The SAAM Rating: Categorizing Maize Roots

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Importance of Root Architecture

- Root architecture plays a crucial role for nutrient and moisture uptake.
- Different agronomic managements can influence root growth.
    - Increasing plant population decreases root mass
- Hybrids differ in their response to managements such as plant population and N applications.

Importance of Root Architecture

Can root architecture help explain hybrid response to management?

Differences among hybrids?

- Hybrids differ in their response to managements such as plant population and N applications.

Research Objectives

- Characterize hybrids based on their root architecture.

Hybrids Evaluated at 3 Sites

Commercial Hybrids

	RM		RM
6128V2P	111	6414V2P	114
6152D1	111	6442AM	114
6296AM	112	6506VZ	115
6381AM	113	6585TCV2P	115

Champaign (CU), IL (2023 & 2024), Nashville (NV), IL (2024)

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3,216 Total Roots in 2024

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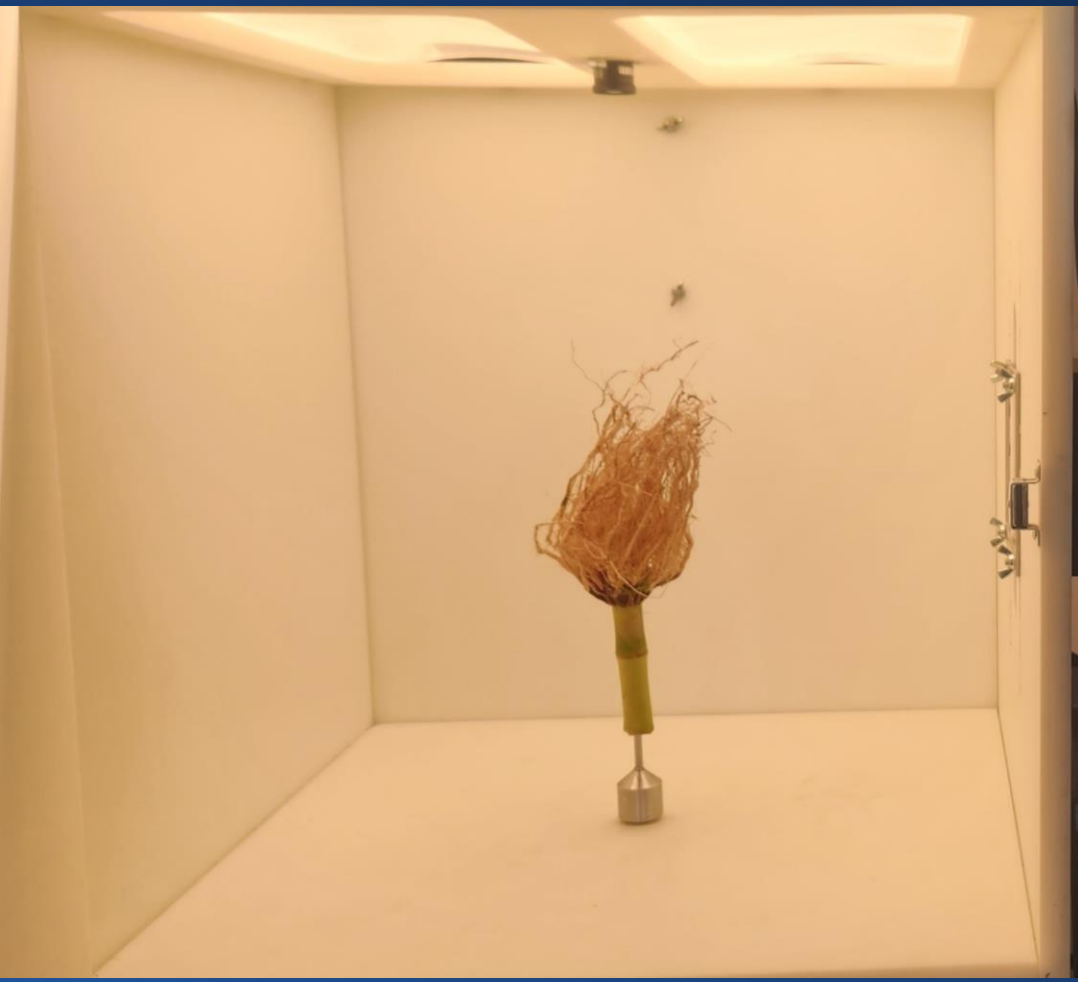
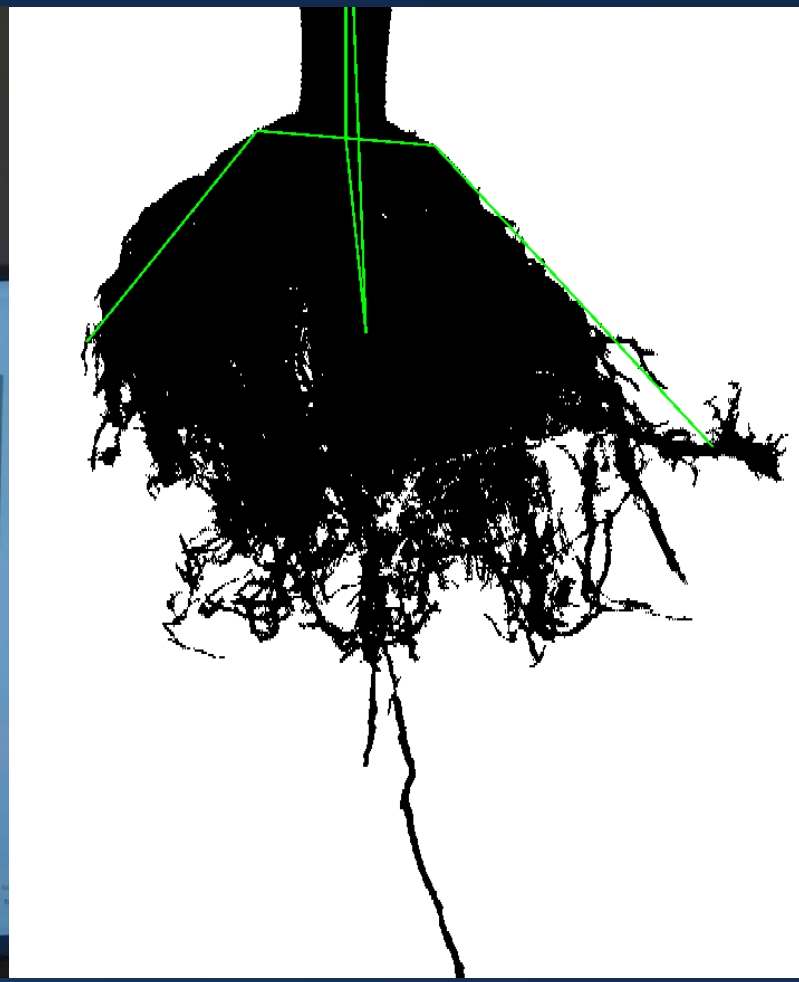
Corn Root Observation Platform (CROP)





