DropXL Sorghum

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

Presenter:

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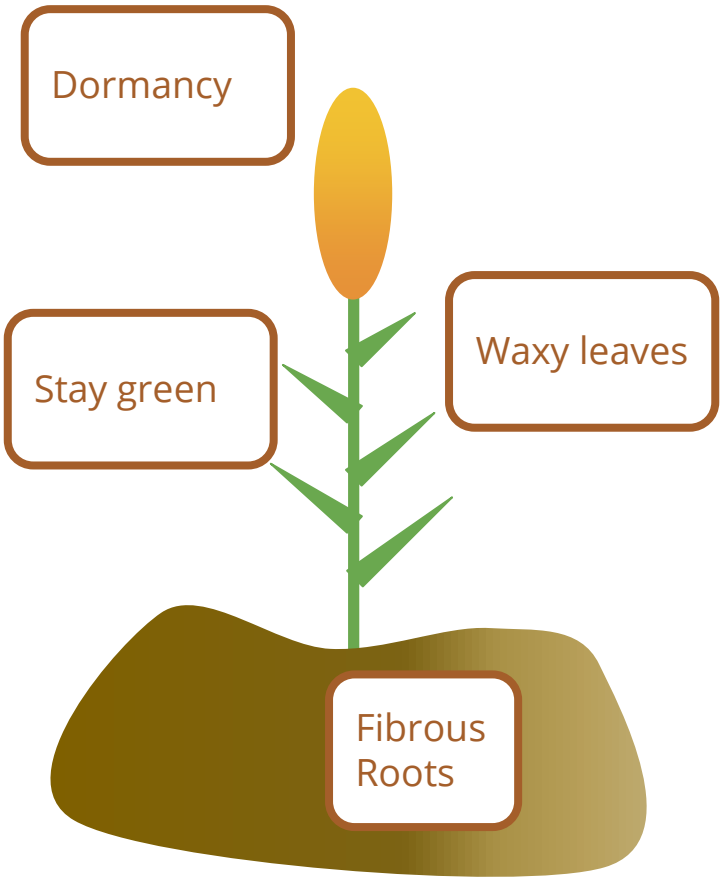
