Agronomic Optimum Nitrogen Rate for Corn (*Zea mays* L.) Production in Mississippi

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Introduction

- Crop yield goals (CYG) has been advised by 34 land grand universities as a method for nitrogen (N) recommendation (Rodriguez et al., 2019)
- The CYG does not account for abiotic variations within a location, in a year or between years (Raun et al., 2017)
- Misapplication of N leads to environmental (Mee, 2006) and economic losses as it is a large expense within an agricultural budget
- If nutritional management of crops remains unaltered, excessive N will exacerbate already problematic environmental and economical concerns (Stevens et al., 2005)

Objective

- Identify the agronomic optimum nitrogen rates (AONR) at different precision management levels

Hypothesis

- Each level of management will possess a distinct AONR depending on the year, location and timing of N application

Materials and Methods

Locations and Soil
- Black Belt Experiment Station in Brooksville, Mississippi (Brooksville silty clay loam)
- R. R. Foil Plant Science Research Center in Starkville, Mississippi (Leeper silty clay loam)
- Delta Research Extension Center in Stoneville, Mississippi (Bosket fine sandy loam)
- North Mississippi Research Extension Center in Verona, Mississippi (Marietta loam)

Experimental Design
- Randomized complete block design with 12 treatments (Table 1) replicated four times
- Brooksville, Starkville, and Verona plot size were 3.9 m x 9.1m on 96 cm beds
- Stoneville plot size was 9.1 m x 4.2 m on 101 cm beds

Planting Dates and Varieties
- Brooksville, MS was April 27th , DEKALB DKC67-44
- Starkville, MS was April 27th , DEKALB DKC67-44
- Stoneville, MS was April 6th , DEKALB DKC70-27
- Verona, MS was April 29th , DEKALB DKC68-69

Data Analysis
- Extrication of AONR was be completed using Linear (L), Quadratic (Q), Linear-plateau (LP), and Quadratic-plateau (QP) models using "Easynls package" in R statistical software
- Analysis of variance was conducted using GLIMMIX procedure in SAS statistical software and differences among treatment means were separated using Fisher's least significant difference procedure

Table 1. Treatments Structure and N application timing employed at Starkville, Stoneville, Brooksville, and Verona, MS, 2020

Treatment	Preplant (kg N/ha) V1-2	Side dress (kg N/ha) V5-6	Total N rate
1	0	0	0
2	224	0	224
3	45	0	45
4	45	34	78
5	45	67	112
6	45	101	146
7	45	134	179
8	45	168	213
9	45	202	246
10	90	0	90
11	134	0	134
12	179	0	179

Results

- The environmental mean grain yields were significant across locations (Figure 2).
- Highest yield was recorded at Stoneville (11 Mg ha^{-1}), then Starkville (10 Mg ha^{-1}), Brooksville (9 Mg ha^{-1}) and lowest at Verona (5 Mg ha^{-1}) (horizontal blue dotted line, Figure 2)
- Grain yield was significant due to N application at each location (Figure 2A, B, C, D)
- With combined data, AONR was found to be 218 kg N ha^{-1} resulting in a yield of 9.9 Mg ha^{-1}, QP was best fit with a low coefficient of determination (R^2 = 0.23) (Figure 3A).
- Starkville was best explained by QP model with R^2 = 0.9, the yield started plateauing at 252 kg N ha^{-1} reaching max. yield of 12.5 Mg ha^{-1} (Figure 3B)
- Stoneville was fitted by Q model R^2 = 0.39, the max. yield was 11.7 Mg ha^{-1} at 131 kg N ha^{-1}, yield started decreasing beyond this point (Figure 3C).
- Brookville was best explained by the LP model with R^2 = 0.79, at 9.8 Mg ha^{-1} with an AONR of 97 kg N ha^{-1} (Figure 3D)
- Verona was best fitted with L model, R^2 = 0.86 where yield linearly increased with application of N (Figure 3E)

Discussion

- Overall, the differences in models indicates that there can be markedly different N requirements depending on location . This data suggests that locations should be individually analyzed for N recommendation as failure to adhere to this would lead to over or under application of N (Raun et al.,2017).
- Active sensors to predict N requirement in-season could be used as an alternative to CYG in fertilizer N recommendations (Dhillon et al., 2020).