Dr. Tony Grift – Agricultural and Biological Engineering
Dr. Martin Bohn – Crop Sciences

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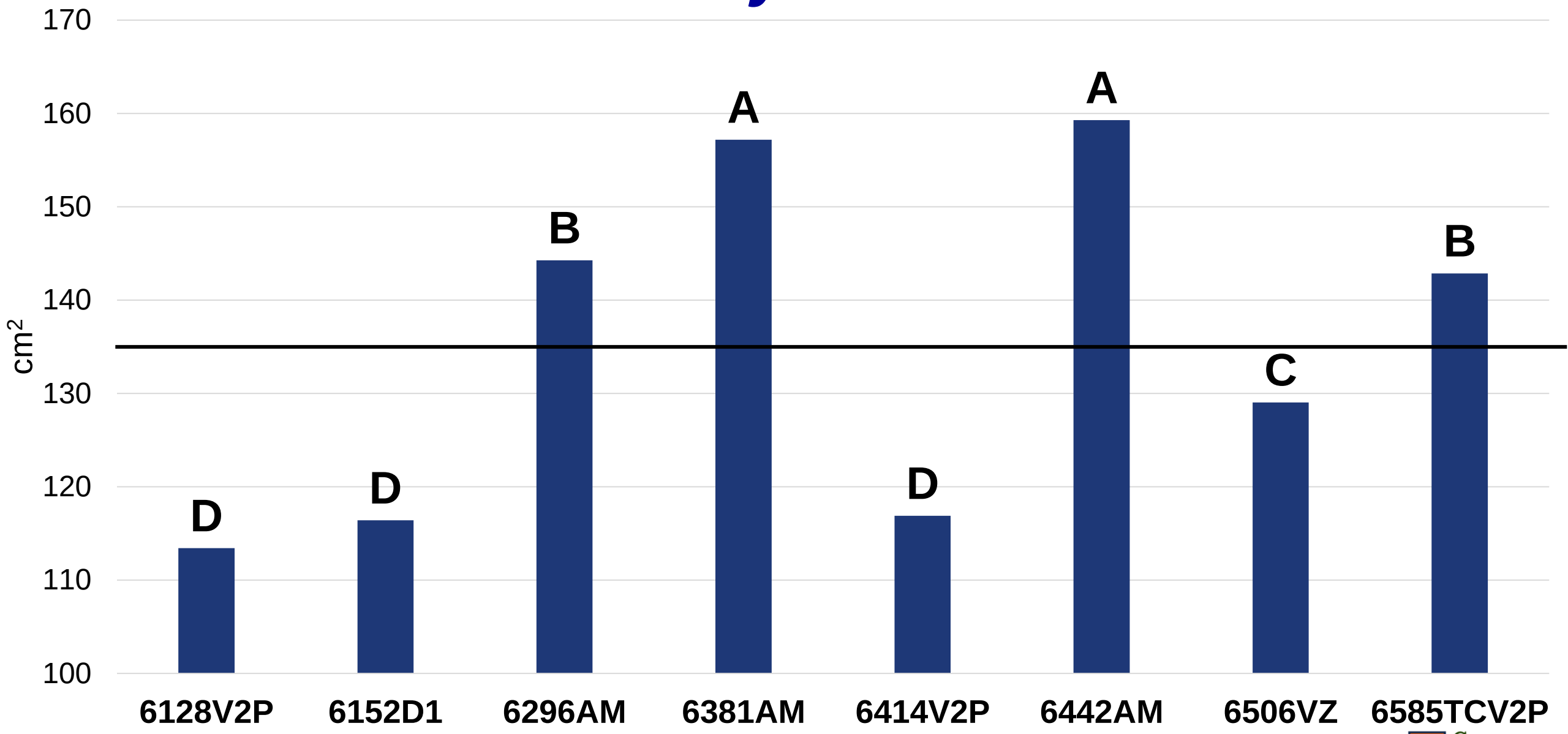