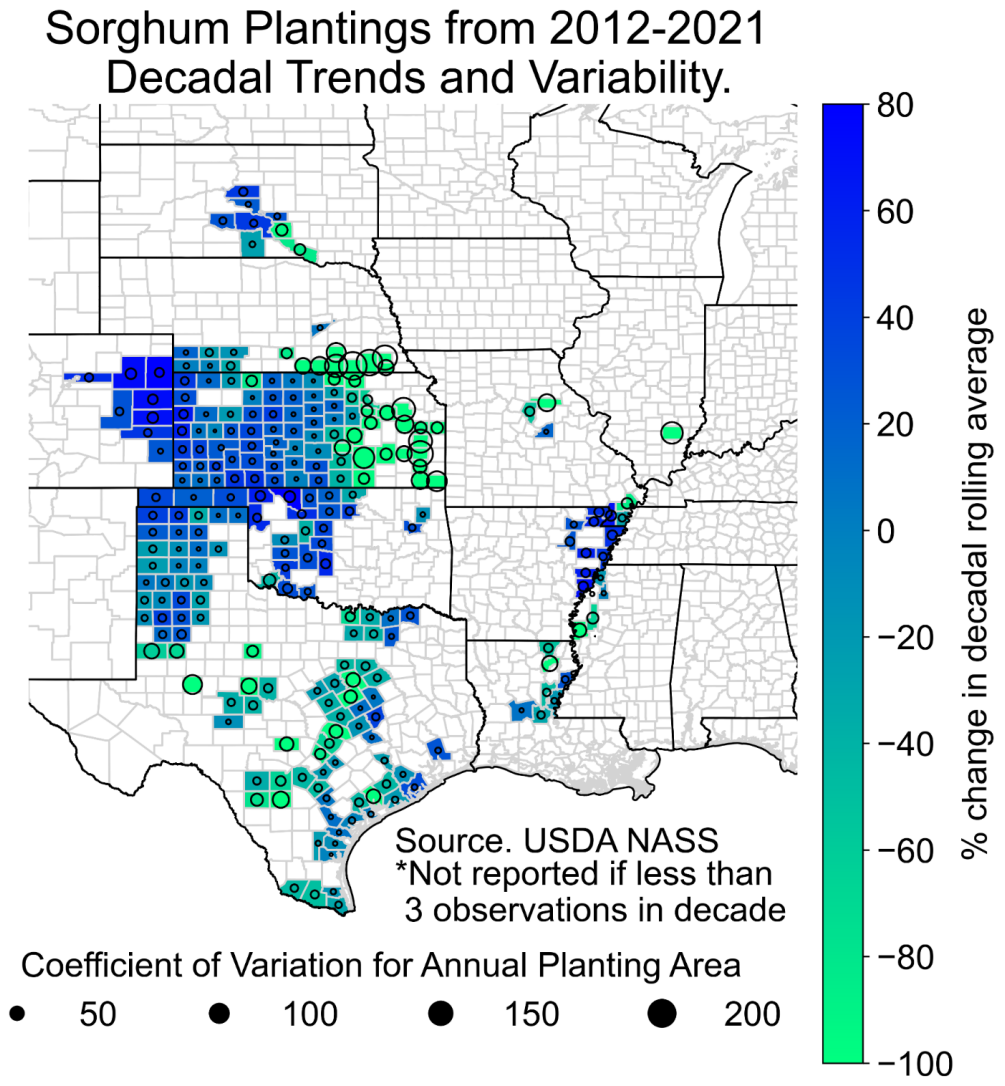
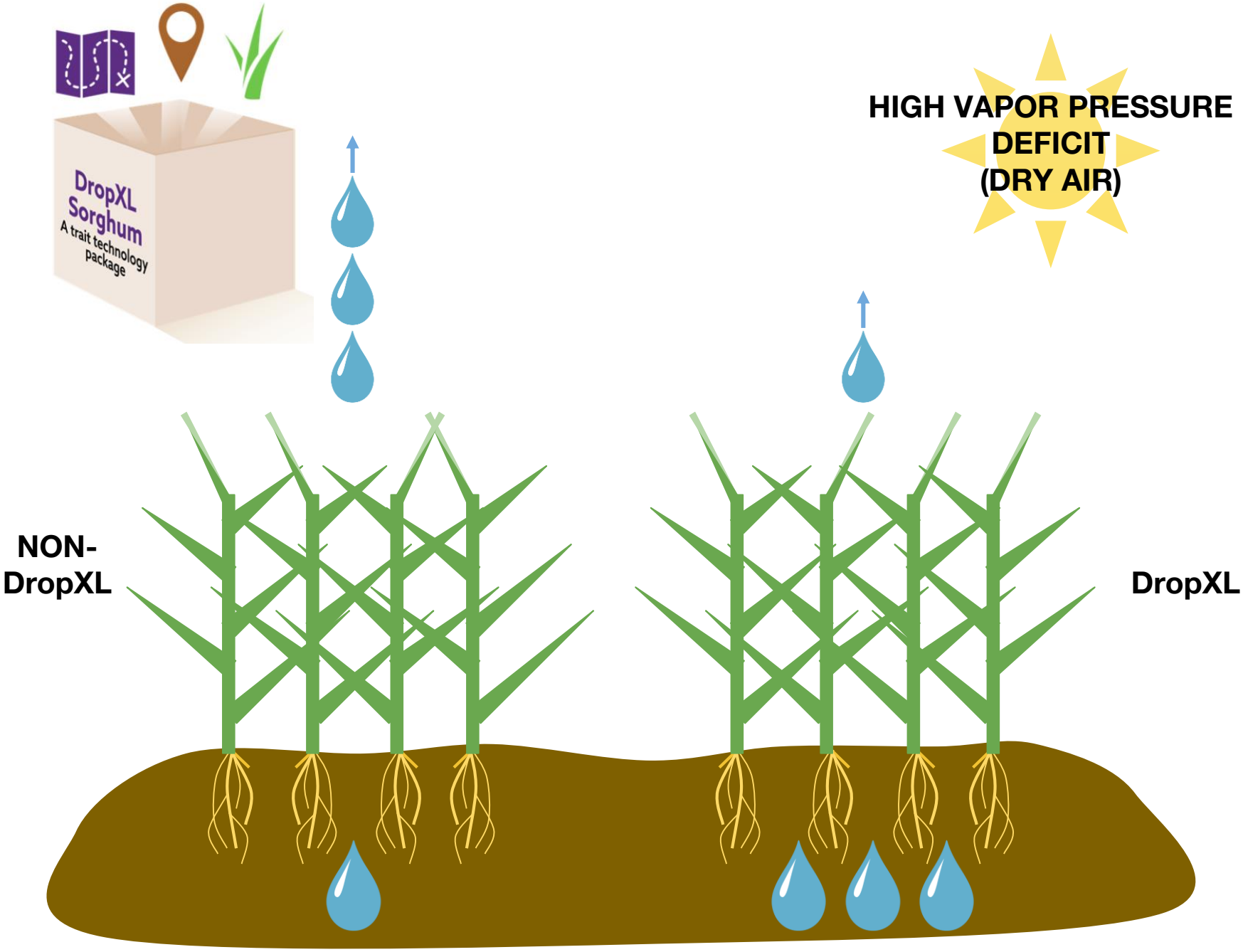
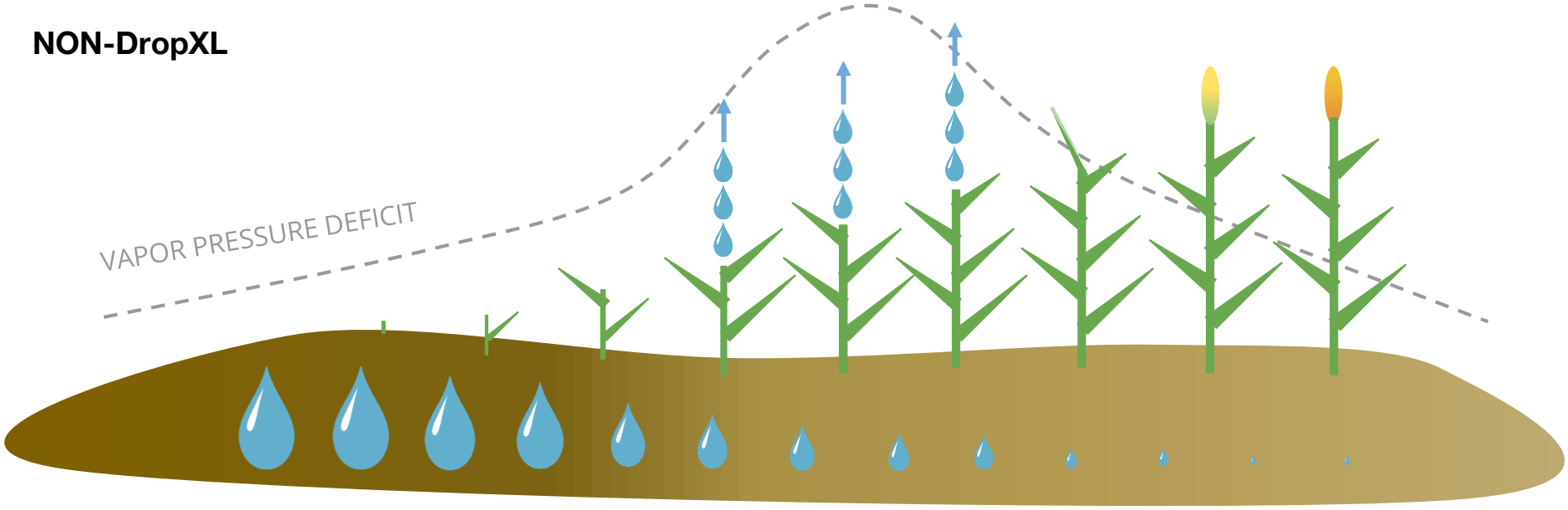
Md. Abdullah Al Bari, Postdoc Research Fellow, KSU


