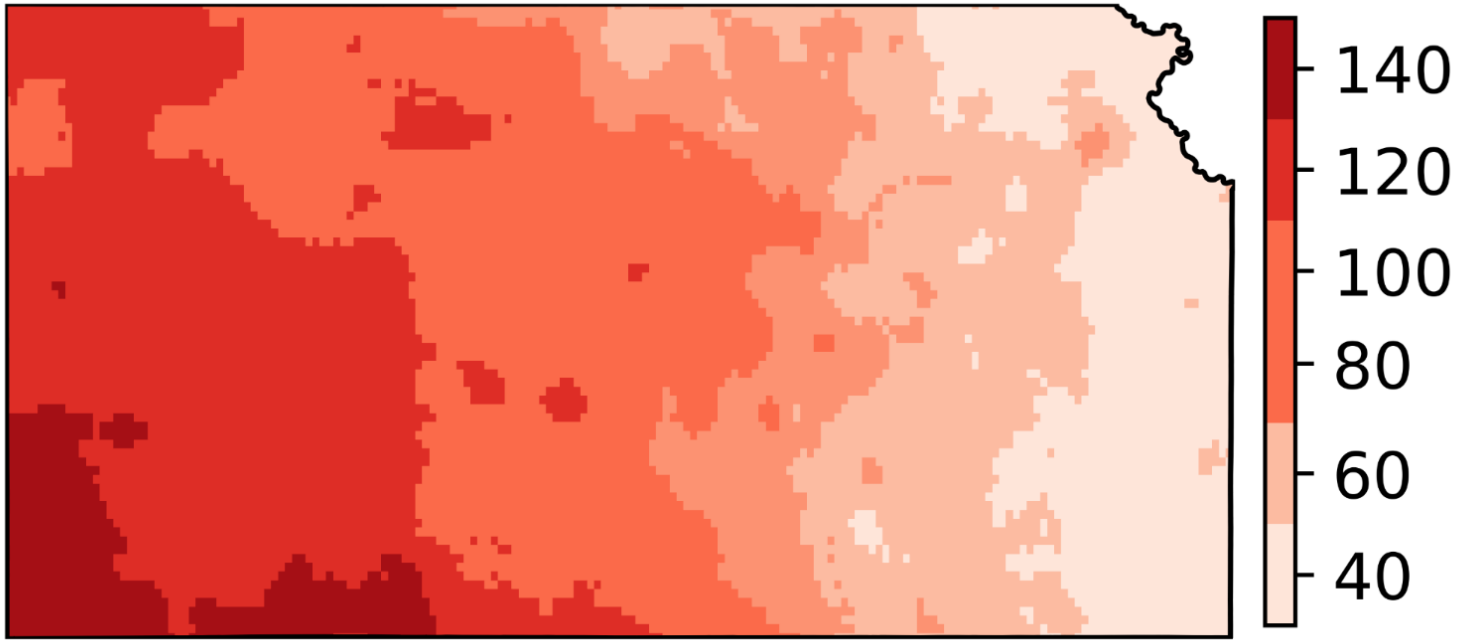
TRAIT MARKER

TRAIT DONOR

+5 bu/ac

~¾ inch

Do we need water efficient crop?



- Daily weather data from the past 30 years, Kansas shows high VPD (>2.5 kPa)
- Western Kansas has 100-140 days with such stress
- Breeding water efficient crop can save water and increase productivity

