

# USING SOIL AND TOPOGRAPHIC CHARACTERISTICS FOR CORN SEEDING RATE OPTIMIZATION IN IOWA

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## Introduction, Objectives, and Methods

The capability to use variable seeding rates has increased dramatically in recent years. Meanwhile, farmers and agronomists frequently collect and analyze soil samples to determine nutrient needs for subsequent crops. The objective of this research was to use key soil and topographic characteristics to optimize seeding rates to maximize grain yield.

The objectives of this research was to 1) determine corn seeding rate interactions with soil attributes and topographic characteristics and 2) identify soil attributes and topographic characteristics that could be used as the basis of variable rate seeding for corn grain production.

Treatments included five seeding rates (61,750; 74,100; 86,450; 98,800; and 111,150 seeds ha<sup>-1</sup>) in a randomized complete block design with four or five replications in three central Iowa fields from 2012 to 2014. Soil samples were analyzed for available P, exchangeable K, pH, SOM, CEC, and texture. Topographic characteristics (in-field elevation, slope, aspect, and curvature) were determined from publicly available Light Detection and Ranging (LIDAR) data. Grain yield and moisture were measured using the combine's yield monitor. Grain yield is reported at 155 g kg<sup>-1</sup> grain moisture. Statistical analysis was conducted using the PROC REG with stepwise regression procedure. The PROC MIXED procedure with grain yield as the response variable and seeding rate, seeding rate squared, and identified soil and topographic parameters plus seeding rate interactions with soil and topographic parameters as dependent variables. Optimum seeding rates were determined by using derivatives to solve for seeding rate at maximum yield.