2023 Influence of Hybrid on Surface Area



Values averaged over three nitrogen treatments

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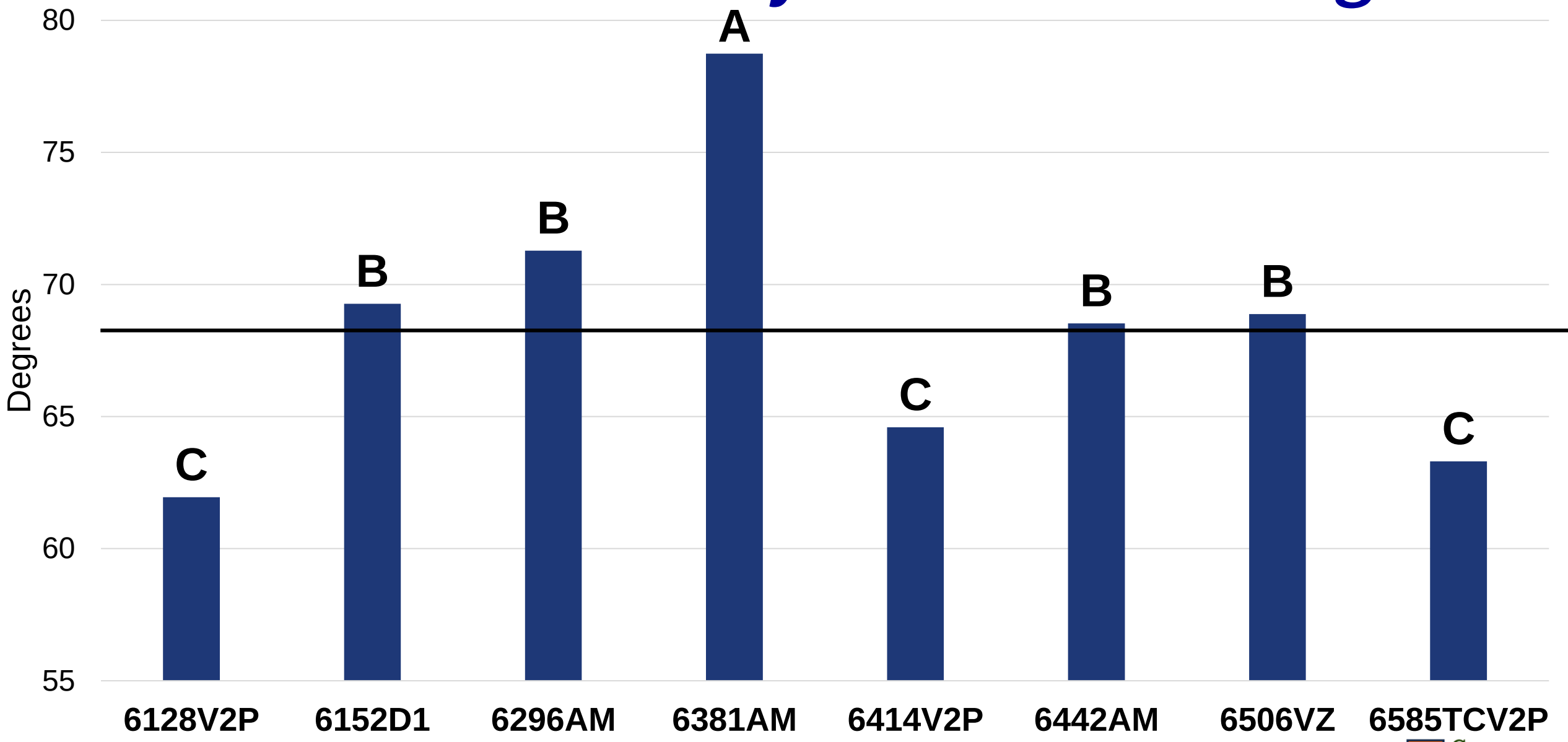
2023 Influence of Hybrid on Root Angle