Source: PRISM Climate Normals 1991-2020

2023 **TRAIT MARKER**
Genetic Dissection

On going: 2023

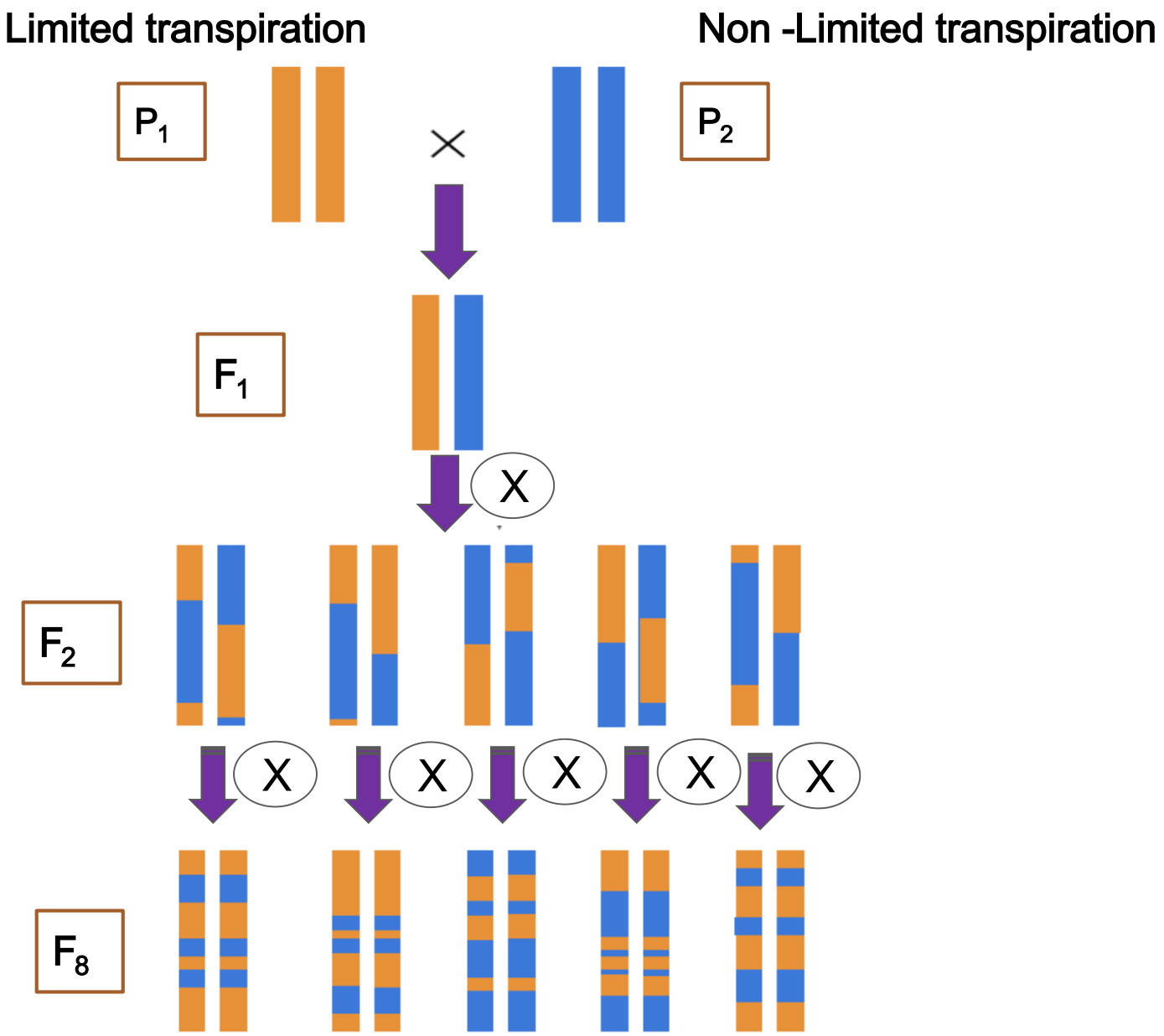
A holistic approach to genetically dissect traits and develop markers to track water use efficient traits

2024 **TRAIT DONOR**
Resource generation

On going: 2024

Donor lines with desirable agronomic traits to transfer DropXL traits to breeding program