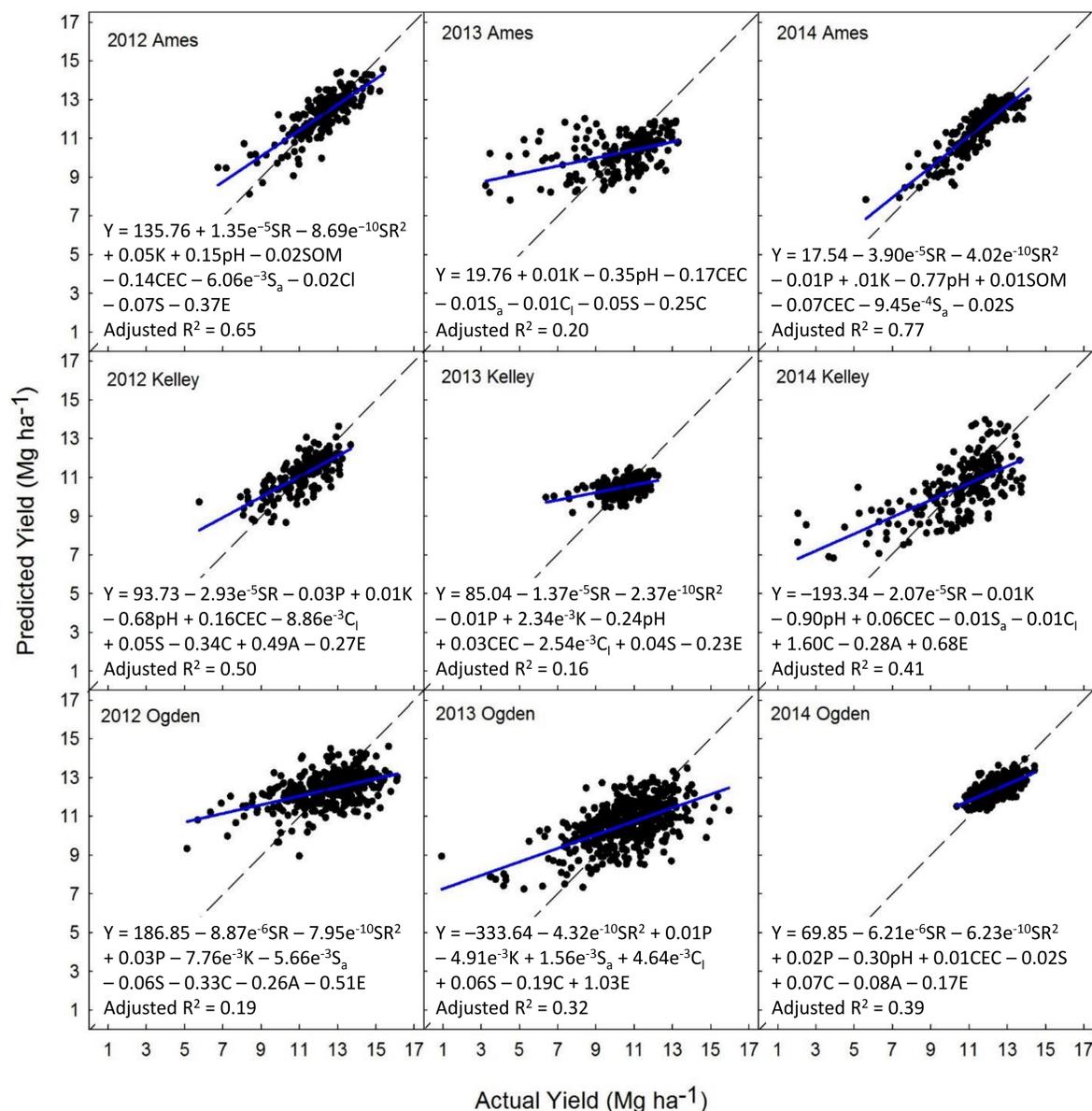


Fig. 1. Multiple regression analysis results for corn grain yield by seeding rate, soil parameters and topographic parameters for each site-year. Dashed black line, 1:1 line.

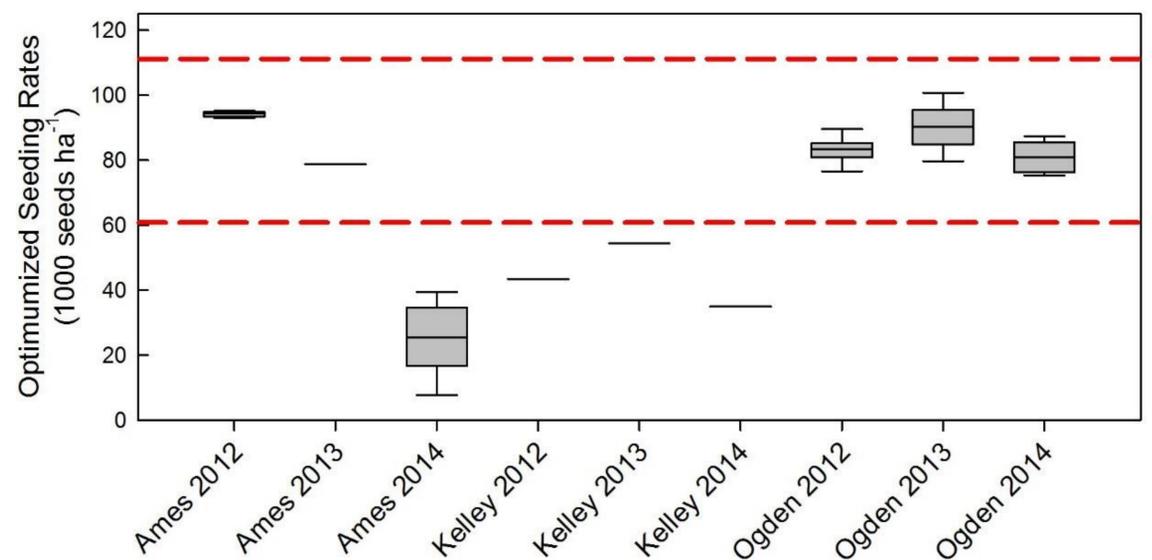


Fig. 2. Range of optimized seeding rates for each subplot of each site-year in central Iowa. Median, line within box; 25<sup>th</sup>/75<sup>th</sup> percentile, box; 10<sup>th</sup>/90<sup>th</sup> percentile, whiskers; red dashed line indicates upper and lower seeding rate experimental units.