Dormancy
Stay green
Waxy leaves
Fibrous Roots

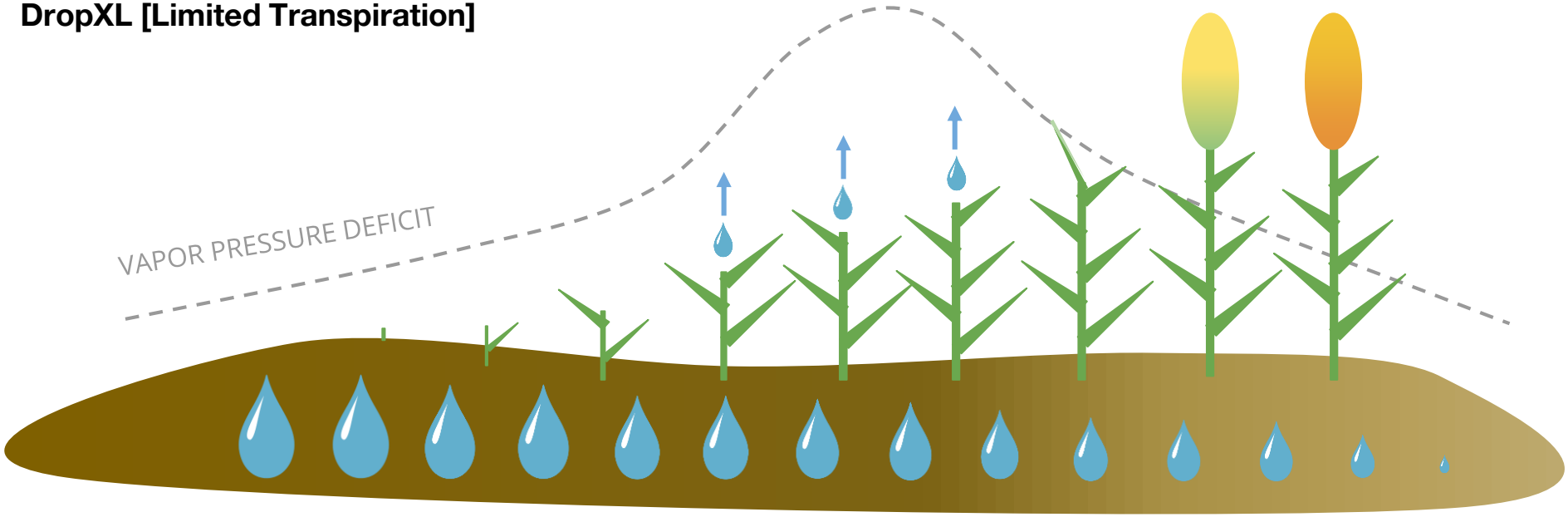

Sorghum Plantings from 2012-2021
Decadal Trends and Variability.
Source. USDA NASS
*Not reported if less than
3 observations in decade
Coefficient of Variation for Annual Planting Area
50
100
150
200
80
60
40
20
0
−20
−40
−60
−80
−100
% change in decadal rolling average


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

NON-DropXL



DropXL [Limited Transpiration]



