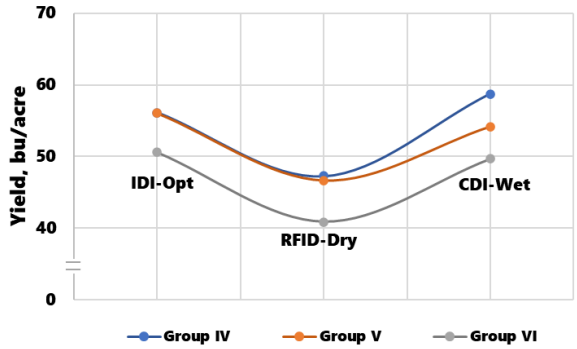
Water Resiliency Soybean Variety Performance Trials

Summary

- Soybean yield varied with maturity group under Optimal, Dry (rainfed), and Wet irrigation and drainage (DAI) treatment levels.
- Overall, Groups IV and V varieties outperformed Group VI varieties, accounting for the difference in varietal entries. Group IV and V varietal performance was not significantly different.
- Late vegetative wet stress days, coupled with major dry stress days during the reproductive growth stages, produced an unusual "concave" yield curve, wherein Wet and Optimal treatment levels performed on par, and the Dry treatment underperformed across the board. This suggests that Wet stress experienced by soybeans during the late vegetative stage before R1 does not significantly reduce yield.



Soybean response to drainage and irrigation (DAI) levels in 2025. Wet stress was targeted solely for late vegetative to R1 stage. Solid dots represent the average yield for Group IV, V, and VI varieties.

2025 Soybean Resilience Trial Information
Performance by DAI Level Exposure

DAI Level	*n*	*Yield*, bu/acre*	*CV*
CDI-Wet	52	54.9	10.2
IDI-Optimal	52	54.4	10.0
RFID-Dry	52	45.2	14.0

*Means with the same color band are not different at the LSD α=0.05 test level.

2025 Soybean Resilience Trial Information
Performance by Maturity Group

Maturity Group	*n*	*Yield*, bu/acre*	*CV*
IV	72	54.1	13.2
V	36	52.3	10.1
VI	48	47.1	14.6

*Means with the same color band are not different at the LSD α=0.05 test level.

2025 Soybean Resilience Trial Information
DAI Level × Maturity Group

DAI Level	*Maturity Group*	*n*	*Yield*, bu/acre*	*CV*
IDI-Opt	IV	24	56.1	9.3
	V	12	56.1	7.2
	VI	16	50.6	9.6
RFID-Dry	IV	24	47.3	13.9
	V	12	46.7	5.1
	VI	16	40.9	15.0
CDI-Wet	IV	24	58.7	5.8
	V	12	54.2	6.8
	VI	16	49.7	10.1

*Means with the same color band are not different at the LSD α=0.05 test level.

Introduction

Principal goals of the water resiliency performance trials are:

- To evaluate elite, commercially available soybean varieties to levels of water stress during ach crop growth stage.
- To generate objective data for extension agents, producers, and advisors in selecting hybrids appropriate for their field situations.

The trials, conducted at the Total Ag Water Management (TAWM) Site at the Tidewater Research Station in Plymouth, NC, imposed artificial water stress during the growing season on a uniform soil type and observed natural precipitation. Thirteen varieties from three agribusiness suppliers were trialed in 2025. The varieties were randomized and replicated four times in a two-level experimental design on a Portsmouth fine sandy loam soil. The target planting density was 120,000 seeds/acre on 30-inch row spacing. The trial plots were planted on May 23 and harvested sequentially from the 22nd of October through 11th November using a plot combine equipped with a sensor-based electronic yield monitoring and display system. Yield data were analyzed using a mixed-effects model with drainage and irrigation (DAI) level, maturity group, and variety as fixed effects, and replication as a random effect in SAS 9.4 Proc Glimmix. Mean separation was performed via least significant difference (LSD, $\alpha = 0.05$); the two top-yielding ranges are displayed.

The drainage and irrigation (DAI) treatments implemented by the project are designed to achieve different levels of exposure to water stress during the growing season, as described below.