Population development



DropXL mapping population

Population started 2018

Small population summer 2021

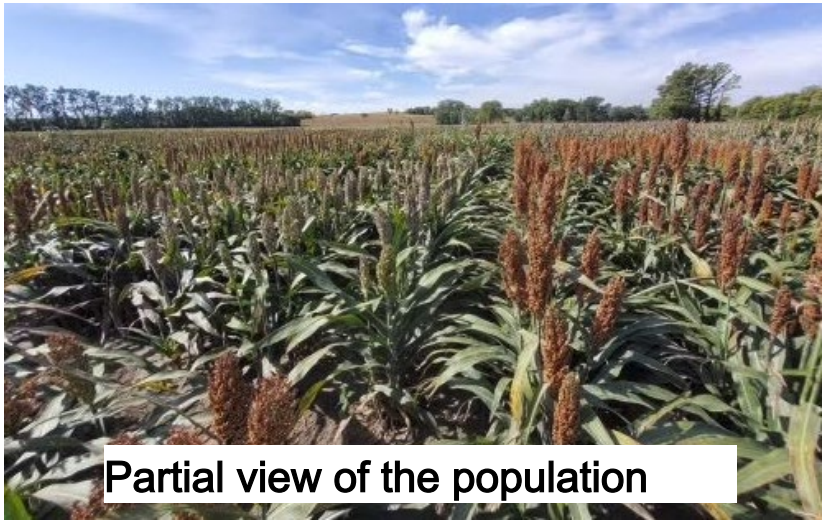
- Total of 160 lines
- Lines at F_4 & F_6 generation