Values averaged over three nitrogen treatments

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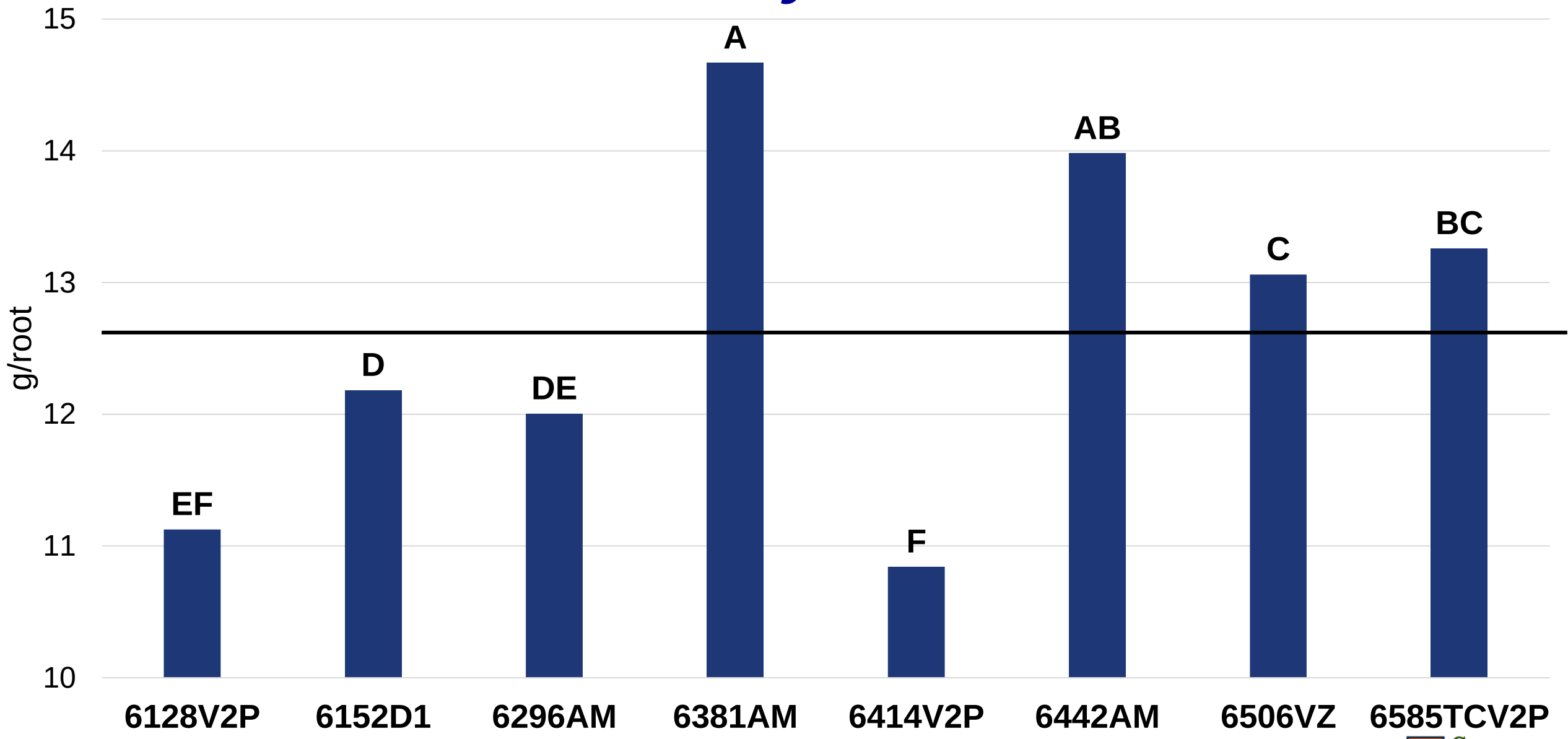
2023 Influence of Hybrid on Root Mass



