IOWA STATE UNIVERSITY
Department of Agronomy

Alex Cleveringa & Fernando Miguez

Absolute Yield Instead of Relative Yield for Fertilizer Recommendations?

INTRODUCTION

For decades now, methods for creating fertilizer recommendations have remained constant. A soil test is correlated with relative yield (RY, Fig. 1), and then the test is calibrated within each soil test category (Fig. 2). However, Colwell et al. (1988) identified five objections of using RY that have not been addressed:

1. RY does not provide a basis for estimating economic fertilizer rates
2. Maximum attainable yield is poorly defined and subjective
3. The relationship between yield and soil analysis is not simply proportional to maximum yield
4. Calculating RY can produce statistical bias
5. Results from combining different experiments with different experimental designs are invalid

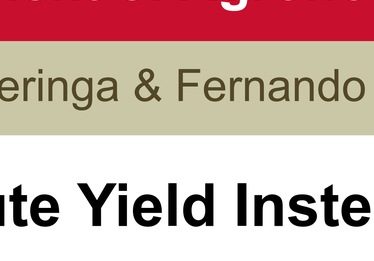

Figure 1. Mehlich-3 soil test K correlation to relative yield. Red line indicates the critical soil test value of 130 mg/kg.

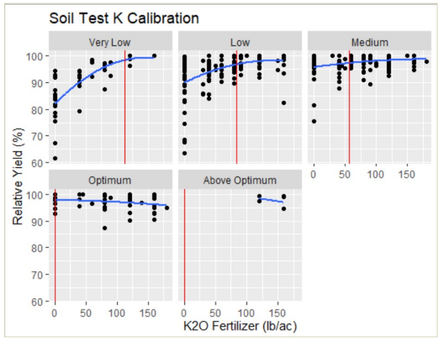

Figure 2. Calibration of K_2O fertilizer to relative yield to provide recommendations for each category. The red lines indicate the recommended fertilizer application rate.

DATA & METHODS

- The data are publicly available from Popp et al. (2020), and consist of 414 observations of rice from 91 site-years grown in Arkansas from 2001 – 2018
- Mehlich-3 extractable soil test K was measured for each site, a range of K_2O fertilizer rates were applied, and yield was measured
- To avoid the problems previously outlined, we used a linear-plateau model to represent the relationship between K_2O fertilizer and absolute yield, and then introduced the covariate soil test K (Fig. 3)

RESULTS

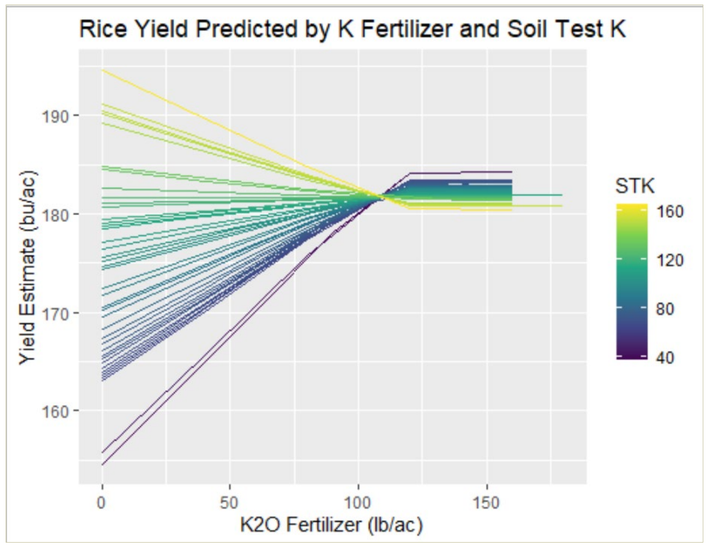

Figure 3. Predicted yields from linear-plateau model as a function of K_2O fertilizer and soil test K (STK).

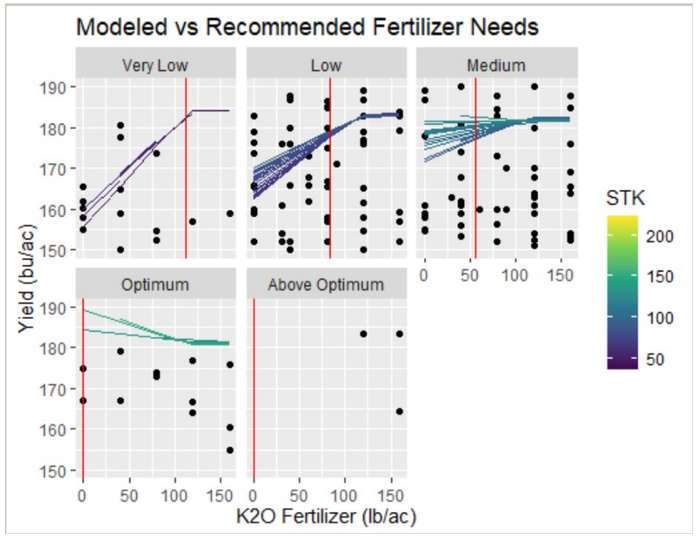

Figure 4. Comparison of modeled and traditional fertilizer recommendations. The red lines indicate the traditionally-applied recommendations

CONCLUSIONS

- ❖ AY addresses all objections to RY and allows for further analysis, such as Economically Optimal K Rate
- ❖ Similar CSTV in both models, 123 vs. 130
- ❖ RY says all "Medium" soils should receive 56 lb/ac K2O fertilizer, AY says from 0 – 115 lb/ac
- ❖ More covariates to identify (soils, weather, management) to distribute variation away from error term
- ❖ RY is a shortcut we no longer need

REFERENCES

Colwell, J. D., Suhet, A. R., & Van Raij, B. (1988). Statistical procedures for developing general soil fertility models for v ariable regions. Canberra, ACT, CSIRO Division of Soils.

Popp, M. P., Slaton, N. A., Norsworthy, J. S., & Dixon, B. (2021). Rice yield response to potassium: An economic analysis. Agronomy Journal, 113(1), 287-297.

This material is based upon work supported by National Science Foundation (NSF) under Grant No. 1828942

ASA, CSSA, SSSA International Annual Meeting
November 7, 2022