Table 1. Seeding Rate Optimization Function for Ogden in 2012 – 2014.

$$2012 \quad Y = 179.86 - 6.67e^{-6}SR - 888e^{-12}SR^2 - 2.0e^{-5}(C \times SR) + 0.02P - 3.7e^{-3}K + 0.02pH - 4.29e^{-3}SOM - 0.02CEC - 6.54e^{-3}S_a - 2.03e^{-3}C_i - 0.05S - 0.41C - 0.28A - 0.49E$$

$$2013 \quad Y = -338.36 - 2.41e^{-3}SR - 418e^{-12}SR^2 + 7.26e^{-6}(E \times SR) + 5.02e^{-3}P - 3.94e^{-3}K - 0.12pH - 4.84e^{-3}SOM + 8.37e^{-3}CEC + 1.45e^{-3}S_a + 3.66e^{-3}C_i + 0.05S - 0.21C - 0.09A - 1.05E$$

$$2014 \quad Y = 75.40 - 3.2e^{-5}SR - 614e^{-12}SR^2 - 5.72e^{-6}(pH \times SR) + 0.02P + 1.26e^{-4}K - 0.28pH - 1.32e^{-3}SOM - 3.4e^{-4}CEC + 2.9e^{-4}S_a + 5.69e^{-4}C_i - 0.02S + 0.06C - 0.06A - 0.18E$$

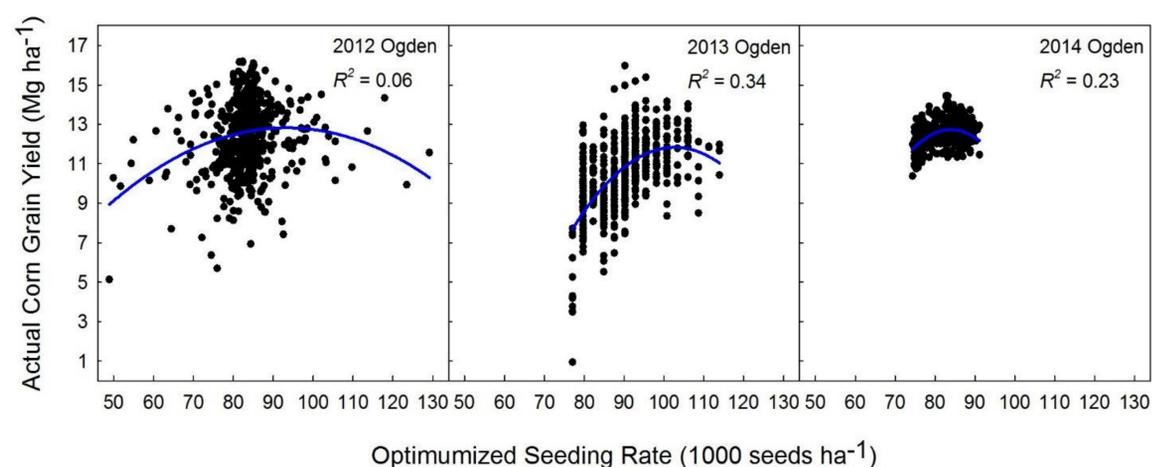


Fig. 3. Corn grain yield at the optimized seeding rates for each subplot for Ogden in 2012 to 2014.

## Summary and Conclusions

There were no interactions between seeding rate and soil or topographic attributes in four site-years resulting in a single optimum seeding rate for each site-year. Four site-years had optimized seeding rates below the lowest seeding rate experimental unit and are not meaningful because excessive extrapolation beyond the data range. Seeding rate optimization in five site-years resulted in seeding rate by soil and topographic attribute interactions; four site-years had single variable by seeding rate interaction (pH, in-field elevation, curvature) and one site-year multiple variables interact with seeding rate (pH, CEC, SOM). The mean optimized seeding rate at Ames in 2012 was 94,256 seeds ha<sup>-1</sup> with a range of 2,471 seeds. At Ogden in 2012, 2013, and 2014 the mean optimized seeding rates were 83,270; 90,383; and 81,027 seeds ha<sup>-1</sup> with a range of 22,408; 23,723; and 13,495 seeds respectively. One-third of the site-years resulted in meaningful seeding rate optimizations with a wide enough range to justify variable seeding rate applications. However, no single soil attribute or topographic characteristic was identified for corn seeding rate optimization.