Values averaged over three nitrogen treatments

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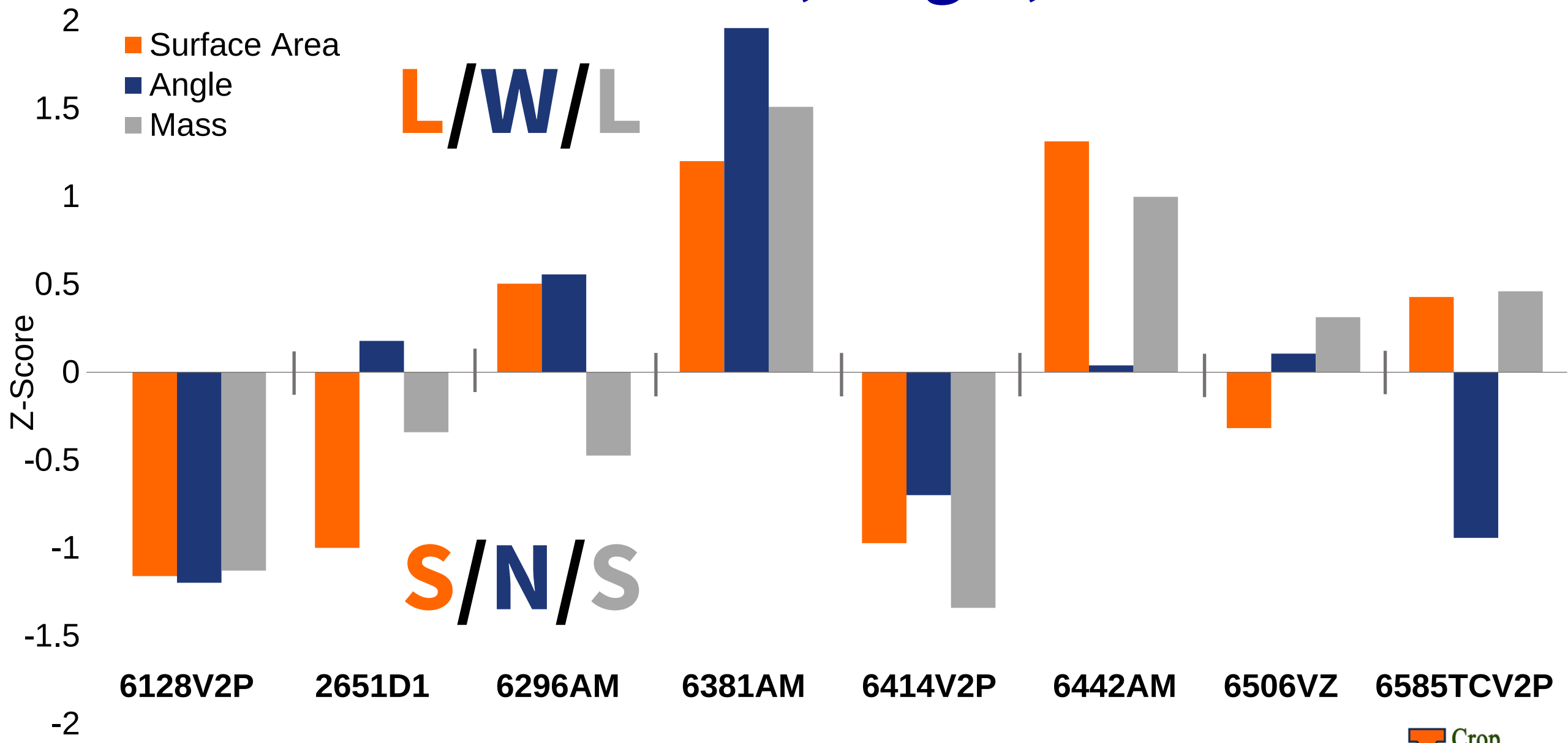
2023 Surface Area, Angle, and Mass



Values averaged over three nitrogen treatments

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SAAM Rating

- Integrates root surface area, angle, and mass into one root characterization per hybrid
- Separates each measurement into two groups
  - Surface Area: Small/Large
  - Angle: Narrow/Wide
  - Mass: Small/Large
- Eight different SAAM Ratings to categorize hybrid root architecture

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6128V2P 6152D1 6296AM 6585TCV2P 6381AM

SAAM Rating†

surface area/angle/mass

S/N/S S/W/S L/W/S L/N/L L/W/L

† Surface Area, Angle, Mass (SAAM); (W) Small (S) Large (L) Narrow (N) Wide

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Are the SAAM Rating Parameters Conserved Across Environments?

