

Smart Forage Sorghum: Precision Sensing for Optimized Irrigation Water Management

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OAP Forage Sorghum Research Planning Meeting

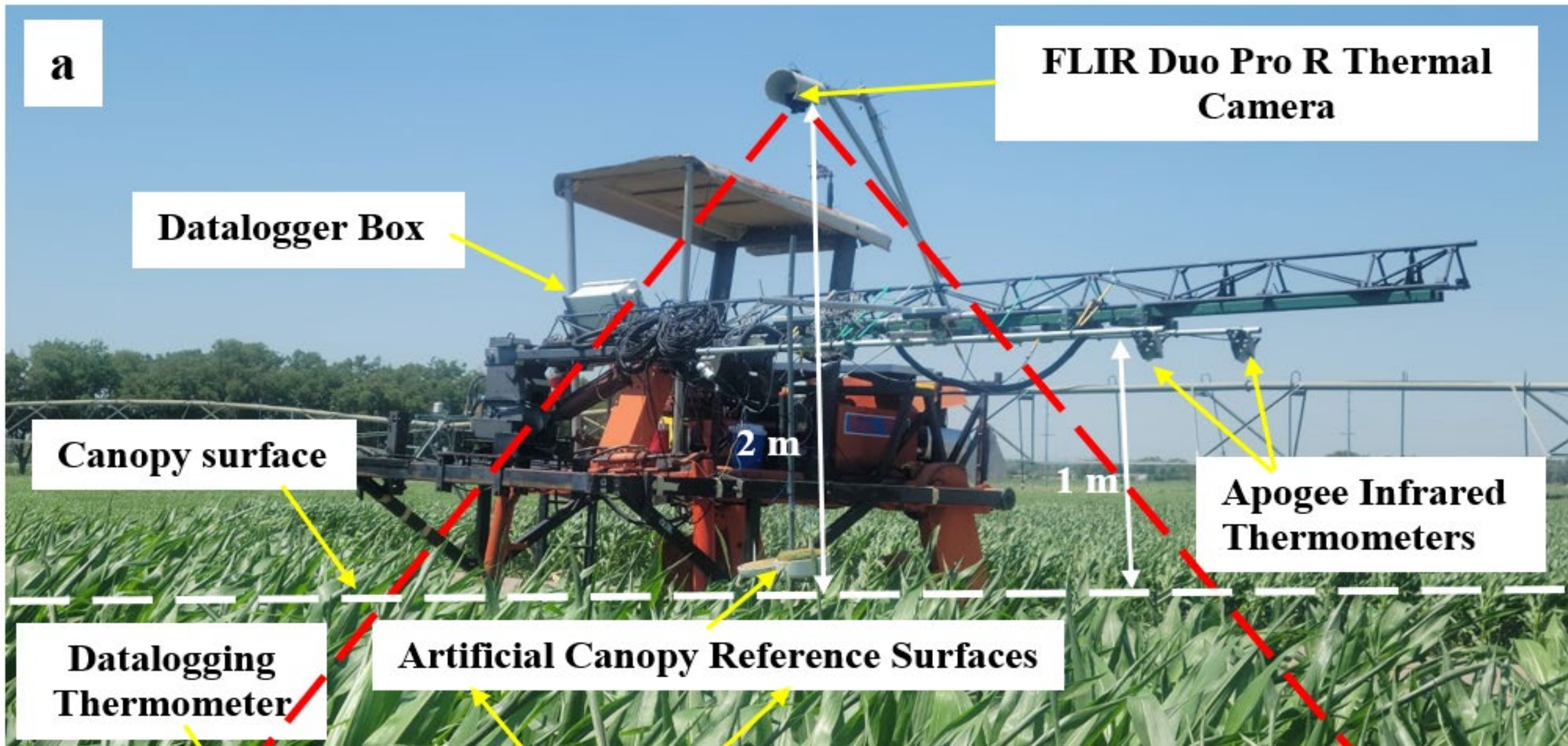
12/10 – 12/11, 2024