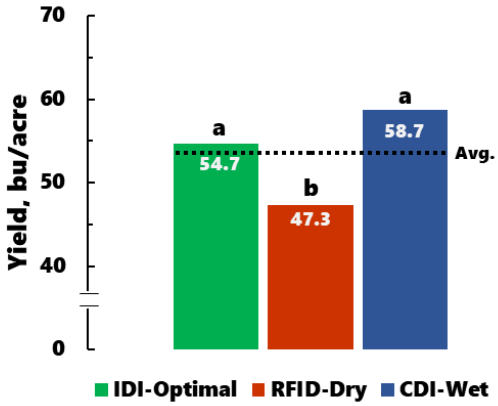
- Rainfed + Intensive Drainage (RFID-Dry): Intended to create drier than normal conditions typical of well-drained sites in NC. Drain tile spacing is 37.5', which is highly intensive for a Portsmouth fine sandy loam soil and intended to provide a much higher drainage intensity than needed for efficient crop production on this soil type. Soil moisture content is entirely governed by natural rainfall and by tile drains discharging at full capacity throughout the growing season.
- Intensive Drainage + Irrigation (IDI-Optimal): Intended to create ideal conditions representative of efficient water management systems. Soil water matric potential is continuously monitored at 8" and 20" depths in the root zone, with subsurface drip irrigation applied during drier-than-normal periods.
- Controlled Drainage + Irrigation (CDI-Wet): Intended to create a water-saturated root zone typical of river bottoms and tidal controlled drainage areas during most growing seasons. Tile drainage spacing is 37.5' and is controlled to reduce natural drainage capacity and impose wet stress artificially at specific growth stages. This is coupled with subsurface drip irrigation to further impose wet stress.

Key Performance Statistics for **Group IV** Varieties, Tidewater Research Station 2025

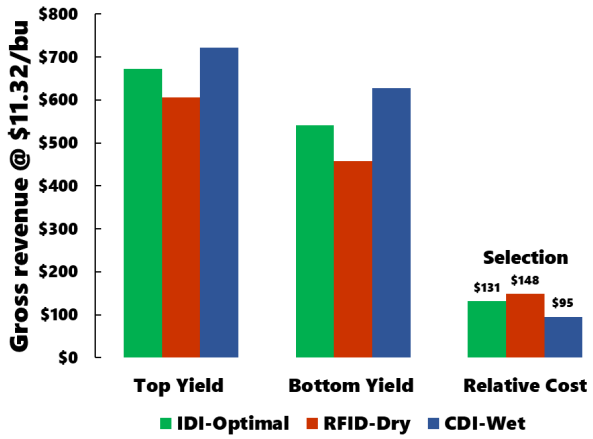
2025 Group IV Soybean Resilience Trial Information

DAI Level	*Company*	*Entry*	*RM Group*	*n*	*Yield* bu/acre*	*CV*
IDI-Optimal	Pioneer	P43Z44E	4.3	4	59.4	7.1
	Pioneer	P45Z5E	4.5	4	59.4	4.0
	Scout	GT479XFS	4.7	4	57.9	5.6
	Pioneer	P45A81E	4.5	4	57.3	5.8
	So. Harvest	SH4622E3	4.6	4	55.0	6.0
	Scout	GT487XFS	4.8	4	47.8	10.8
		Mean		24	56.1	9.3
		LSD, 0.05			4.6	
RFID-Dry	Pioneer	P45Z5E	4.5	4	53.6	5.1
	Pioneer	P43Z44E	4.3	4	52.3	8.7
	Pioneer	P45A81E	4.5	4	51.7	5.1
	Scout	GT479XFS	4.7	4	44.0	6.9
	Scout	GT487XFS	4.8	4	41.7	17.6
	So. Harvest	SH4622E3	4.6	4	40.5	4.7
		Mean		24	47.3	13.9
		LSD, 0.05			4.7	
CDI-Wet	Pioneer	P43Z44E	4.3	4	63.8	6.7
	Pioneer	P45Z5E	4.5	4	59.7	4.6
	Pioneer	P45A81E	4.5	4	58.9	2.1
	Scout	GT479XFS	4.7	4	58.2	2.5
	Scout	GT487XFS	4.8	4	56.6	3.0
	So. Harvest	SH4622E3	4.6	4	55.4	1.2
		Mean		24	58.7	5.8
		LSD, 0.05			3.4	
Overall	Pioneer	P43Z44E	4.3	12	58.5	10.8
	Pioneer	P45A81E	4.5	12	57.6	6.5
	Pioneer	P45Z5E	4.5	12	56.0	7.1
	Scout	GT479XFS	4.7	12	53.4	13.7
	So. Harvest	SH4622E3	4.6	12	50.3	14.9
	Scout	GT487XFS	4.8	12	48.7	16.4
		Mean		72	54.1	13.2
		LSD, 0.05			2.7	

*Means with the same color band are not different at the LSD α=0.05 test level.