Population advancement

- Seed multiplied at Mexico
- Bulk seed production

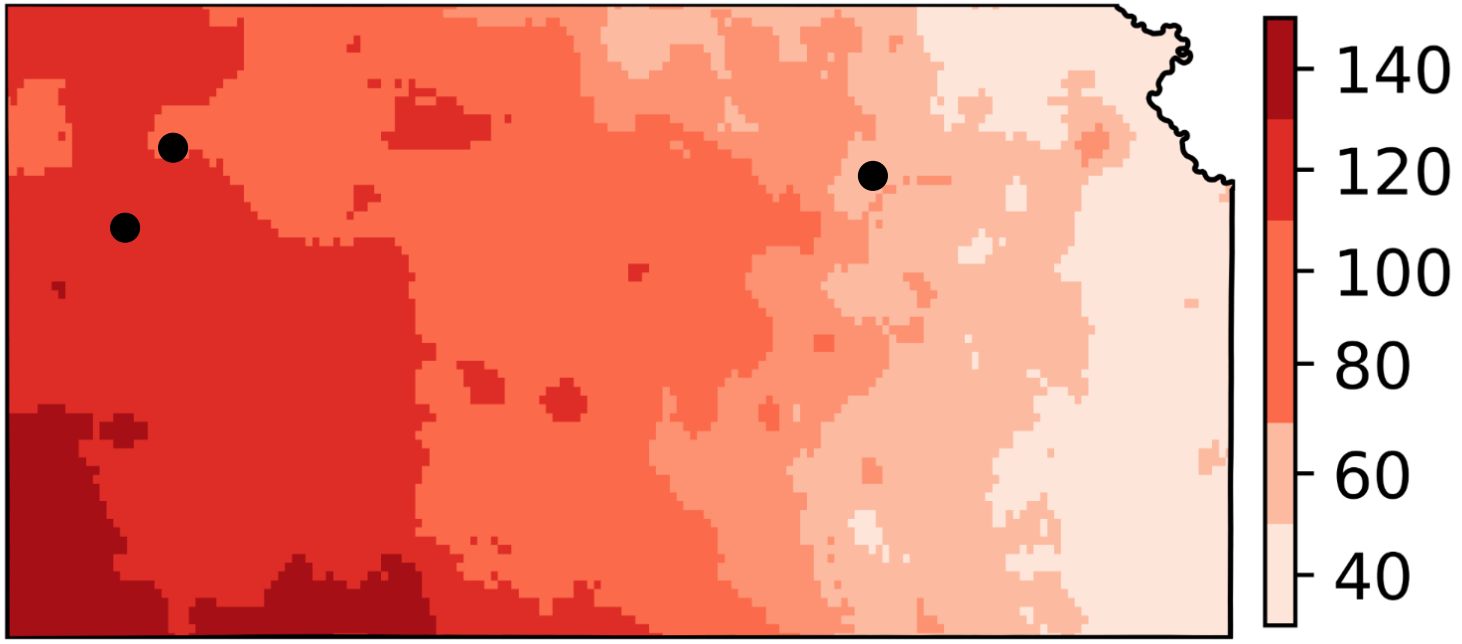
Fully developed population 2022

- A total of 320 lines
- Lines are at F_6 to F_8 generation



Partial view of the population

Where to evaluate the trial?



