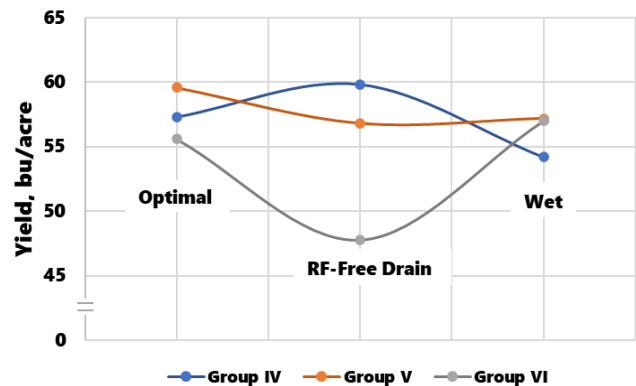


Summary

- Soybean response to water stress varied with relative maturity (RM) group, favoring Group IV varieties under rainfed-free drainage (RF-Free-Drain), Group V under optimal root zone soil water management (Optimal), and Group VI under Optimal and saturated root zone (Wet) treatment exposure.
- Dry exposure suppressed Group VI grain yield overall. Two Group VI varieties averaged +3.9 bu/acre under wet stress, and two varieties performed indifferently, compared to the Optimal soil water treatment.
- Group V varieties exhibited mixed response to wet stress: two varieties returned, on average, +3.1 bu/acre compared to the Optimal soil water treatment. Yield performance for three varieties was indifferent or declined under RF-Free Drain and Wet exposures.



Mixed nature of soybean response to three treatment exposures in 2022. Solid dots are the average yield for Group IV, V, and VI varieties (n=18). Soybean yield potential in different environments may be explained by varietal growth characteristics and the timing and duration of crop stress.

Introduction

The goals of these performance trials were to:

- Evaluate elite, commercially available soybean varieties to water stress exposure during the yield critical R2 to R5 development stages.
- Provide an objective guide for extension agents, producers, and advisors in selecting varieties appropriate for their field situations.

The trials, conducted at the AMPLIFY Total Ag Water Management Site located at the Tidewater Research Station in Plymouth, NC, artificially impose water stress during the growing season under a uniform soil type and observed natural precipitation. Eighteen varieties from six agribusiness partners were trialed in 2022. 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 trials were planted on May 11 and harvested from September 27 to November 9. Yield data were analyzed as a mixed-effects model in SAS 9.4 Proc Glimmix. Mean separation was performed via least significant difference (LSD, $\alpha = 0.05$); the two top yield ranges were selected.



Soybean test plots at the AMPLIFY Total Ag Water Management Site in 2022.

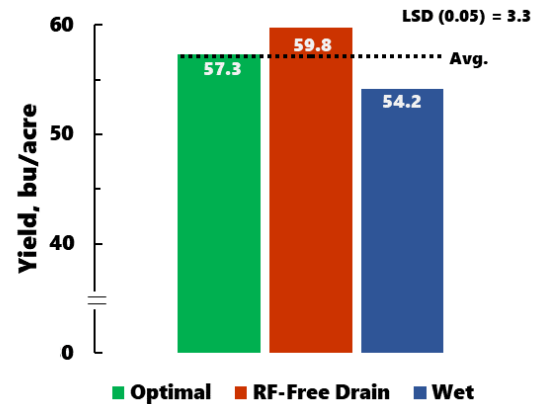
Varieties were evaluated under three soil-water treatments, defined as:

- **Rainfed-Free Drain:** 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 water matric potential was governed entirely by natural rainfall and tile drains discharging at full capacity throughout the growing season.
- **Optimal:** intended to create ideal conditions representative of efficient water management systems. The tile spacing was set to 37.5' to prevent saturated soil conditions. Soil water matric potential was continuously monitored 8" and 20" deep in the root zone. Subsurface drip irrigation was utilized to apply water during dryer than normal periods.
- **Wet:** This treatment was intended to create a water saturated root zone. Tile drainage spacing was 37.5' and controlled to both reduce and/or stop drainage to artificially impose wet stress. This was coupled with subsurface tile and subsurface drip irrigation to further impose wet stress. The drainage outlet was not allowed to free flow unless the groundwater was between 0' and 1.0' below the surface. Irrigation water was continually pumped into the drainage system if the water table fell below 1.0' along with daily subsurface drip irrigation to enhance wet stress conditions. This treatment would represent river bottoms, and tidal controlled drainage areas during most growing seasons. It would be similar to poorly drained and very poorly drained fields with little surface or subsurface drainage capacity.