Spearman Correlation Coefficients

	Root Surface Area		Root Angle		Root Mass	
Variable	23 CU	24 CU	23 CU	24 CU	23 CU	24 CU
	r					
24 CU	0.474*	-	0.626**	-	0.059	-
24 NV	0.548**	0.647***	0.475*	0.647***	0.154	0.415*

*Significant at the 0.05 probability level. **Significant at the 0.01 probability level. ***Significant at the 0.001 probability level.

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Are the SAAM Rating Parameters Conserved Across Environments?

Weather has a greater impact on SAAM Rating parameters than soil environment.

Variable			24 CU
24 CU			-
24 NV			0.415*

*Significant at the 0.05 probability level. **Significant at the 0.01 probability level. ***Significant at the 0.001 probability level.

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3 Site SAAM Rating

Hybrid	SAAM Rating	Hybrid	SAAM Rating
6442AM	L/N‡/L	6506VZ	S/W/S‡
6296AM	L/W/S	6152D1	S/W/S
6381AM	L/W/L	6414V2P	S/N/S
6128V2P	S/N/S	6585TCV2P	L/N/L

†Small (S) Large (L) Narrow (N) Wide (W)
‡3 Site Average SAAM Rating changed from 2023

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Research Objectives

- ✓ Characterize hybrids based on their root architecture.
- Use the SAAM Rating to explain a hybrid's response to nitrogen management.

Treatments

Hybrids		Nitrogen
	SAAM Rating	lbs/acre
6128V2P	S/N/S	
6152D1	S/W/S	120 Preplant
6296AM	L/W/S	
6381AM	L/W/L	120 Preplant + 60 V6 Y-Drop
6414V2P	S/N/S	
6442AM	L/W/L	180 Preplant
6506VZ	S/W/L	
6585TCV2P	L/N/L	

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2023 Effect of Hybrid at Reduced N on Yield

Hybrid	SAAM Rating†	120 lbs N
	surface area/angle/mass	bushels/acre
6585TCV2P	L/N/L	225
6414V2P	S/N/S	220
6128V2P	S/N/S	217
6506VZ	S/W/L	204
6296AM	L/W/S	198
6381AM	L/W/L	191
6442AM	L/W/L	185
6152D1	S/W/S	183

†Small (S) Large (L) Narrow (N) Wide (W)