TRAIT
MAP


TRAIT
MAP
TRAIT
MARKER
TRAIT
DONOR
DropXL
Sorghum
A trait technology
package

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

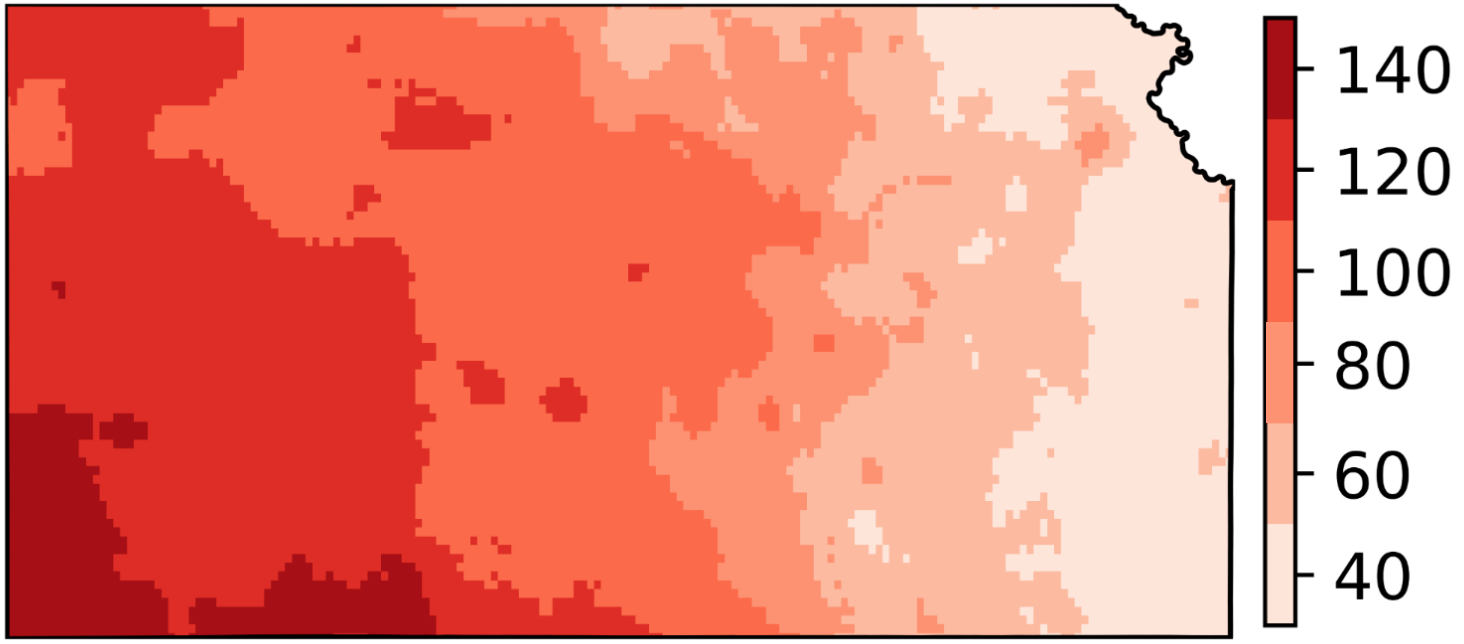
TRAIT MARKER

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

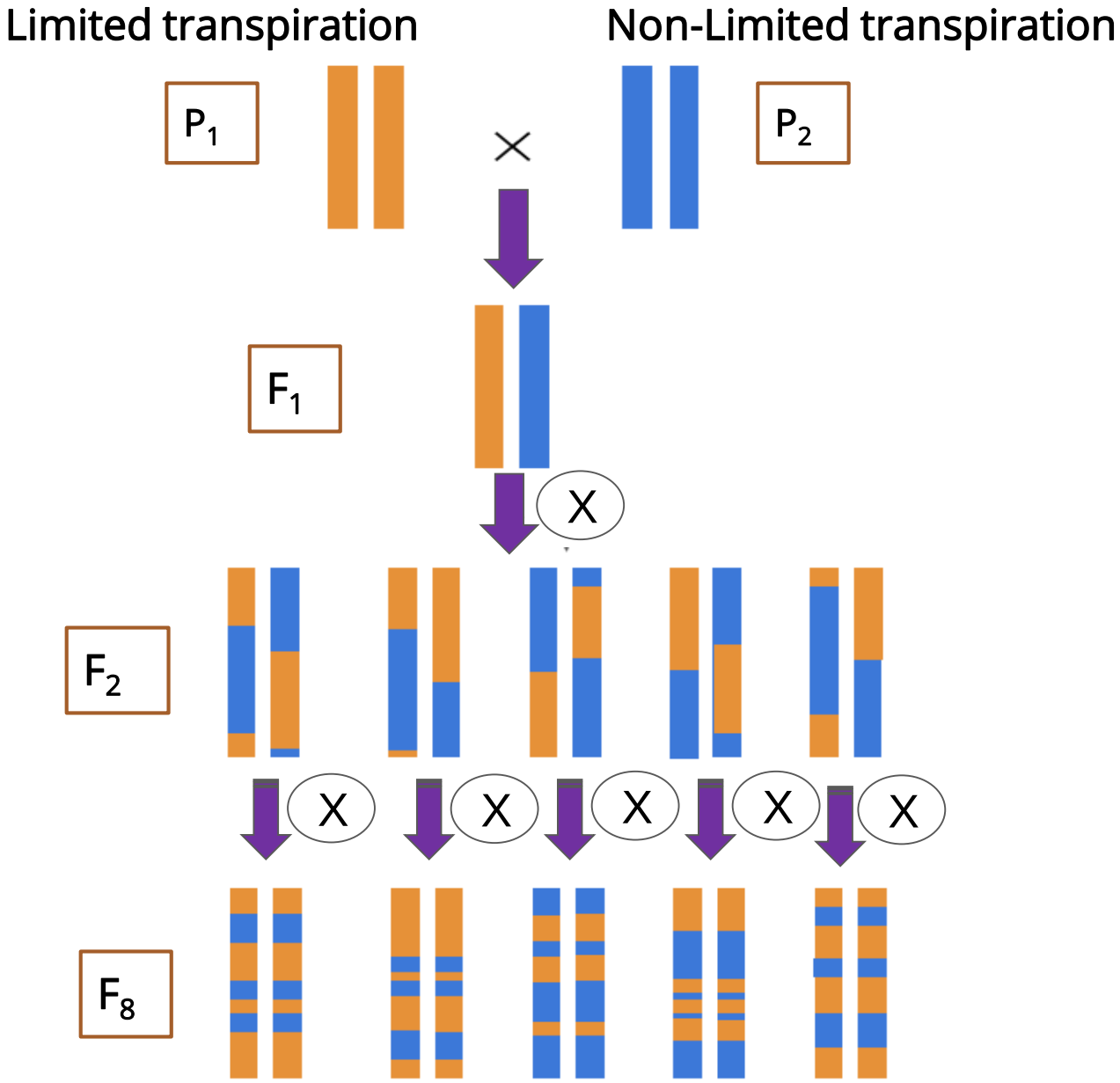
A holistic approach to genetically dissect traits and develop markers to track water use efficient traits