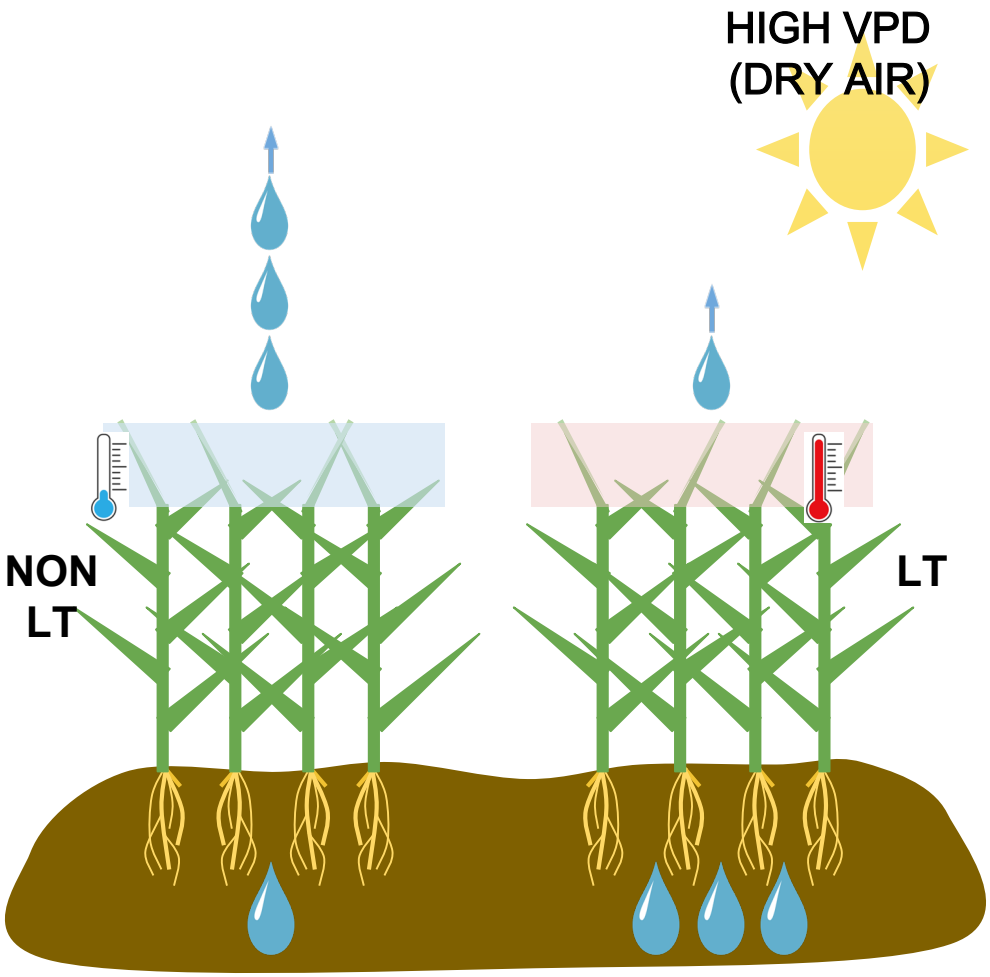
- Manhattan
- Colby
- Tribune

Trial setup 2022

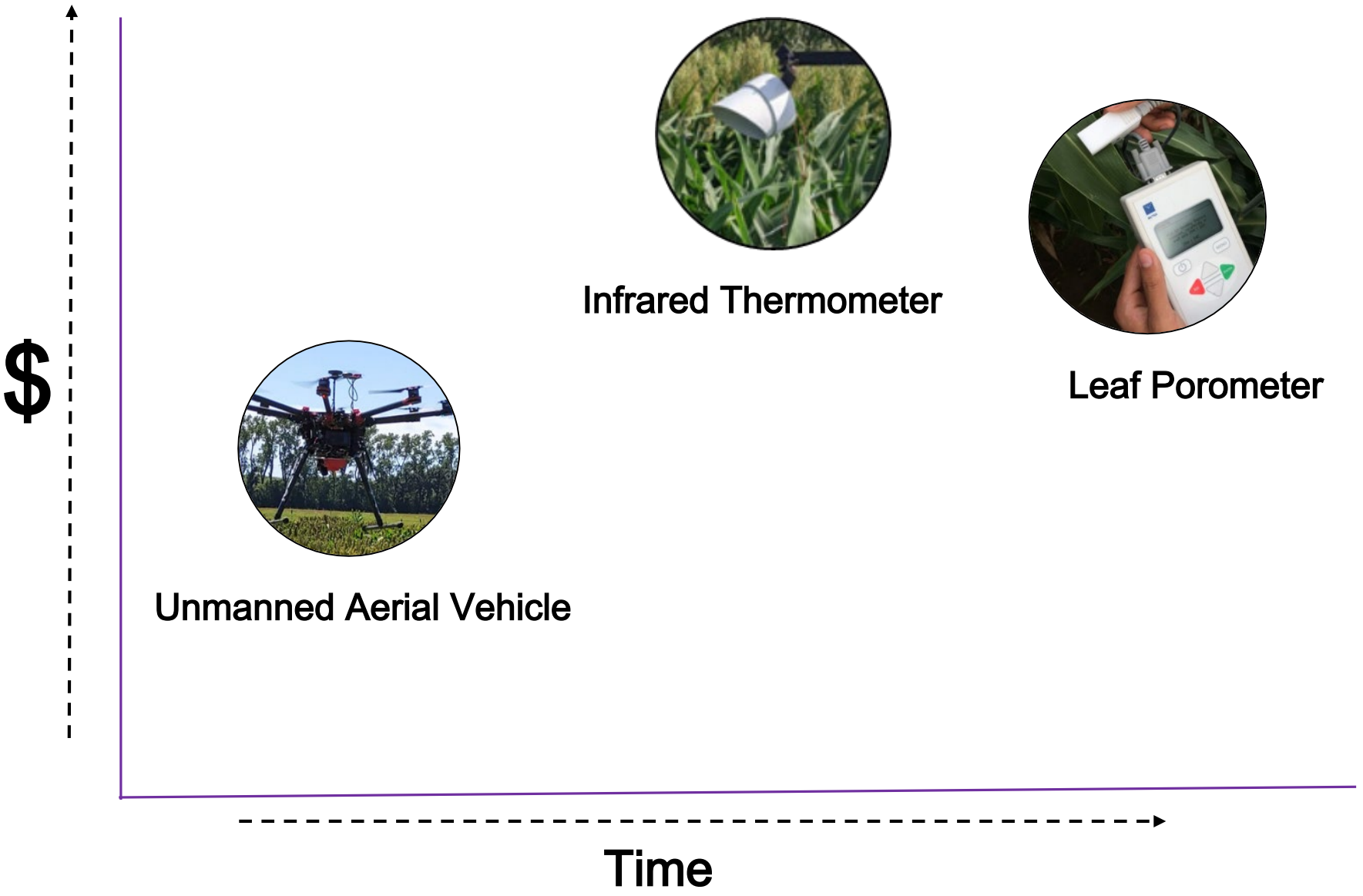
- A population of 320 individuals were planted following a RCBD design with 3 replicates, each plot is 4 row, 10 feet, 987 plots each location
- The trial was set up at 3 locations (Manhattan, Colby, Tribune

DropXL 2022 Trial at Manhattan, KS

How to approach plant phenotyping?