Group IV soybean variety response to Optimal, RFID-Dry (Dryland), and Wet treatment exposure. Means with the same lower-case letter are not different at the LSD α = 0.05 test level.



Gross revenue and relative cost comparison of Group IV variety selection under three soil water treatment exposures, based on the 2025 Tidewater trials. Top Yield is the gross revenue generated by the highest average yielding variety in each management category; Bottom Yield is the gross revenue generated by the lowest average yielding variety. Relative cost is Top Yield – Bottom Yield for each category representing the cost of variety selection in different environments.

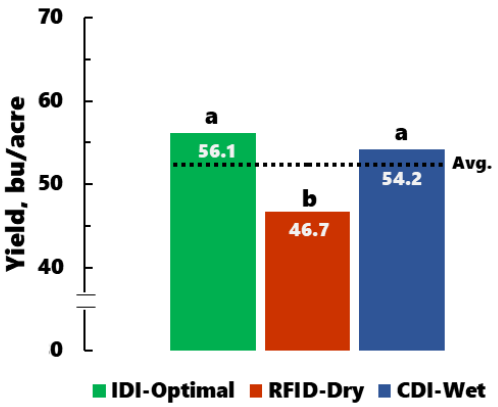
Water Resiliency Soybean Variety Performance Trials

Key Performance Statistics for **Group V** Varieties, Tidewater Research Station 2025

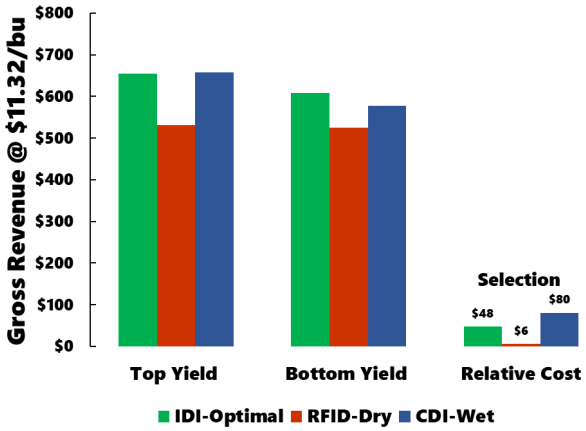
2025 Group V Soybean Resilience Trial Information

DAI Level	Company	Entry	MG Group	n	Yield* bu/acre		CV
IDI-Optimal	Pioneer	P52A14SE	5.2	4	57.9		5.1
	Pioneer	P56A71E	5.6	4	56.7		7.7
	Pioneer	P56Z22E	5.6	4	53.7		8.3
		Average		12	56.1		7.2
		LSD, 0.05			3.4		
RFID-Dry	Pioneer	P56Z22E	5.6	4	46.9		7.4
	Pioneer	P52A14SE	5.2	4	46.9		4.3
	Pioneer	P56A71E	5.6	4	46.4		4.5
		Average		12	46.7		5.1
		LSD, 0.05			4.4		
CDI-Wet	Pioneer	P52A14SE	5.2	4	58.1		3.7
	Pioneer	P56A71E	5.6	4	53.5		5.1
	Pioneer	P56Z22E	5.6	4	51.0		2.6
		Average		12	54.2		6.8
		LSD, 0.05			1.8		
Overall	Pioneer	P52A14SE	5.2	12	54.3		10.9
	Pioneer	P56A71E	5.6	12	52.2		10.2
	Pioneer	P56Z22E	5.6	12	50.5		8.3
		Average		36	52.3		10.1
		LSD, 0.05			1.7		

*Means with the same color band are not different at the LSD α=0.05 test level.



Group V soybean variety response to Optimal, RFID-Dry (Dryland), and Wet treatment exposure. Means with the same lower-case letter are not different at the LSD α = 0.05 test level.



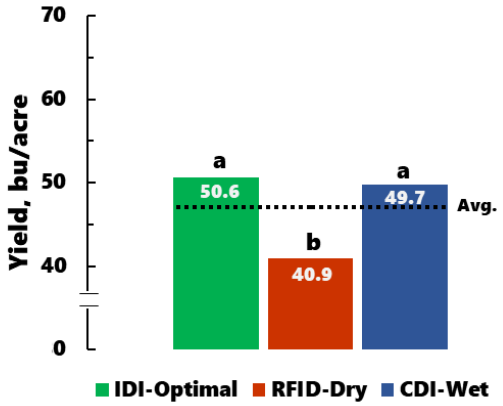
Gross revenue and relative cost comparison of Group V variety selection under three soil water treatment exposures, based on the 2025 Tidewater trials. Top Yield is the gross revenue generated by the highest average yielding variety in each management category; Bottom Yield is the gross revenue generated by the lowest average yielding variety. Relative cost is Top Yield – Bottom Yield for each category, representing the cost of variety selection in different environments.