2025 **TRAIT DONOR**
Resource Generation

On going: 2025

Donor lines with desirable agronomic and dropXL traits to breeding programs

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

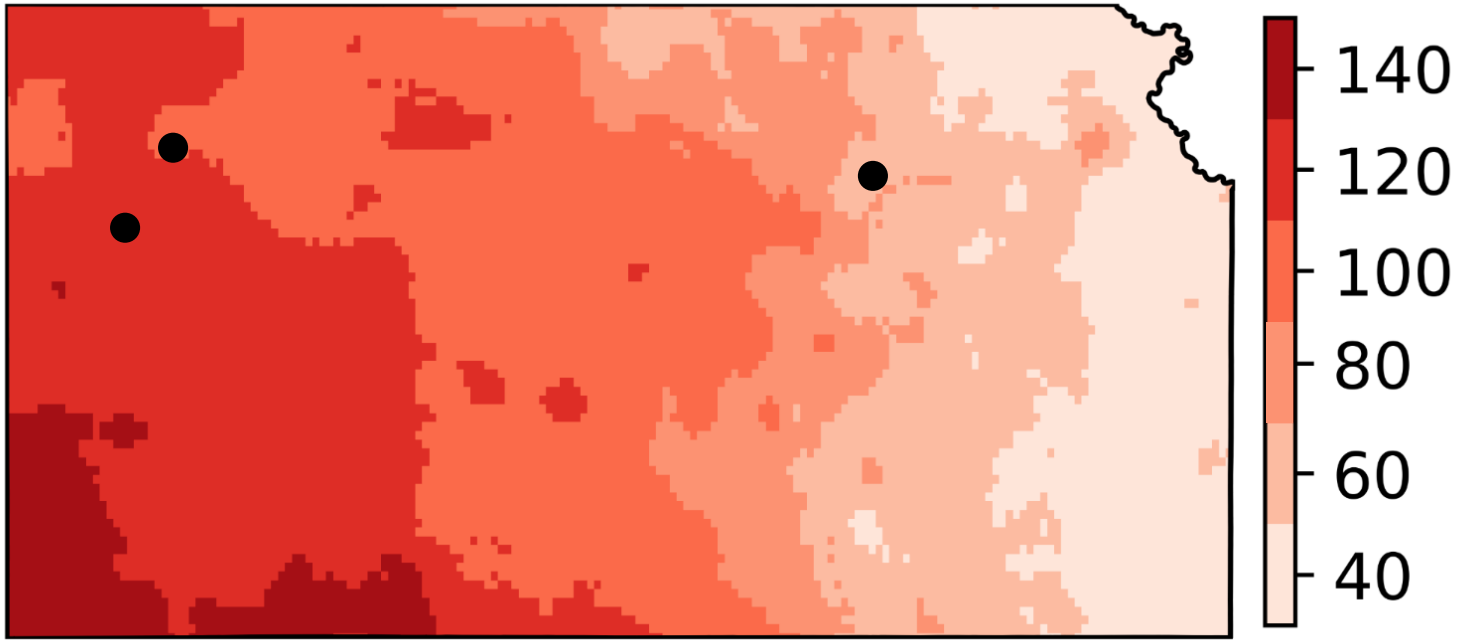
- Seed multiplied at Mexico
- Bulk seed production

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?