Operational cost and time

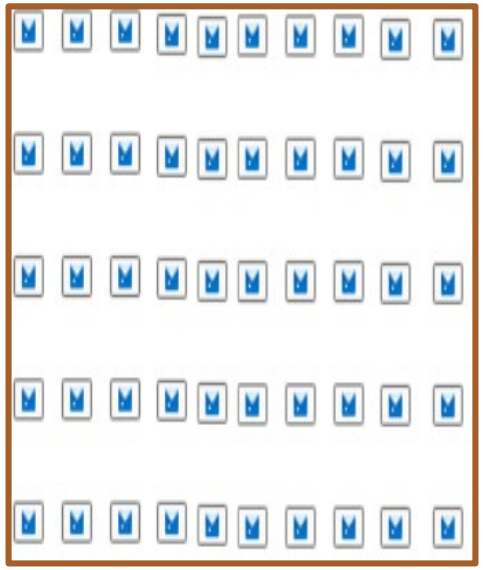


UAV image capturing

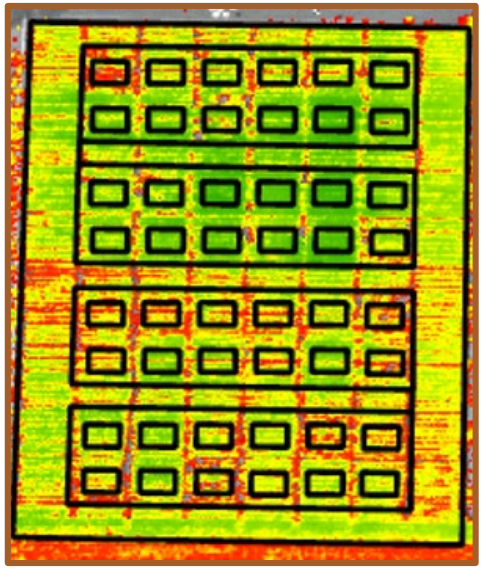
DropXL mapping population at Manhattan, KS

Trevor Witt flying UAV

How do you get from drone imagery to data driven approaches?