LSD (0.05) = 24

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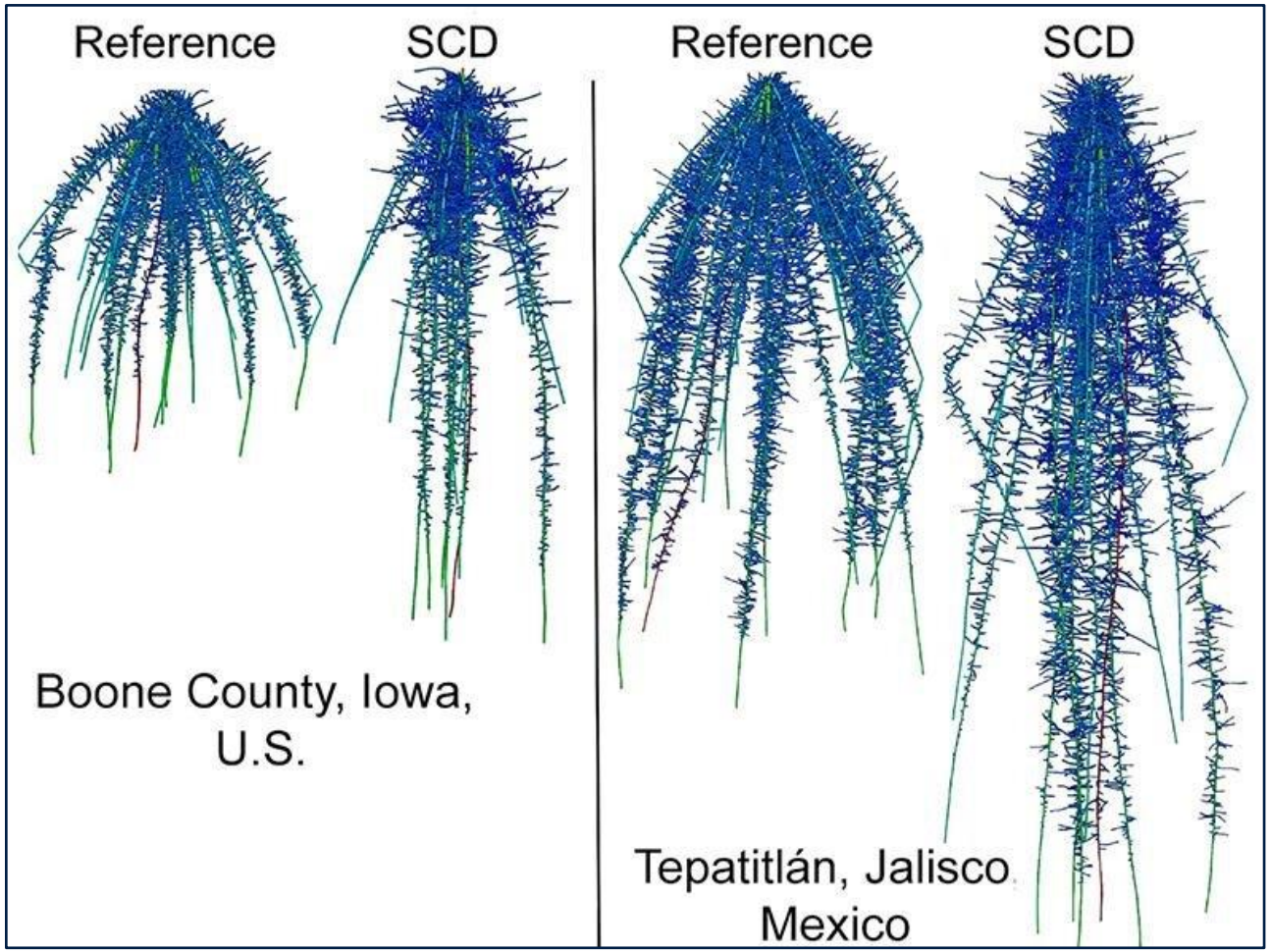
Steeper, Deeper, Cheaper Roots Increased Deep Soil Water Capture, Nitrogen Uptake, and Plant Biomass.



Schäfer, et al. (2022). In silico evidence for the utility of parsimonious root phenotypes for improved vegetative growth and carbon sequestration under drought. Frontiers in Plant Science.

Schneider, et al. (2022). Root angle in maize influences nitrogen capture and is regulated by calcineurin B-like protein (CBL)-interacting serine/threonine-protein kinase 15 (ZmCIPK15). Plant Cell and Environment.

3 Site Yield Average of Hybrid at Reduced N

Hybrid	SAAM Rating†	120 lbs N
	surface area/angle/mass	bushels/acre
6414V2P	S/N/S	245
6585TCV2P	L/N/L	228
6381AM	L/W/L	225
6128V2P	S/N/S	223
6296AM	L/W/S	221
6506VZ	S/W/S‡	218
6152D1	S/W/S	212
6442AM	L/N‡/L	210

†Small (S) Large (L) Narrow (N) Wide (W)
‡3 Site Average SAAM Rating changed from 2023

LSD (0.05) = 19

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2023 Yield Response to Split N Application

Hybrid	SAAM Rating†	180 lbs N	120 + 60 lbs N
	surface area/angle/mass	bushels/acre	Δ bushels/acre
6442AM	L/W/L	207	+10
6296AM	L/W/S	208	+9
6381AM	L/W/L	198	+6
6128V2P	S/N/S	206	+5
6506VZ	S/W/L	219	-3
6152D1	S/W/S	194	-5
6414V2P	S/N/S	233	-14
6585TCV2P	L/N/L	240	-21

†Small (S) Large (L) Narrow (N) Wide (W)

LSD (0.1) = NS

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2023 Yield Response to Split N Application

Hybrid	SAAM Rating†	180 lbs N	120 + 60 lbs N
	surface area/angle/mass	bushels/acre	Δ bushels/acre
6442AM	L/W/L	207	+10
6296AM	L/W/S	208	+9
6381AM	L/W/L	198	+6
6128V2P	S/N/S	206	+5
6506VZ	S/W/L	219	-3
6152D1	S/W/S	194	-5
6414V2P	S/N/S	233	-14
6585TCV2P	L/N/L	240	-21