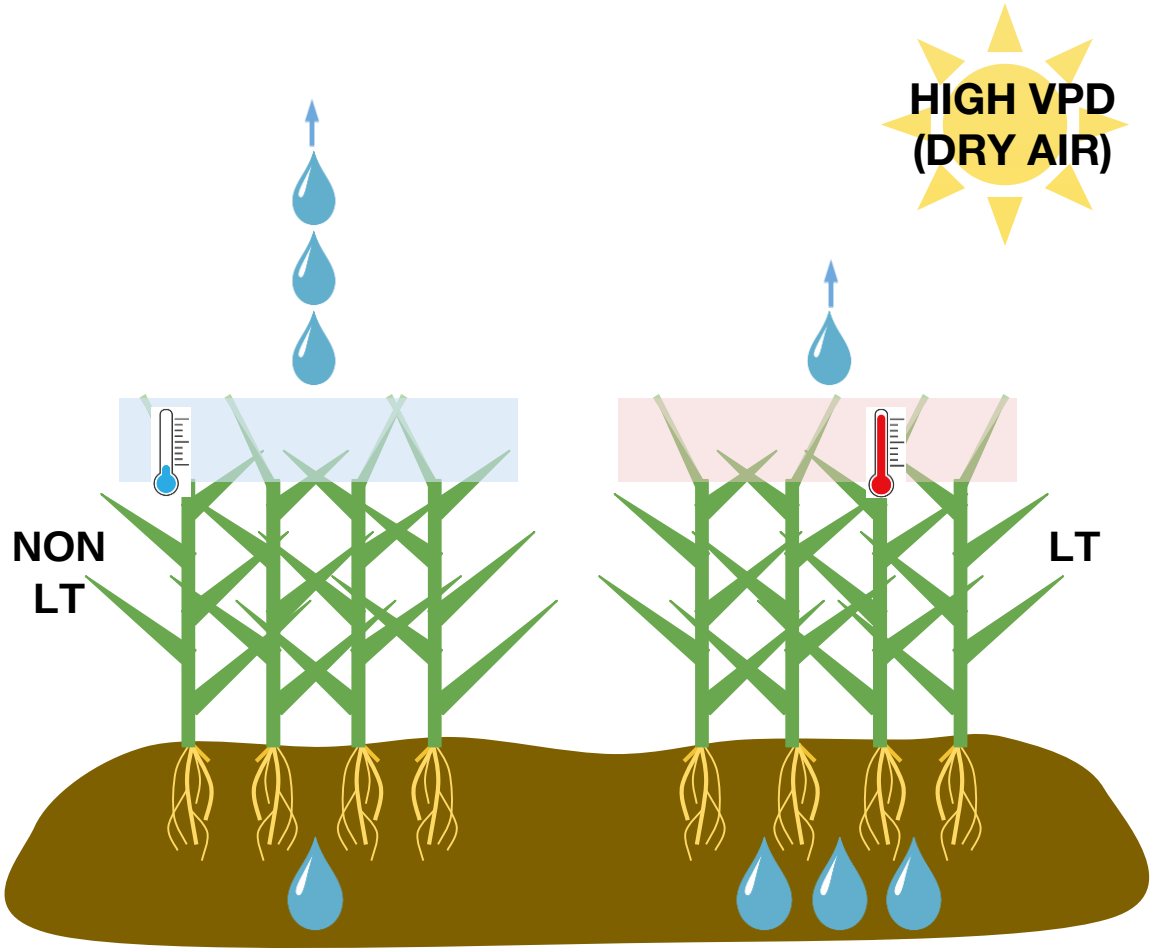
- Manhattan
- Colby
- Tribune

Trial setup 2022

- A population of 320 individuals were planted in a RCBD design with 3 replicates, 10 ft 4 row plots, 987 plots each location
- The trial was at 3 locations (Manhattan, Colby, Tribune of KS) covering 12 acres total

DropXL 2022 Trial at Manhattan, KS

How to approach plant phenotyping?