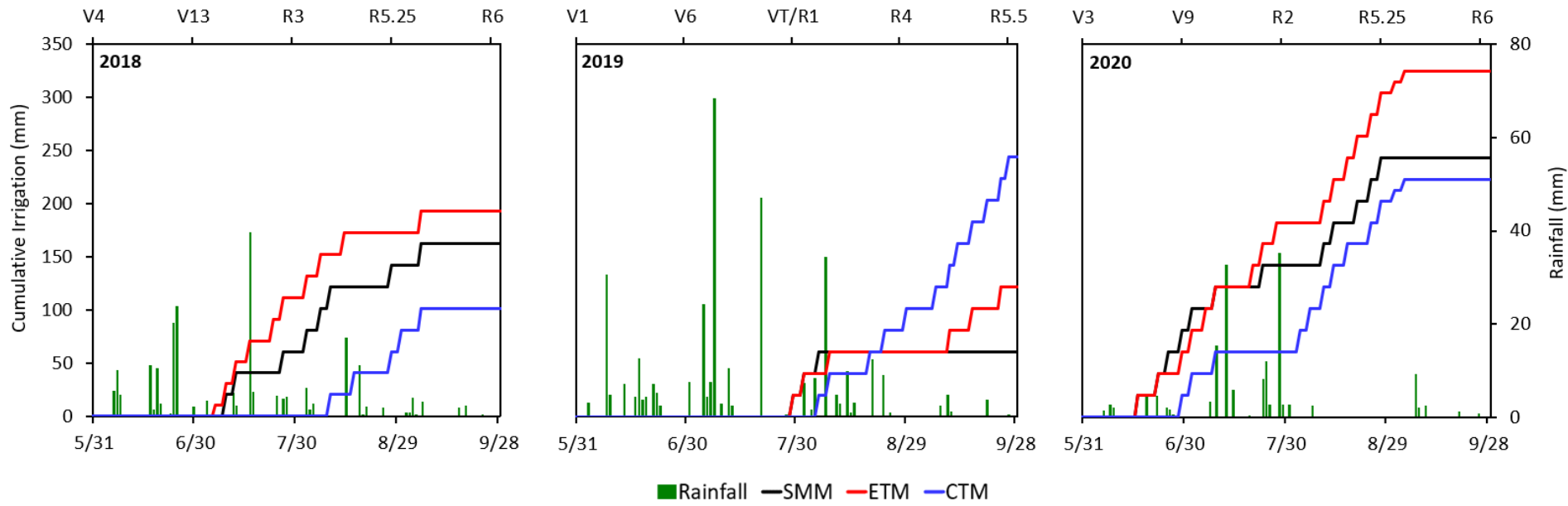
USDA ARS Bushland

Background and Past Research

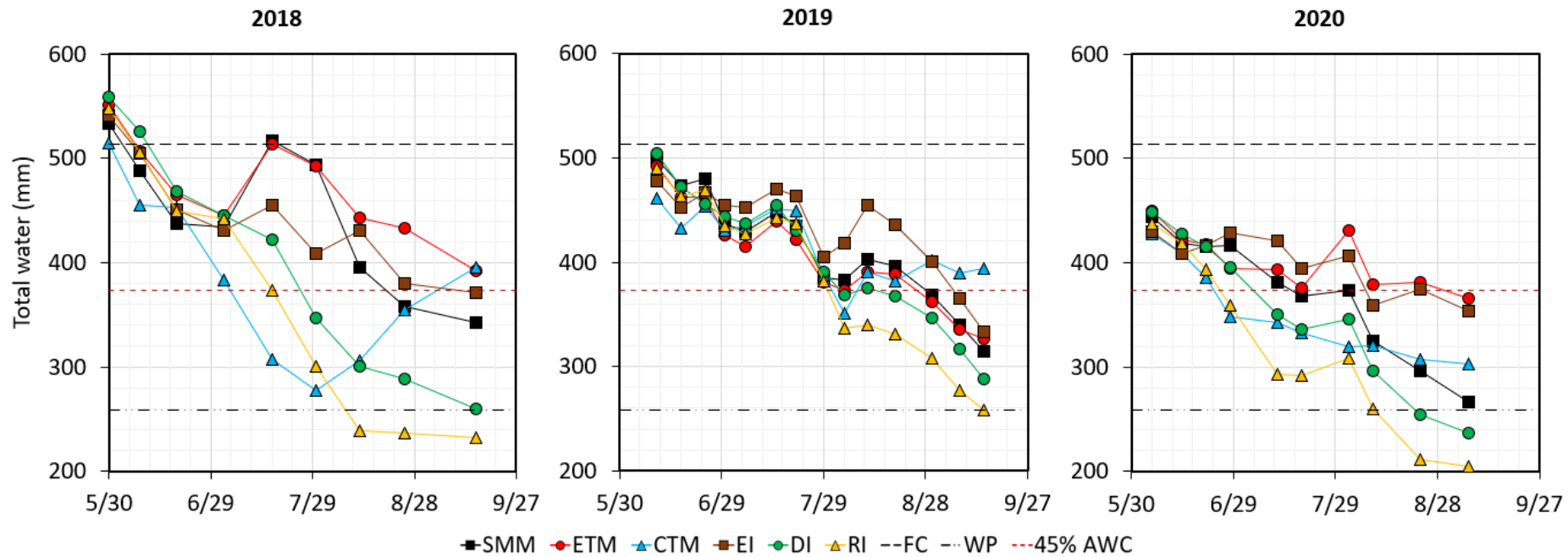