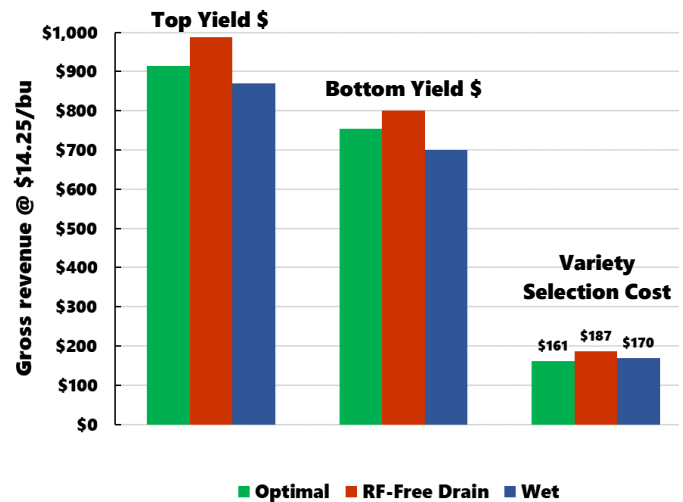
Key Performance Statistics for **Group IV** Varieties, Tidewater Research Station 2022

2022 Group IV Soybean Resilience Trial Information

Soil-Water Regime	Company	Entry	RM Group	n	Yield [†] bu/acre	CV
Optimal	Pioneer	P42A84E	4.2	4	64.2	10.1
	Pioneer	P48A14E	4.8	4	59.2	10.4
	Bayer	AG41XF2	4.1	4	58.2	10.5
	AgriGold	G4742XF	4.7	4	57.6	7.7
	Bayer	AG48XF2	4.8	4	56.2	5.5
	Pioneer	P45T88E	4.5	4	55.9	3.8
	MorSoy	4616RX	4.6	4	55.9	11.5
	Pioneer	P46A09E	4.6	4	55.5	9.4
	Syngenta	S45-P9XF	4.5	4	52.9	10.2
		<i>Mean</i>			57.3	
	<i>LSD, 0.05</i>			6.4		
RF-Free Drain	Pioneer	P42A84E	4.2	4	69.3	2.3
	Bayer	AG48XF2	4.8	4	61.4	7.0
	Bayer	AG41XF2	4.1	4	61.0	4.5
	AgriGold	G4742XF	4.7	4	60.6	4.8
	Pioneer	P48A14E	4.8	4	60.0	5.9
	Pioneer	P45T88E	4.5	4	56.8	11.3
	Pioneer	P46A09E	4.6	4	56.8	9.7
	MorSoy	4616RX	4.6	4	56.3	6.6
	Syngenta	S45-P9XF	4.5	4	56.2	4.3
		<i>Mean</i>			59.8	
	<i>LSD, 0.05</i>			5.8		
Wet	Bayer	AG48XF2	4.8	4	61.0	1.2
	Pioneer	P42A84E	4.2	4	60.8	7.0
	Pioneer	P45T88E	4.5	4	53.8	1.1
	Pioneer	P48A14E	4.8	4	53.6	1.8
	Syngenta	S45-P9XF	4.5	4	53.4	4.0
	Bayer	AG41XF2	4.1	4	53.0	6.2
	MorSoy	4616RX	4.6	4	52.2	3.1
	Pioneer	P46A09E	4.6	4	51.0	4.5
	AgriGold	G4742XF	4.7	4	49.1	8.7
		<i>Mean</i>			54.2	
	<i>LSD, 0.05</i>			3.8		
Overall	Pioneer	P42A84E	4.2	12	64.7	8.5
	Bayer	AG48XF2	4.8	12	59.6	6.2
	Pioneer	P48A14E	4.8	12	57.6	8.3
	Bayer	AG41XF2	4.1	12	57.4	9.1
	AgriGold	G4742XF	4.7	12	55.7	11.1
	Pioneer	P45T88E	4.5	12	55.5	6.8
	MorSoy	4616RX	4.6	12	54.8	8.1
	Pioneer	P46A09E	4.6	12	54.4	9.0
	Syngenta	S45-P9XF	4.5	12	54.2	6.6
		<i>Mean</i>			57.1	
	<i>LSD, 0.05</i>			3.0		



Group IV soybean yield response to Optimal, Dry, and Wet treatment exposure.