Future Research

- Location specific models including plant morphological features, vegetation indices and climatological data should be evaluated to improve site-specific N recommendation

Figure 1. Camden Oglesby measuring stem diameter at Starkville, MS.

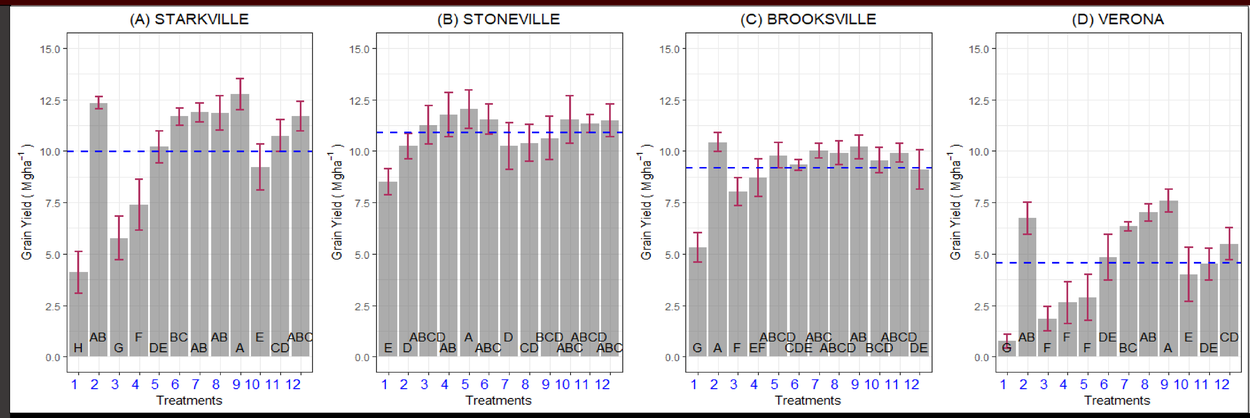

Figure 2. The effect of total N application rate on grain yield in Starkville (A), Stoneville (B), Brooksville (C), and Verona (D), MS. The horizontal blue dotted line represents environmental mean at each location. Columns with the same letters were not significantly different, LSD P < 0.05.

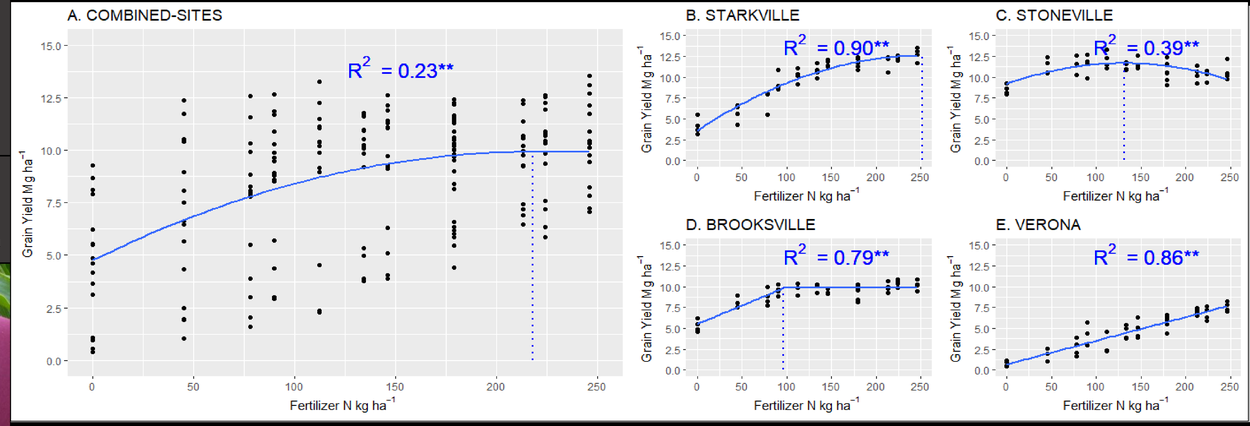

Figure 3. The effect of total N application rate on grain yield. All data combined (A), Starkville (B), Stoneville (C), Brooksville (D), and Verona (E), MS. The coefficient of determination (R^2) with * and ** indicating P < 0.05 and 0.01 respectively. The vertical blue dotted line represents agronomic optimum nitrogen rate (AONR) at which the maximum yield was obtained.

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References

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