Multi-Year Analysis of Biomass Production and Nutrient Efficiency in a Diverse Switchgrass Panel

Background/Objective

- High biomass yield and processing quality are the most important factors impacting the economic viability of biofuels and bioproducts. Efficient nitrogen (N) management is critical in the pursuit of sustainable biomass production.

Approach

- Switchgrass fields were established with a highly diverse panel under natural conditions in Watkinsville, Georgia (UGA) and under low (0 kg of N/ha) and moderate (134 kg of N/ha) N treatments at the University of Tennessee, Knoxville (UTK).
- Comprehensive phenotyping was conducted over four growing seasons (2019 – 2022) assessing nitrogen-use efficiency (NUE), nitrogen-remobilization efficiency (NRE), biomass yield, and biomass composition (lignin content & syringyl-to-guaiacyl (S/G) ratio).

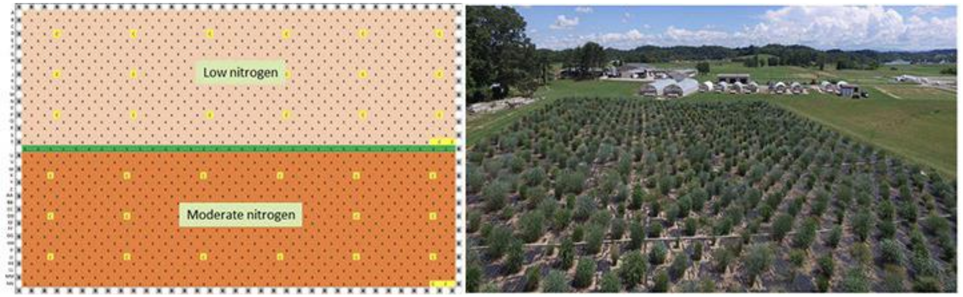
Results

- High yielding genotypes with high NUE were identified in the low N treatment at the UTK site.
- Genotypes with up to 94% NRE were also identified at the UTK site.
- Top performing genotypes overlapped between UTK and UGA sites by 20-37%.
- There were either no or low correlations between biomass yield and lignin content in whole tillers across both field sites, but moderate correlations were observed for S/G ratios.

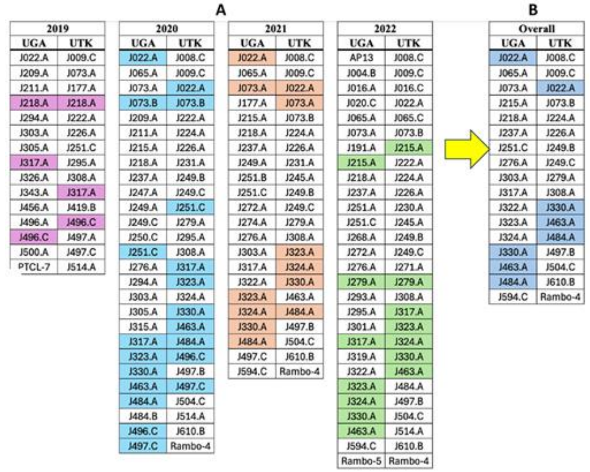
Significance/Impacts

- This multi-year field study identifies high-yielding, nitrogen-efficient switchgrass genotypes with stable biomass and processing traits across diverse environments. The findings support sustainable biofuel production by highlighting genetic variation in nitrogen-use and remobilization efficiency and provide valuable targets for breeding programs aimed at optimizing both yield and feedstock quality.

Mazarei et al., Bioenergy Research 2025 (In Press)



A highly diverse switchgrass panel was planted in spring 2019 at Knoxville, Tennessee (35.903094, −83.959253). The honeycomb field design included 330 switchgrass accessions (2 replicates/accession) with 3.5 m plant spacing.



A

2019		2020		2021		2022	
UGA	UTK	UGA	UTK	UGA	UTK	UGA	UTK
J022.A	J009.C	J022.A	J008.C	J022.A	J008.C	AP13	J008.C
J209.A	J073.A	J065.A	J009.C	J065.A	J009.C	J004.B	J009.C
J211.A	J177.A	J073.A	J022.A	J073.A	J022.A	J016.A	J016.C
J218.A	J218.A	J073.B	J073.B	J177.A	J073.A	J020.C	J022.A
J294.A	J222.A	J209.A	J222.A	J215.A	J073.B	J065.A	J065.C
J303.A	J226.A	J211.A	J224.A	J218.A	J224.A	J073.A	J073.B
J305.A	J251.C	J215.A	J226.A	J237.A	J226.A	J191.A	J215.A
J317.A	J295.A	J218.A	J231.A	J249.A	J231.A	J215.A	J222.A
J326.A	J308.A	J237.A	J249.B	J251.B	J245.A	J218.A	J224.A
J343.A	J317.A	J247.A	J249.C	J251.C	J249.B	J237.A	J226.A
J456.A	J419.B	J249.A	J251.C	J272.A	J249.C	J251.A	J230.A
J496.A	J496.C	J249.C	J279.A	J274.A	J279.A	J251.C	J245.A
J496.C	J497.A	J250.C	J295.A	J276.A	J308.A	J268.A	J249.B
J500.A	J497.C	J251.C	J308.A	J303.A	J323.A	J272.A	J249.C
PTCL-7	J514.A	J276.A	J317.A	J317.A	J324.A	J276.A	J271.A
		J294.A	J323.A	J322.A	J330.A	J279.A	J279.A
		J303.A	J324.A	J323.A	J463.A	J293.A	J308.A
		J305.A	J330.A	J324.A	J484.A	J295.A	J317.A
		J315.A	J463.A	J330.A	J497.B	J301.A	J323.A
		J317.A	J484.A	J484.A	J504.C	J317.A	J324.A
		J323.A	J496.C	J497.C	J610.B	J319.A	J330.A
		J330.A	J497.B	J594.C	Rambo-4	J322.A	J463.A
		J463.A	J497.C			J323.A	J484.A
		J484.A	J504.C			J324.A	J497.B
		J484.B	J514.A			J330.A	J504.C
		J496.C	J610.B			J463.A	J514.A
		J497.C	Rambo-4			J594.C	J610.B
						Rambo-5	Rambo-4

B

Overall	
UGA	UTK
J022.A	J008.C
J065.A	J009.C
J073.A	J022.A
J215.A	J073.B
J218.A	J224.A
J237.A	J226.A
J251.C	J249.B
J276.A	J249.C
J303.A	J279.A
J317.A	J308.A
J322.A	J330.A
J323.A	J463.A
J324.A	J484.A
J330.A	J497.B
J463.A	J504.C
J484.A	J610.B
J594.C	Rambo-4

Top performing genotypes at the UTK and UGA sites. (A) High biomass yielding in 2019 – 2022. (B) Top performers consistently over four years. Highlighted genotypes indicate overlap between UTK and UGA.