Leaf porometer

$$$$

Leaf porometer

$$$$

Infrared thermometer

$$$$$

$

Leaf porometer

$$$$

Infrared thermometer

$$$$$

$

Unmanned Aerial Vehicle

$

Operational cost and time

Unmanned Aerial Vehicle

Infrared Thermometer

Leaf Porometer

$

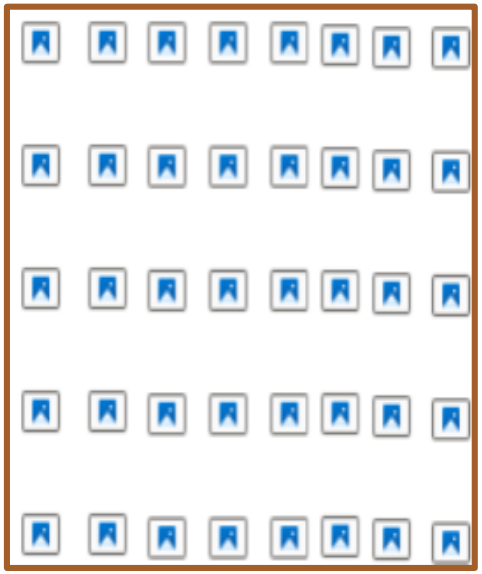
Time

UAV image capturing

DropXL mapping population at Manhattan, KS

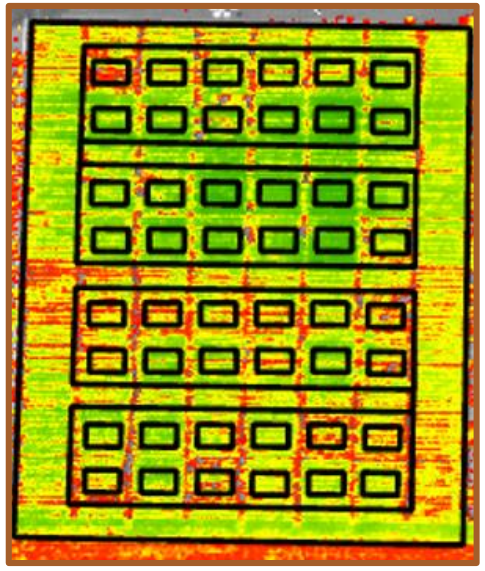
Trevor Witt flying UAV

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



Raw images

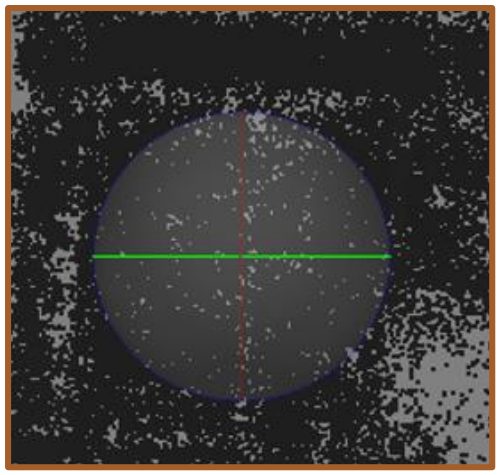
?