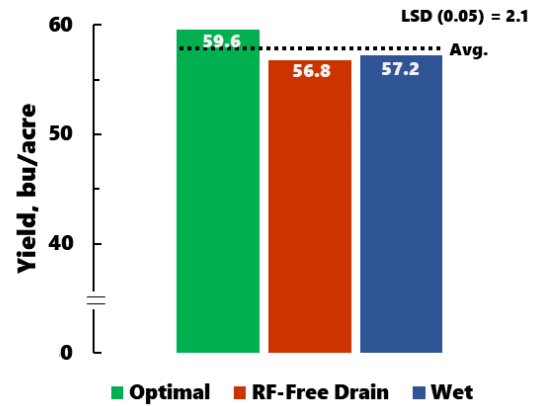
Gross revenue and relative cost comparison of Group IV variety selection under three soil water treatment exposures, based on the 2022 Tidewater trials. Top Yield \$ is the gross revenue generated by the highest average yielding variety in each management category; Bottom Yield \$ is the gross revenue 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.

[†]Means with the same color band are not different at the LSD $\alpha=0.05$ test level.

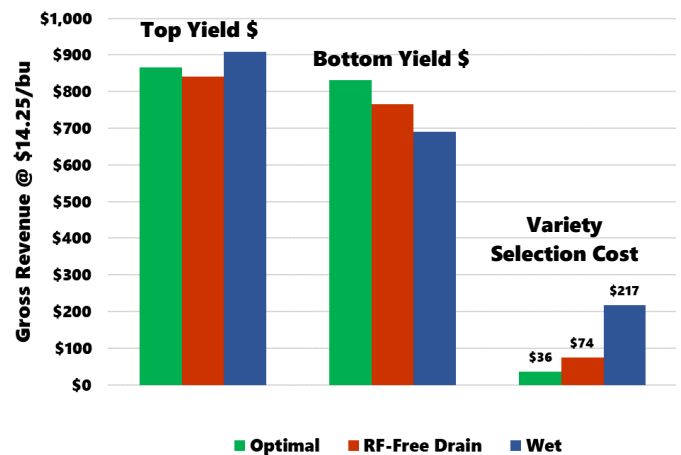
Key Performance Statistics for **Group V** Varieties, Tidewater Research Station 2022 con't.

2022 Group V Soybean Resilience Trial Information						
Soil-Water Regime	Company	Entry	MG Group	n	Yield [‡] bu/acre	CV
Optimal	Bayer	AG56XF2	5.6	4	60.8	3.6
	Pioneer	P59A11SX	5.9	4	60.8	1.5
	Pioneer	P52A14SE	5.2	4	59.7	3.2
	Pioneer	P56A71E	5.6	4	58.7	2.5
	AgriGold	G5110XF	5.1	4	58.3	6.0
	Average					59.6
LSD, 0.05					3.1	
RF-Free Drain	Bayer	AG56XF2	5.6	4	59.0	4.1
	Pioneer	P56A71E	5.6	4	58.4	4.1
	Pioneer	P52A14SE	5.2	4	57.3	4.9
	Pioneer	P59A11SX	5.9	4	55.3	7.1
	AgriGold	G5110XF	5.1	4	53.8	8.3
	Average					56.8
LSD, 0.05					5.0	
Wet	Pioneer	P59A11SX	5.9	4	63.7	2.7
	Pioneer	P52A14SE	5.2	4	62.9	6.9
	Bayer	AG56XF2	5.6	4	55.7	3.1
	Pioneer	P56A71E	5.6	4	55.1	7.3
	AgriGold	G5110XF	5.1	4	48.5	2.7
	Average					57.2
LSD, 0.05					4.7	
Overall	Pioneer	P52A14SE	5.2	12	60.0	6.2
	Pioneer	P59A11SX	5.9	12	59.9	7.2
	Bayer	AG56XF2	5.6	12	58.5	5.0
	Pioneer	P56A71E	5.6	12	57.4	5.4
	AgriGold	G5110XF	5.1	12	53.5	9.7
	Average					57.9
LSD, 0.05					2.3	

[‡]Means with the same color band are not different at the LSD $\alpha=0.05$ test level.



Group V soybean yield response to Optimal, Dry, and Wet treatment exposure.