Sensing platform



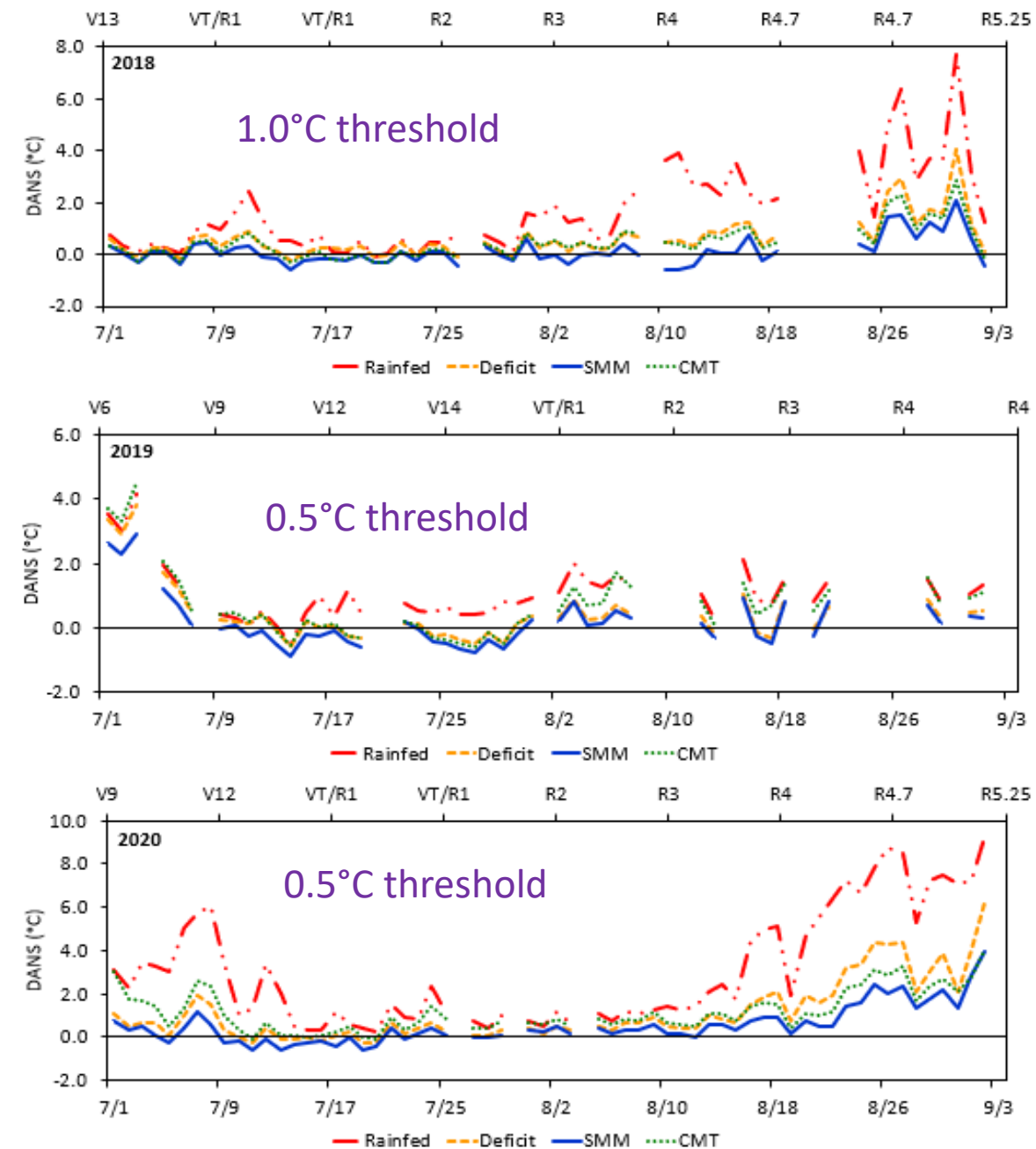
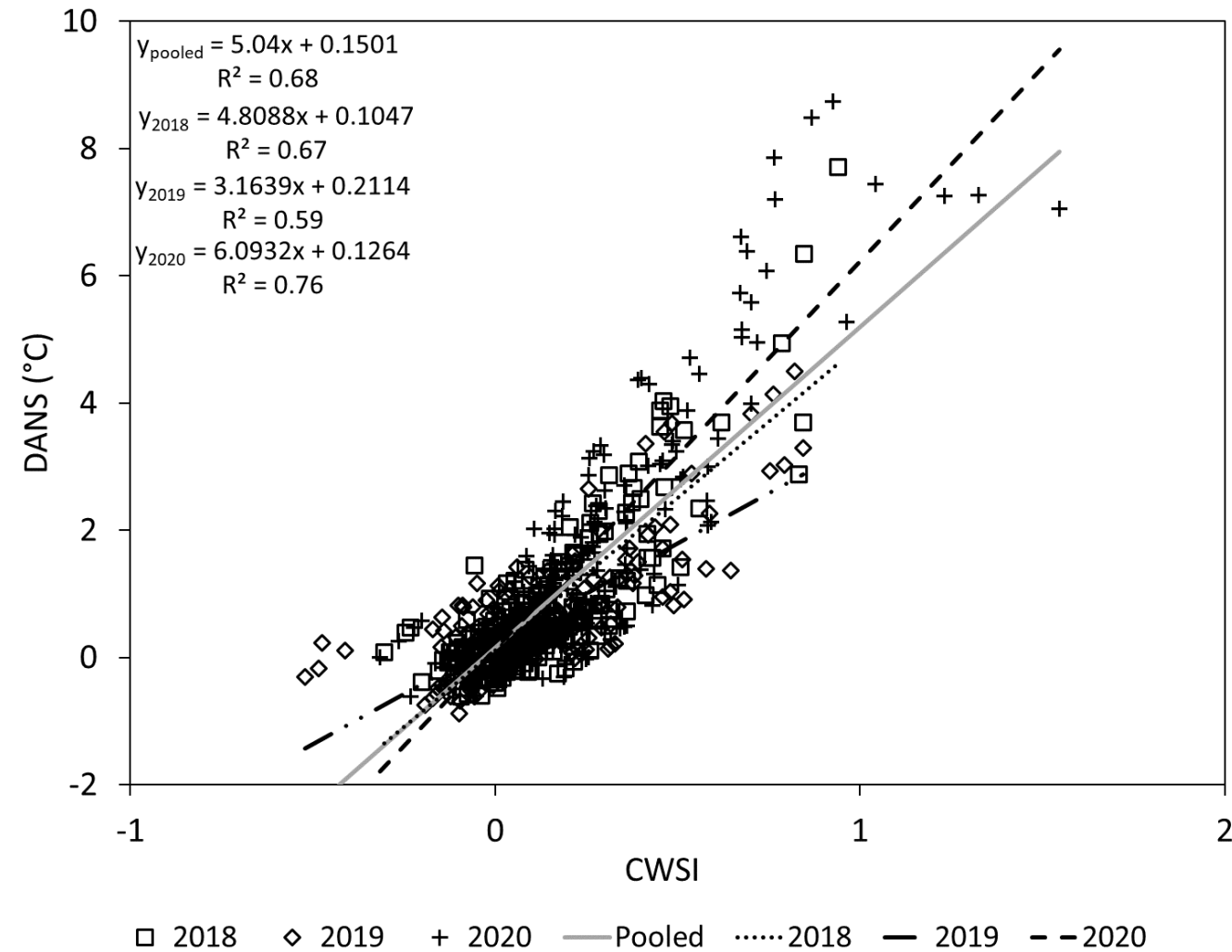