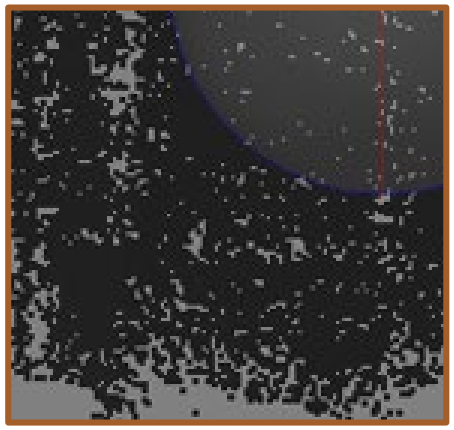
Raw images



Plot level temperature data

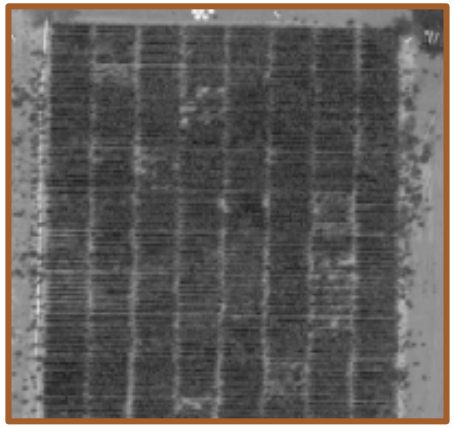
UAV image processing pipeline

Raw images



Sparse Cloud

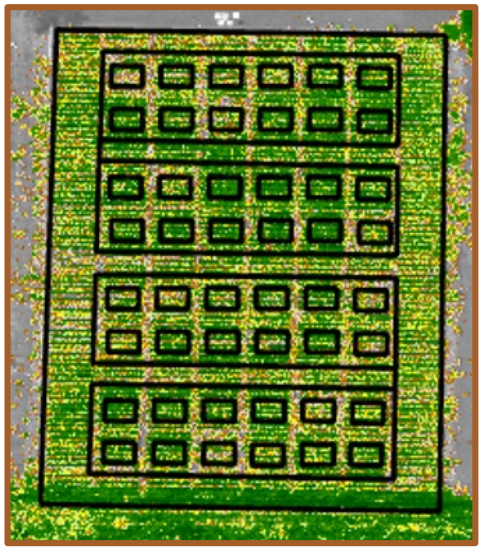
Dense Cloud



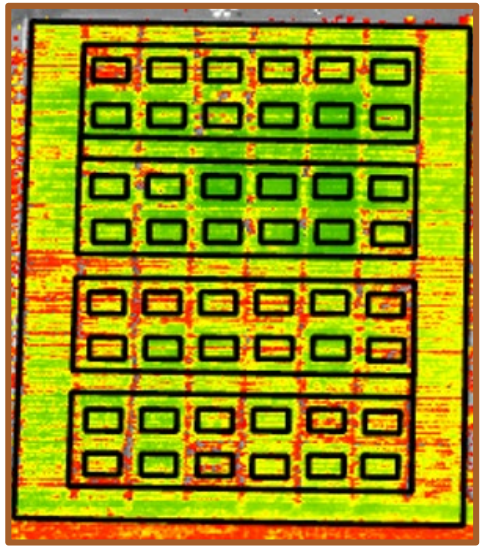
Orthomosaic

Plot level data extraction

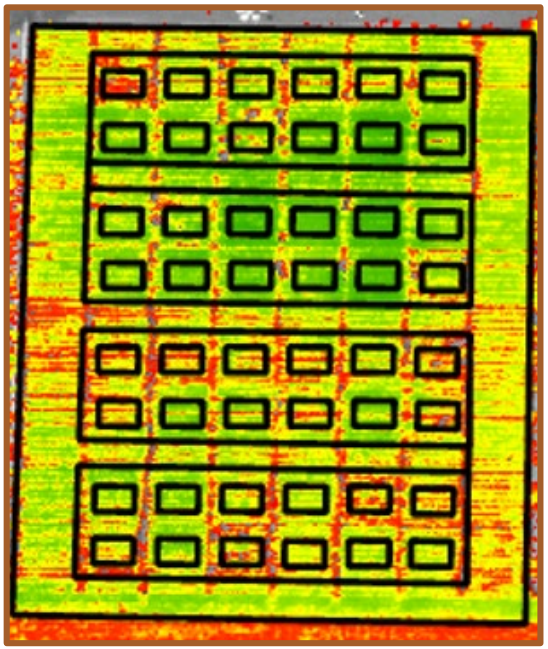
Orthomosaic



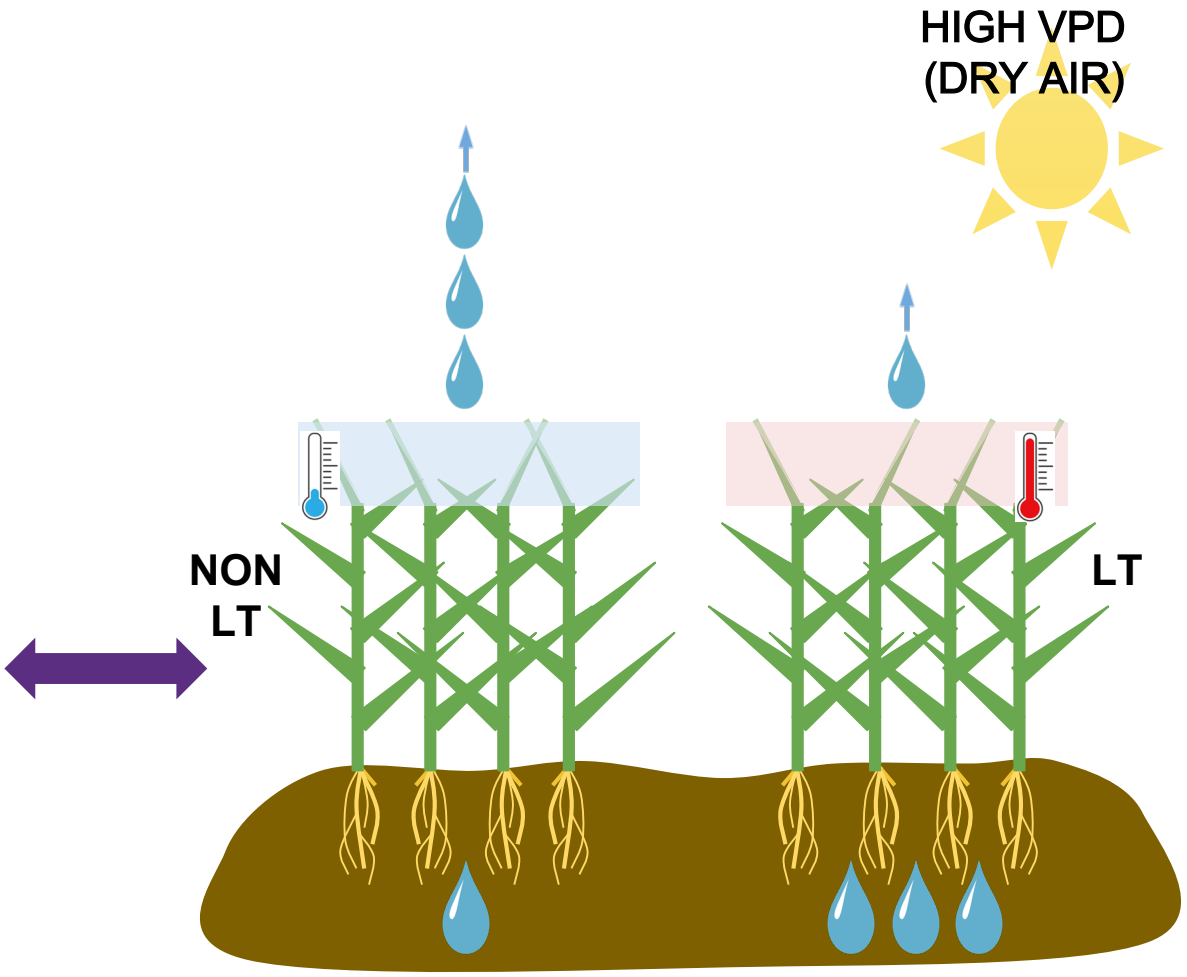
Overlaying shapefile



Plot level temperature



Plot level temperature data



Expected outcome

- Generated markers would guide breeding with better precision and rapid introgression of traits

- DropXL sorghum also providing water efficient germplasms, inbred lines, and hybrids

TRAIT MARKER

Spring 2023

Architecture
Candidate
Markers

TRAIT DONOR

Spring 2025

Germplasms
Inbreds
Hybrids

Acknowledgements

THE TEAM

Terry Felderhoff, Molecular Sorghum Breeding
Sarah Sexton-Bowser, CSIP Managing Director
Md. Abdullah Al Bari, Genetics and Phenomics
Rob Aiken, Cropping Systems
Trevor Witt, UAV Specialist

CENTER FOR
SORGHUM
IMPROVEMENT

Thank you!!