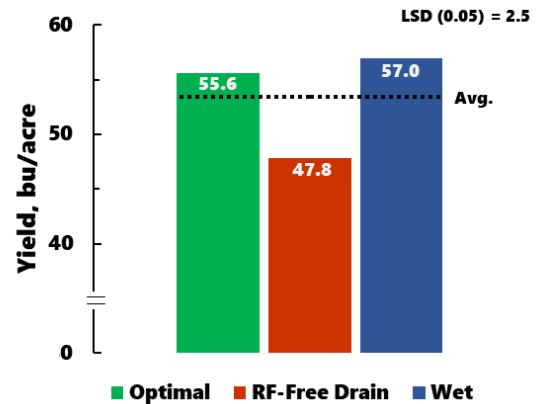
Gross revenue and relative cost comparison of Group V variety selection under three soil water treatment exposures, based on the 2022 Tidewater trials. Top Yield \$ is the gross revenue generated by the highest average yielding variety in each management category; Bottom Yield \$ is the gross revenue 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 2022 con't.

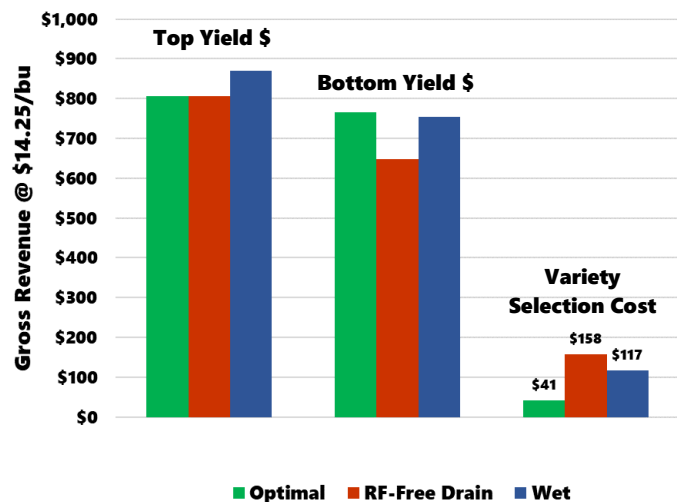
2022 Group VI Soybean Resilience Trial Information						
Soil-Water Regime	Company	Entry	MG Group	n	Yield [#] bu/acre	CV
Optimal	Pioneer	P63A93E	6.3	4	56.6	█
	Pioneer	P68A41BE	6.8	4	56.6	
	AgVenture	AV68Y8BE	6.8	4	55.5	
	AgVenture	AV67W7X	6.7	4	53.7	
	Average				55.6	
LSD, 0.05				4.2		
RF-Free Drain	Pioneer	P68A41BE	6.8	4	49.9	█
	AgVenture	AV67W7X	6.7	4	49.5	
	Pioneer	P63A93E	6.3	4	46.4	
	AgVenture	AV68Y8BE	6.8	4	45.5	
	Average				47.8	
LSD, 0.05				5.7		
Wet	Pioneer	P68A41BE	6.8	4	61.1	█
	Pioneer	P63A93E	6.3	4	59.4	
	AgVenture	AV67W7X	6.7	3	54.6	
	AgVenture	AV68Y8BE	6.8	4	52.9	
	Average				57.0	
LSD, 0.05				3.2, 3.5*		
Overall	Pioneer	P68A41BE	6.8	12	55.9	█
	Pioneer	P63A93E	6.3	12	54.1	
	AgVenture	AV67W7X	6.7	11	52.6	
	AgVenture	AV68Y8BE	6.8	12	51.3	
	Average				53.4	
LSD, 0.05				3.2, 3.5*		

[#]Means with the same color band are not different at the LSD $\alpha=0.05$ test level.

*AV67W7X comparisons only.