Cumulative irrigation water applied, daily rainfall and corresponding growth stages



Distribution of neutron moisture meter measured total water (TW) in the 1.8 m soil profile

EI – Excessively irrigated
 DI – Deficit irrigated
 RI – Rainfed



Regression equations of CWSI against the DANS index

Seasonal degrees above non-stressed

Forage Sorghum Research Project Question(s) and Objectives



Research Motivation

- ❑ A gap still exists in qualitatively and quantitatively understanding the crop water stress responses and crop water use dynamics of proposed forage crops in the Southern Ogallala Aquifer Region.

Specific Objective I:

- ❑ Establish data-driven irrigation management strategies for forage sorghum by determining water stress ranges and agronomic responses based off soil moisture monitoring and crop ET modeling.
- ❑ Derive crop coefficient (K_c)
- ❑ Above ground sensing derived vegetation indices (NDVI) and (NDRE))

Specific Objective II:

- ❑ Develop localized canopy temperature related stressed and non-stressed thermal baselines as well as estimate thermal indices (CWSI and DANS) thresholds for forage sorghum
- ❑ Opportunity to use CWSI and DANS to schedule irrigation in forage sorghum will be explored.

Specific Objective III:

- ❑ Quantify farm economic input versus output of forage sorghum production in water limited research locations in Kansas and Texas
- ❑ These results and overall research findings from objectives I and II will be disseminated to producers and stakeholders.

Methods



Research Sites

- ❑ Texas A&M AgriLife
Research Site in Halfway,
Texas
- ❑ Kansas State University
Research and Extension
Center, Garden City, Kansas

Specific objective execution:

- ❑ A soil water balance will be run to estimate crop ET across the irrigation water level treatments and treatment specific Kc values will be computed
- ❑ UAV and/or satellite imagery will be utilized to identify the seasonal crop vegetation index curves for NDVI and NDRE

Specific objective execution:

- Stationary infrared thermometers to monitor canopy temperature (T_c).
- Drone thermal imagery will also be used to capture T_c across all study treatments at the Halfway research farm site.
- Thermal indices to be computed.

Specific objective execution:

- ❑ Net return analyses across the different irrigation treatments to assess the feasibility of adopting forage sorghum production across different irrigation capacities.

- ❑ Dissemination of overall research findings from to producers and stakeholders.

Preliminary Results



Preliminary Results:

- ❑ Sorghum Sudan grass, Variety Champ II (Frontier)
- ❑ Planting date: 4/30/2024
- ❑ 2 Irrigation treatments + Dryland
- ❑ 1st cutting: 6/26/2024

❑ **Measurements taken**

- Neutron soil moisture readings (2- 3 weeks interval)
- Growth stages
- 1 Aerial sensing campaign
- Nutrient Analysis (Ward lab)
- Yield

Preliminary Results:

Treatment ID	In-Season Irrigation (in)	Harvest Weight (lb/ac)
Dryland	0	3290
Irrigation level 1	6.3	7519
Irrigation level 2	4.8	8870

Next Steps:

2025 Growing Season

- Setting up experimental site at research station in Garden City, KS and continuing work in Halfway, TX
- Instrumenting field as proposed in 2025 growing season

Thank you



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