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6442AM	L/N‡/L	225	±0
6296AM	L/W/S	243	+2
6381AM	L/W/L	233	-5
6128V2P	S/N/S	221	+5
6506VZ	S/W/S‡	235	±0
6152D1	S/W/S	228	+1
6414V2P	S/N/S	250	-2
6585TCV2P	L/N/L	242	-6

†Small (S) Large (L) Narrow (N) Wide (W)
‡3 Site Average SAAM Rating changed from 2023

LSD (0.1) = NS

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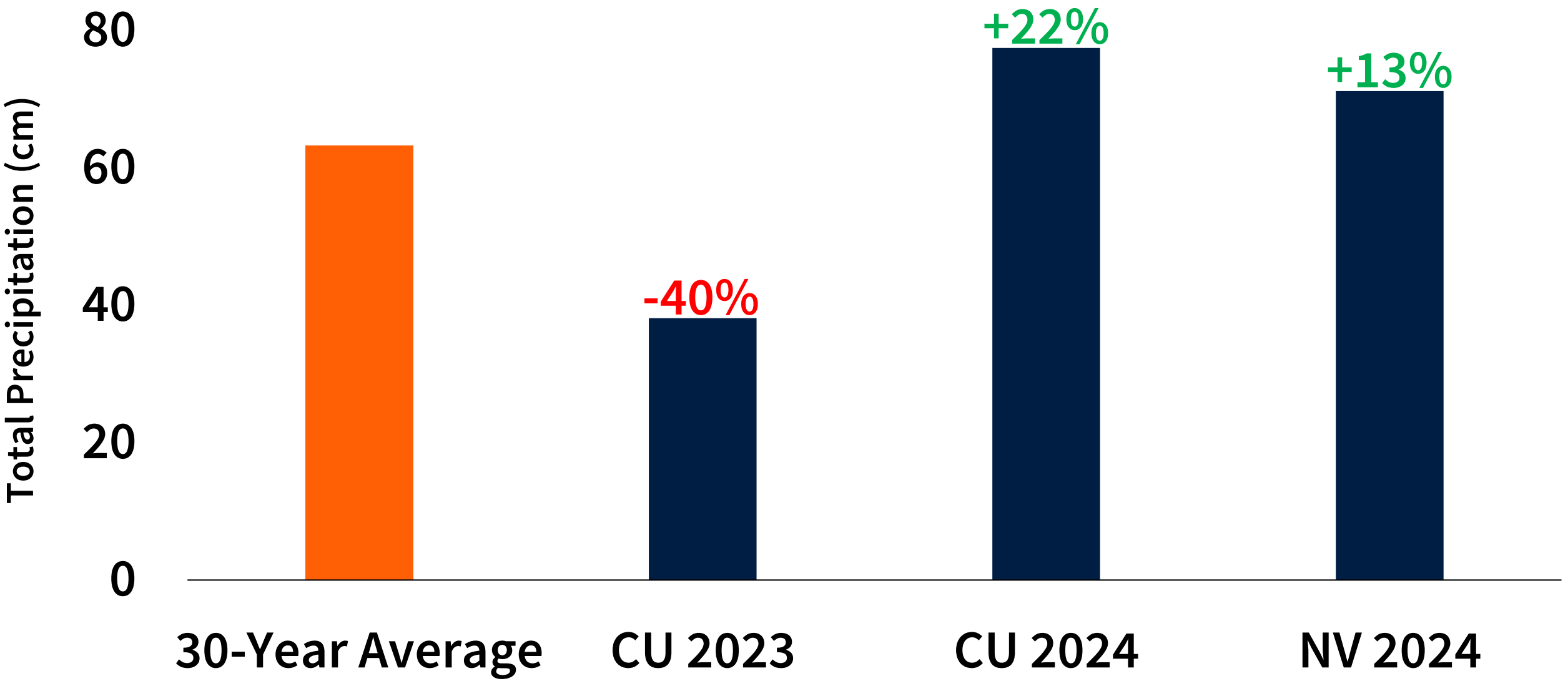
Total Precipitation During the Growing Seasons



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Conclusion

- Narrow rooted hybrids are better suited for stressed or low N environments.
- Maize root architecture is vital for moisture and nutrient uptake under stressed conditions, but its impact becomes less predictable when moisture is sufficient.

Crop Physiology Laboratory Team

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Special Thank You to Beck's Hybrids!

More info at:

Crop Physiology Laboratory

University of Illinois

http://cropphysiology.cropsci.illinois.edu