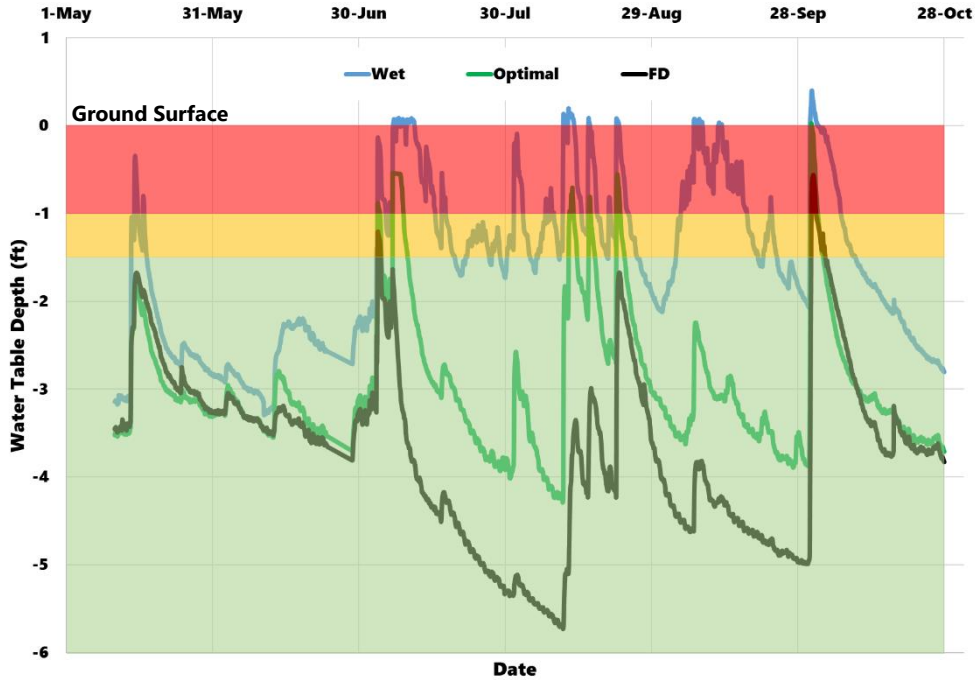


Group VI soybean yield response to Optimal, Dry, and Wet treatment exposure.

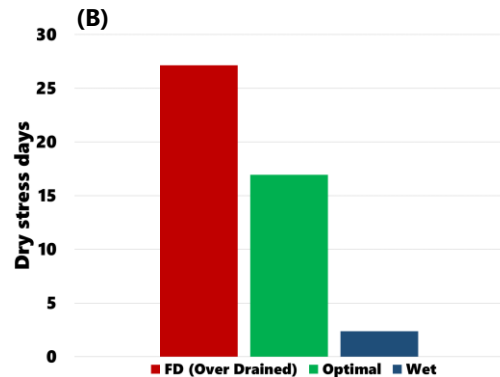
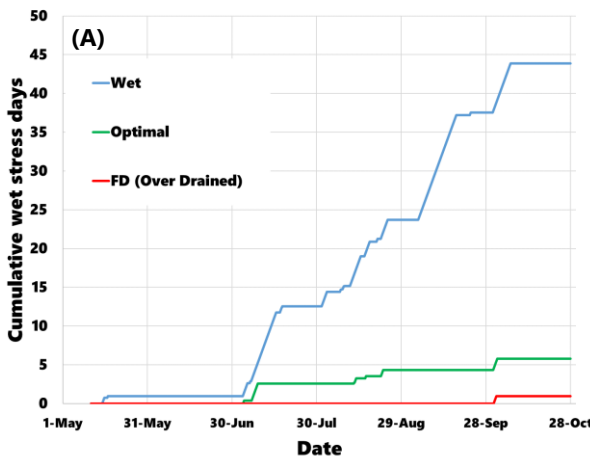


Gross revenue and relative cost comparison of Group VI variety selection under three soil water treatment exposures, based on the 2022 Tidewater trials. Top Yield \$ is the gross revenue generated by the highest average yielding variety in each management category; Bottom Yield \$ is the gross revenue 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