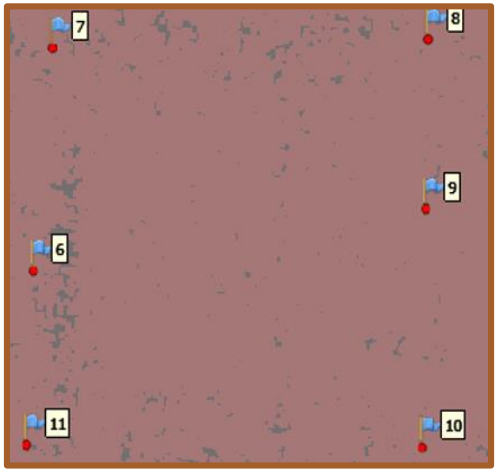
Plot level temperature data

UAV image processing pipeline

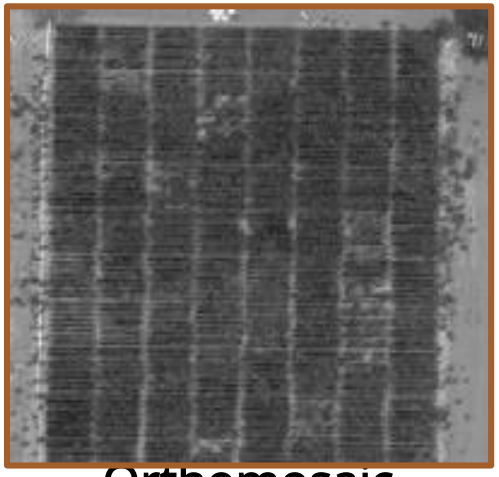
Raw images



Sparse Cloud



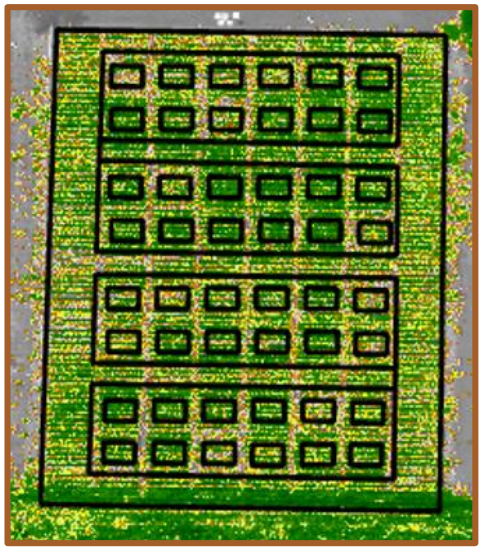
Dense Cloud



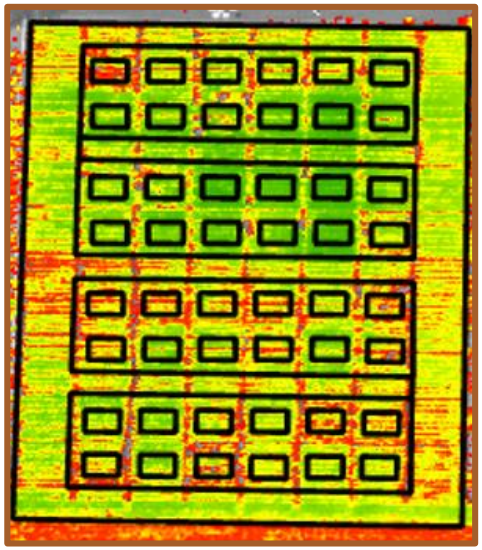
Orthomosaic

Plot level data extraction

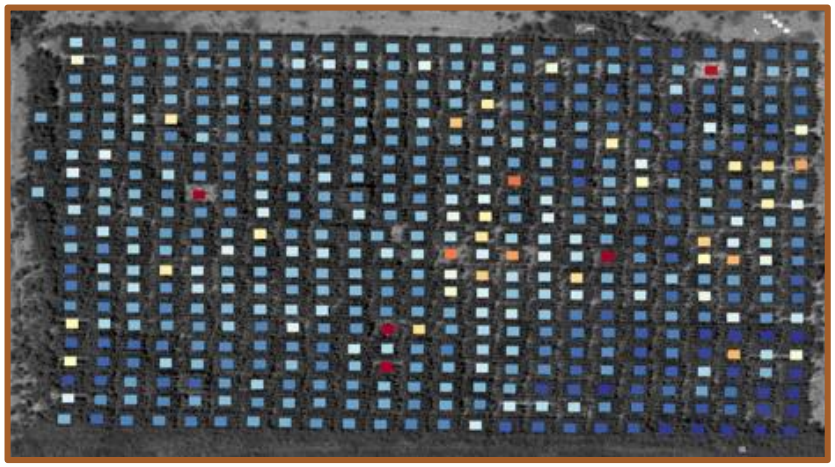
Orthomosaic



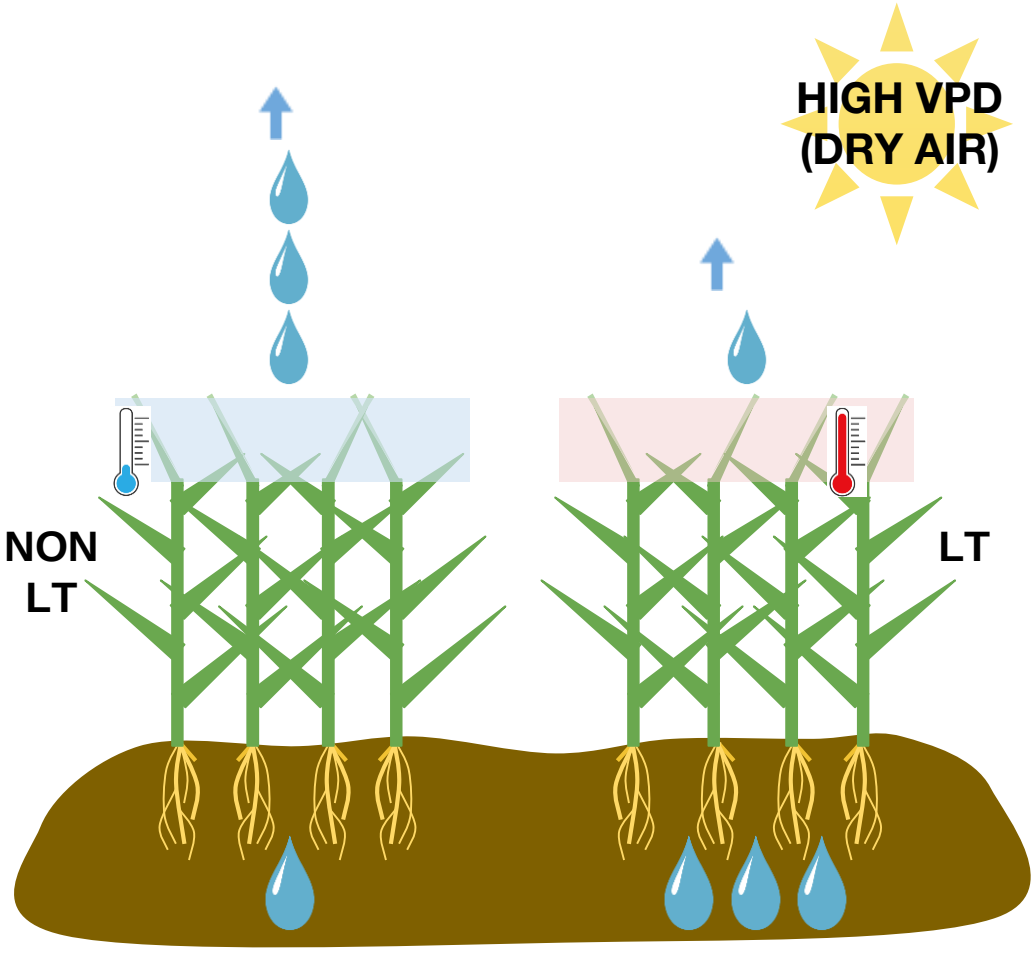
Overlaying shapefile



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

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Thank you!