Yield From Iowa's First Commercial Miscanthus Fields: Implications of Spatial Variability for Productivity and Sustainability Beyond Research Plots

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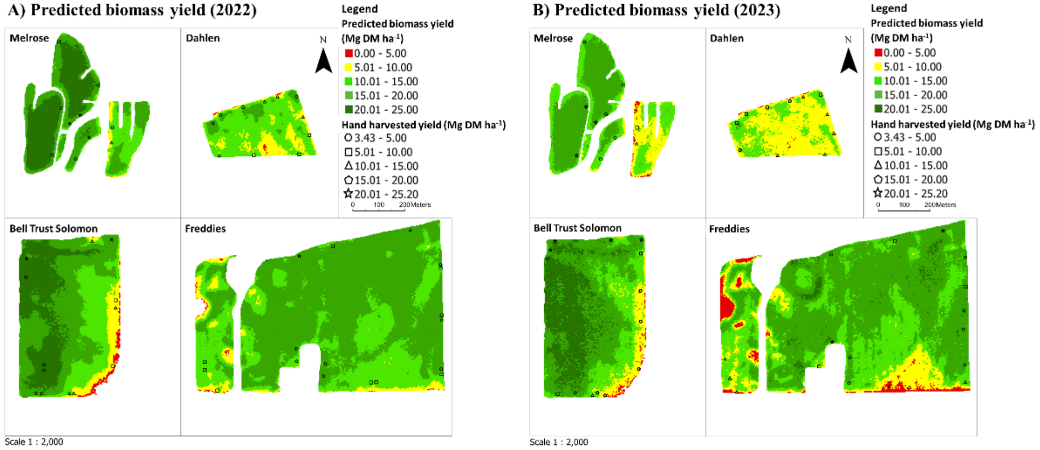
Background/Objective

The cultivation of sterile giant miscanthus (*Miscanthus* × *giganteus, M* × *g*) for bioenergy and bioproducts has expanded into grain-cropped land in the US as local markets developed for this high-yielding perennial grass. However, the magnitude of spatial and temporal variability in yield within US Corn Belt fields, along with impacts on economic return and land management, is poorly understood. This study aimed to advance remotely assessed vegetation indices to accurately represent sub-field *M* × *g* yield and reveal opportunities to improve crop performance.

Approach

This study established a diagnostic model relating remote sensing-derived vegetation indices to ground-truth data from 105 hand-harvested stem biomass samples, which were strategically located to represent the full range of vegetation index observations. Data were collected over a two-year period from four mature commercial *M* × *g* fields totaling 92.81 ha in eastern Iowa, US. The model was then used to predict yield variability and assess economic performance across these fields using transaction-based cost and revenue data from AGgrowTech.



C) Commercial field level net profit considering satellite predicted biomass yield at 15% moisture content.

Year	Field	Number of Pixel	Net Profit ($ ha⁻¹)	sd	se	ci
2022	Bell	25971	888.35	627.95	3.90	7.64
	Dahlen	9127	496.12	312.39	3.27	6.41
	Freddies	54326	784.09	368.28	1.58	3.10
	Melrose	13706	1211.48	506.19	4.32	8.48

Year	Field	Number of Pixel	Net Profit ($ ha⁻¹)	sd	se	ci
2023	Bell	25971	903.92	601.92	3.74	7.32
	Dahlen	9127	83.08	203.52	2.13	4.18
	Freddies	54326	600.33	506.54	2.17	4.26
	Melrose	13706	543.23	451.10	3.85	7.55

The satellite predicted commercial field level *M* × *g* stem biomass yield (dry matter) map (A, B) using a linear regression model and net profit (C) considering satellite predicted biomass yield.

Results

This study revealed considerable spatial and temporal variability in *M* × *g* yields, driven by precipitation, soil fertility, and management practices. Despite the drought conditions during the study period, commercial fields in Iowa achieved yields ranging from 9.27 to 18.11 Mg DM ha^{-1} with significant spatial variability, resulting in net profits ranging from \$83 to \$1211.5 ha^{-1}, with profitability observed in all site years.

Significance/Impacts

This study provides insight on the *M* × *g* management "learning curve" and performance on marginal land and in drought conditions. It demonstrates that addressing yield gaps, reducing costs, and implementing precision agriculture strategies can enhance profitability. These findings confirm *M* × *g* can be a commercially viable bioenergy crop, even in expensive growing regions like Iowa in the US Corn Belt. Yields and net returns are likely to improve with optimized crop management and harvesting strategies.

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