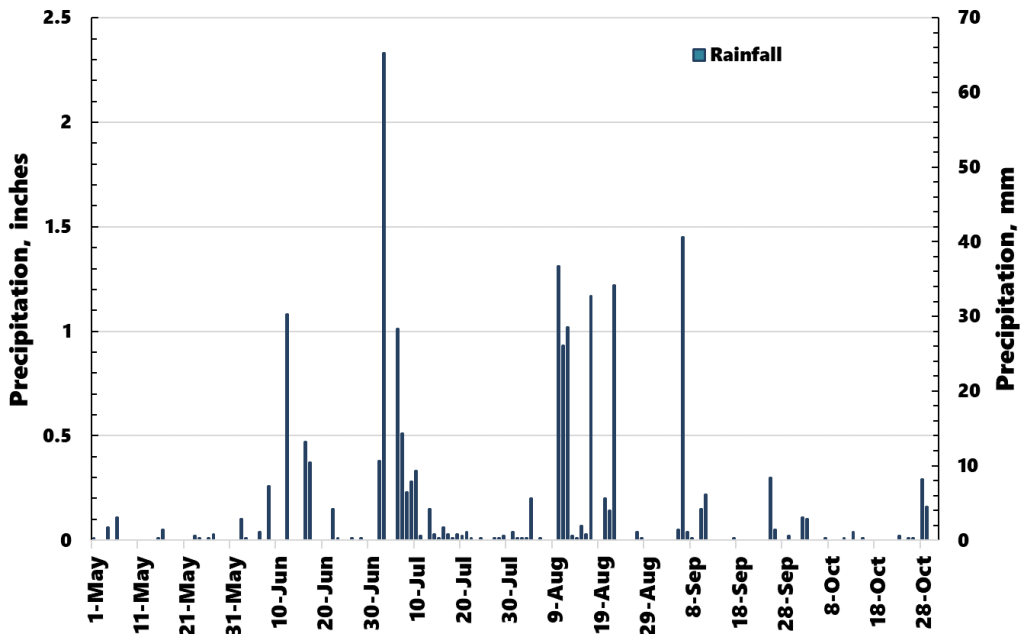
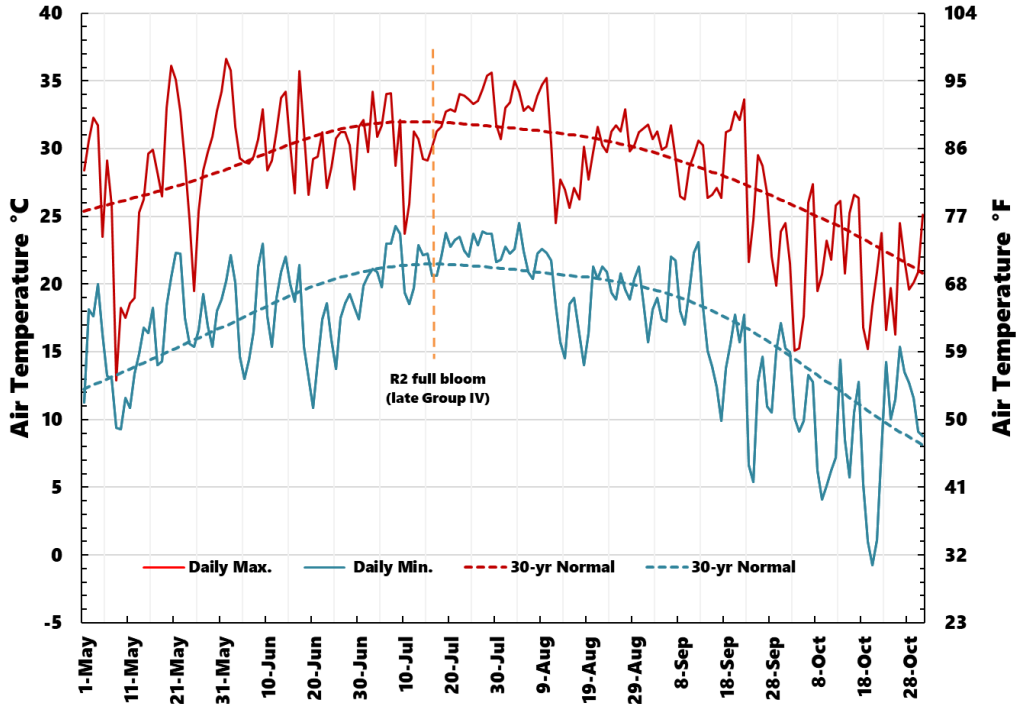


Ground water table depth trace showing depth of the water table beneath soybean in three treatment exposures. Presence of a water table indicates a lack of oxygen essential for healthy root metabolism. Soils in tidal zone areas like the North Carolina Blacklands are naturally poorly drained and depend 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=highest crop stress, <12" deep; Yellow=medium crop stress, 12-18" deep; and Green=no crop stress, >18" deep. Traces running above 0 ft. indicate ponded water.



(A) Cumulative wet stress days at the Total Ag Water Management site in 2022. (B) Number of dry stress days < -55 kilopascals (kPa) matric potential 8" deep in the soybean root zone. Dry stress days under RF-Free Drain were estimated from readings in an adjacent block due to an inoperable sensor. Matric potential is a measure of the energy needed by plants to extract water in a porous medium like soil. Lower matric potential (more negative) causes plants to work harder to provide the water necessary for nutrient uptake, thermoregulation, and carbon assimilation. We defined -55 kPa to indicate "moderate" and "high" stress 8" and 20" inches deep in the root zone in a Portsmouth fine sandy loam soil.

Weather Information for the Tidewater Research Station May-October 2022



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