Key Performance Statistics for **Group VI** Varieties, Tidewater Research Station 2025

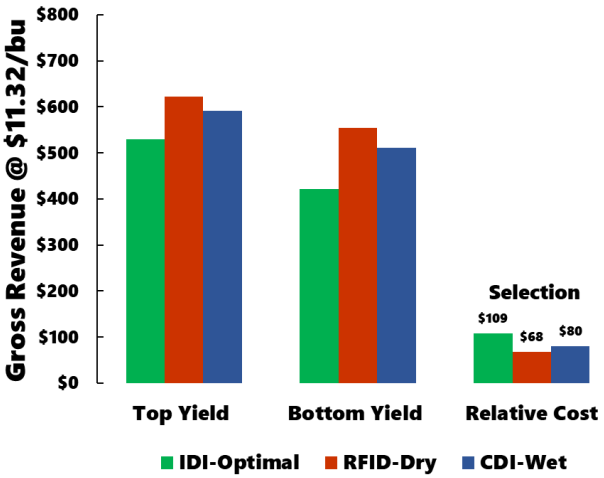
2025 Group VI Soybean Resilience Trial Information

DAI Level	Company	Entry	MG Group	n	Yield* bu/acre	CV
IDI-Optimal	Pioneer	P64Z52E	6.4	4	55.0	13.1
	Pioneer	P68A41BE	6.8	4	49.6	6.1
	Pioneer	P63A93E	6.3	4	49.0	7.4
	Pioneer	P60Z06E	6.0	4	49.0	6.3
		Average		16	50.6	9.6
		LSD, 0.05			5.3	
RFID-Dry	Pioneer	P60Z06E	6.0	4	46.8	17.7
	Pioneer	P63A93E	6.3	4	40.1	8.3
	Pioneer	P68A41BE	6.8	4	39.4	11.9
	Pioneer	P64Z52E	6.4	4	37.2	11.0
		Average		16	40.9	15.0
		LSD, 0.05			8.3	
CDI-Wet	Pioneer	P68A41BE	6.8	4	52.2	16.8
	Pioneer	P64Z52E	6.4	4	51.0	4.4
	Pioneer	P60Z06E	6.0	4	50.4	2.8
	Pioneer	P63A93E	6.3	4	45.1	3.4
		Average		16	49.7	10.1
		LSD, 0.05			6.8	
Overall	P60Z06E	Pioneer	6	12	48.7	10.1
	P64Z52E	Pioneer	6.4	12	47.7	19.2
	P68A41BE	Pioneer	6.8	12	47.1	16.8
	P63A93E	Pioneer	6.3	12	44.7	10.4
		Average		48	47.1	14.6
		LSD, 0.05			3.6	

*Means with the same color band are not different at the LSD α=0.05 test level.

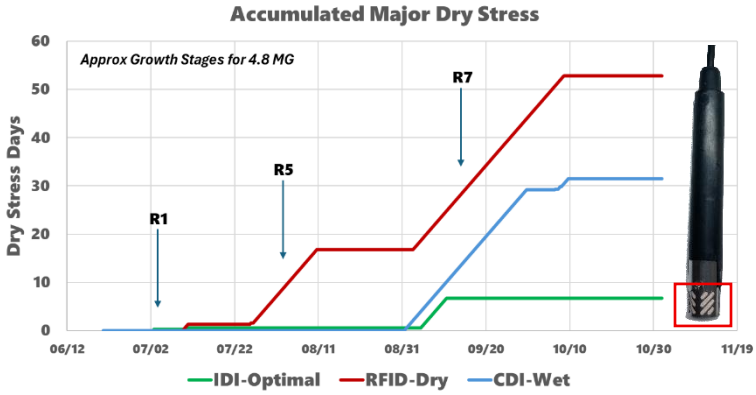


Group VI soybean variety response to Optimal, RFID-Dry (Dryland), and Wet treatment exposure. Means with the same lower-case letter are not different at the LSD α = 0.05 test level.

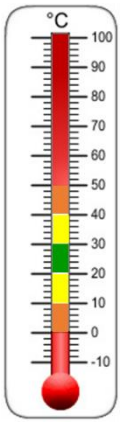


Gross revenue and relative cost comparison of Group VI variety selection under three soil water treatment exposures, based on the 2025 Tidewater trials. Top Yield is the gross revenue generated by the highest average yielding variety in each management category; Bottom Yield is the gross revenue generated by the lowest average yielding variety. Relative cost is Top Yield – Bottom Yield for each category representing the cost of variety selection in different environments.

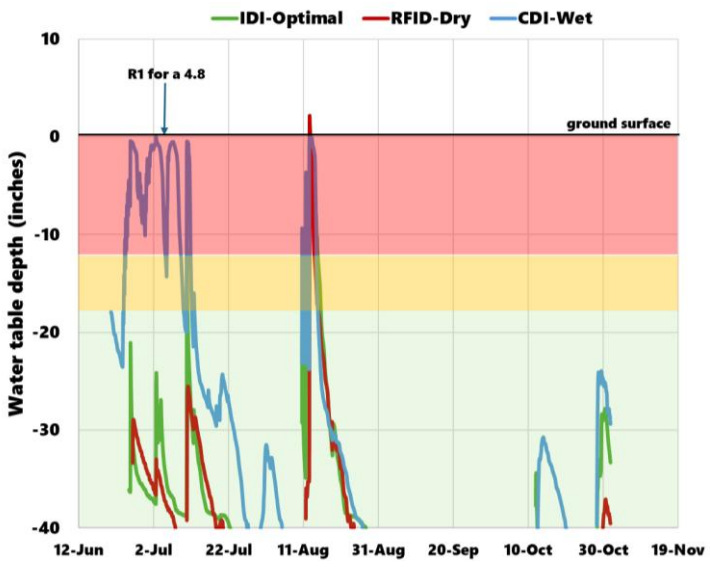
Interpretive Guide and Indicators



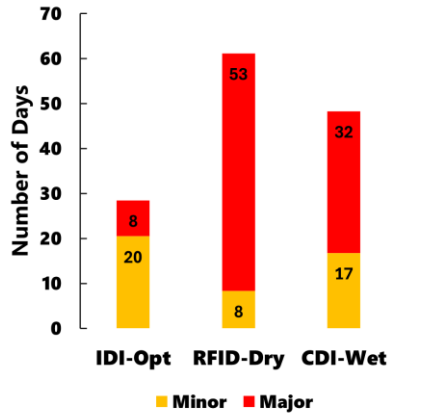
Dry stress levels in soybean were determined by monitoring in-season matric potential in real time 8" deep in the root zone (Inset: Meter Group T22 sensor). Matric potential is a measure of the energy needed by plants to extract water from a porous medium like soil. Lower matric potential (more negative) requires plants to expend greater effort to supply the water needed for nutrient uptake, thermoregulation, and carbon assimilation. The red, blue, and green lines in the chart above are cumulative major dry stress days defined as <-100 kPa, and "minor" stress -55 kPa to -100 kPa, at 8" deep in the root zone in a Portsmouth fine sandy loam soil. Episodes of "minor" stress may occur during irrigation events depending on the rate of water redistribution in the soil.



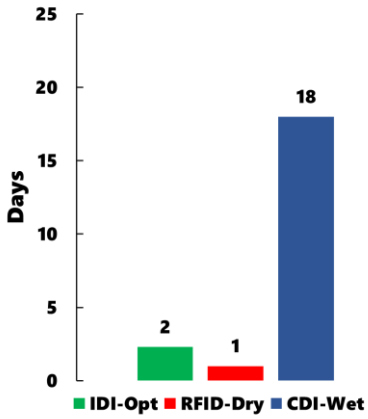
Above, thermometer measuring heat content with fill color indicating human comfort ranges. Right: dial gauge measuring soil water matric potential in kilopascals (kPa) with fill color indicating plant comfort ranges. Green=optimal Red= danger zone.



Groundwater table depth trace showing the water table depth beneath the soybean in three treatment exposures. The presence of a water table indicates a lack of oxygen, which is essential for healthy root metabolism. Soils in tidal-zone areas, such as the North Carolina Blacklands, are naturally poorly drained and depend entirely on water-table management via efficient drainage for agricultural productivity. Depth to water table is a critical stress indicator. Zones are color coded according to the depth and relative crop stress level: Red=high crop stress, <12 inches deep; Yellow=medium crop stress, 12-18 inches deep; and Green=no crop stress, >18 inches deep. A "wet stress day" is defined as a 24-hr. period of saturated crop root zone with water table <12 inches beneath ground surface. Traces running above 0 ft. indicate surface ponded water. Soils were saturated for a brief period around August 12 due to simultaneous high-intensity rainfall events (see daily precipitation record, Page 6).

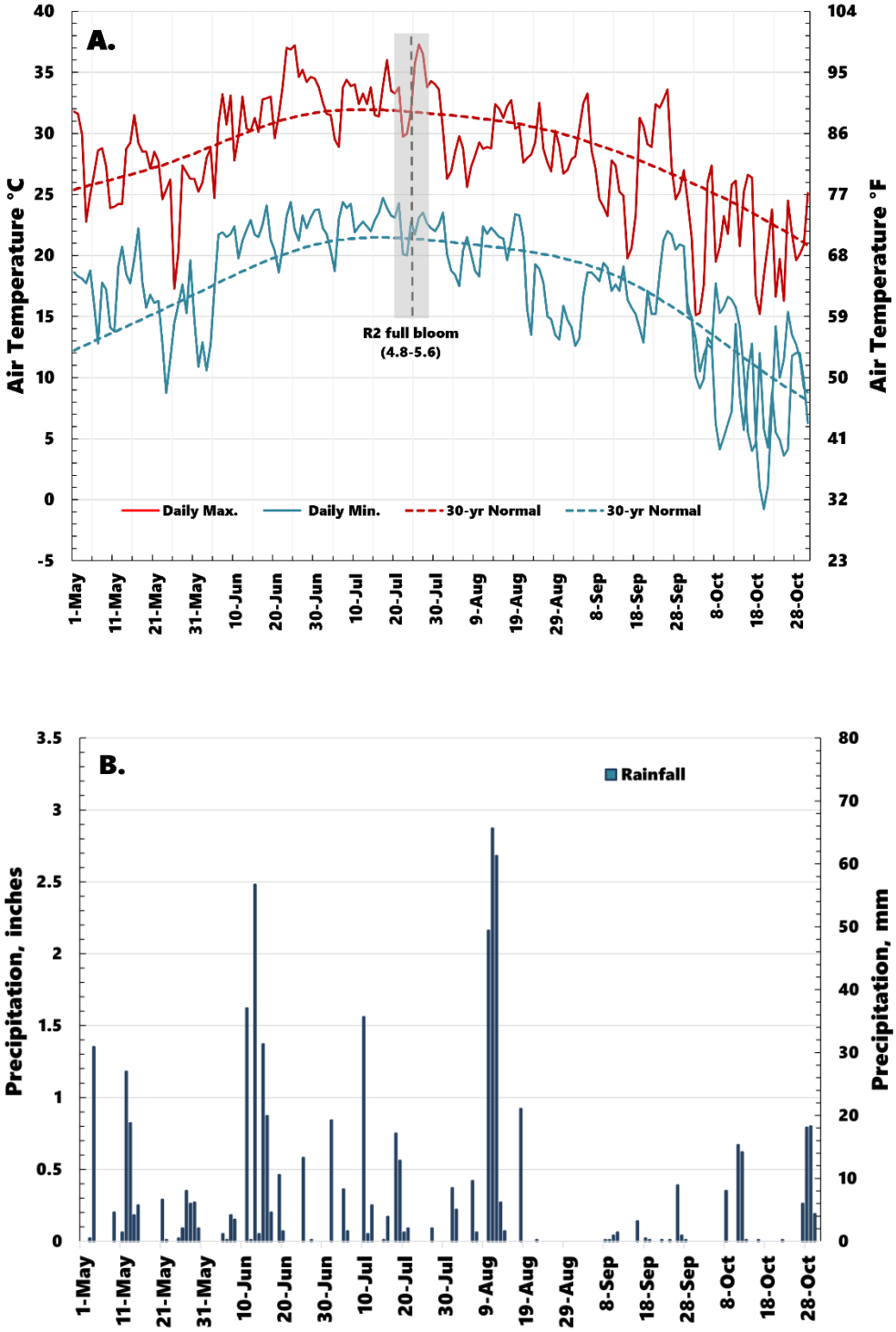


2025 soybean dry stress R1 through R6+, top 12 inches of root zone



2025 soybean wet stress R1 through R6+, top 12 inches of root zone

Weather Information for the Tidewater Research Station May-October 2025



May 1 to October 31, 2025. Panel **A:** Daily maximum and minimum temperatures, and 30-yr Normals. Grey rectangle is R2 interval across drainage treatments and varieties. Panel **B:** Daily precipitation.

Acknowledgements

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