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Can We Identify Covariates Using Absolute Yield for Fertilizer Recommendations?

INTRODUCTION

- One concern with using relative yield as the response variable in fertility trials is that relationships between yield and soil analysis are not always proportional (Colwell et al., 1988)
- Additionally, statistical power is lost when we subset data
- Potentially interesting relationships between variables that vary across subdivisions may be broken

DATA & METHODS

The data consist of simulations of five different site-years with three replications of five fertilizer rates each, varying the simulated rates for each site-year (Figure S1). Yield response follows a linear-plateau model (Eq. 1). We created a covariate (rainfall) that has a positive effect on the intercept and break-point. Different amounts of random noise following a normal distribution were added to the linear-plateau lines, ranging from 0.01 to 1.0 Mg ha^{-1} at intervals of 0.01. This process was replicated 5000 times. Relative yield (RY) was calculated (Eq. 2), where Y_{ijk} is the yield in plot *i* in rep *j* in site-year *k*, and Y_{kmax} is the highest yield at each site-year. The data were then fit to the model described, and analysis was done to determine the effectiveness of each response variable in detecting the interaction between the break-point and the covariate.

$$Yield = \begin{cases} a + bx, when\ x < xs \\ a + bx_s\ when\ x \geq x_s \end{cases} \quad \text{Eq. 1}$$

$$RY_{ijk} = \frac{Y_{ijk}}{Y_{kmax}} \quad \text{Eq. 2}$$

RESULTS

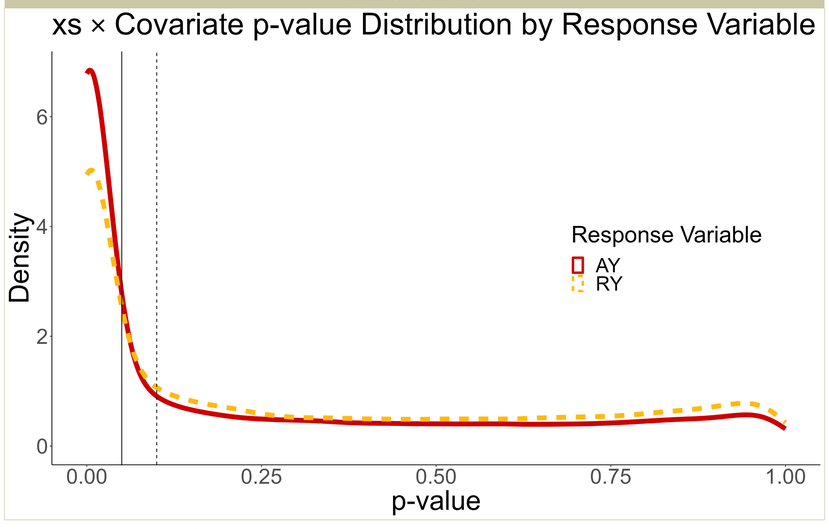

Figure 1. Distribution of *p*-values of the interaction between the break-point (xs) and the covariate of absolute yield (AY) and relative yield (RY) for all converged models. The solid vertical line represents $p = 0.05$, the dashed line represents $p = 0.10$.

	Absolute Yield	Relative Yield	Ratio (AY/RY)
Convergence	101,000	106,575	0.948
xs x Cov IXN[1] ($p \leq 0.05$)	52,369 (**51.2%**)	42,594 (**40.0%**)	**1.23**
xs x Cov IXN ($p \leq 0.10$)	57,661 (**57.1%**)	48,904 (**45.9%**)	**1.18**

Table 1. Total number of data points from simulations that converged for each response variable with the number and percentage of those data points that had significant *p*-values of the break point x covariate interaction.
1: break-point (CSTV) by covariate interaction

REFERENCES

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

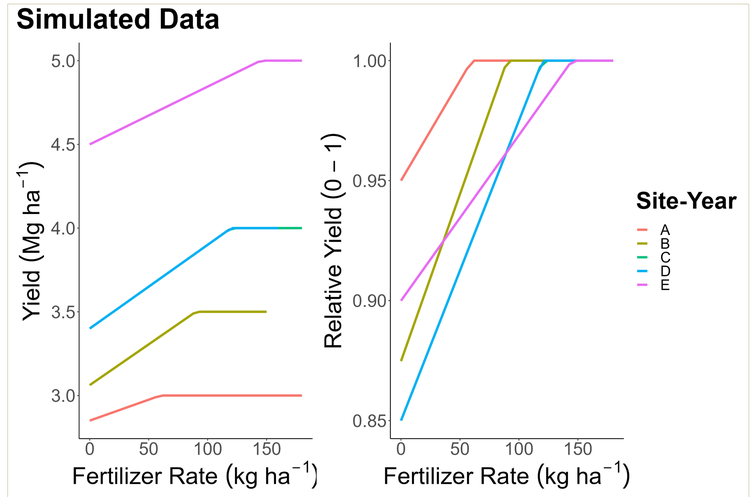

Figure S1. Lines fit for each site-year to a linear-plateau model for absolute and relative yield.

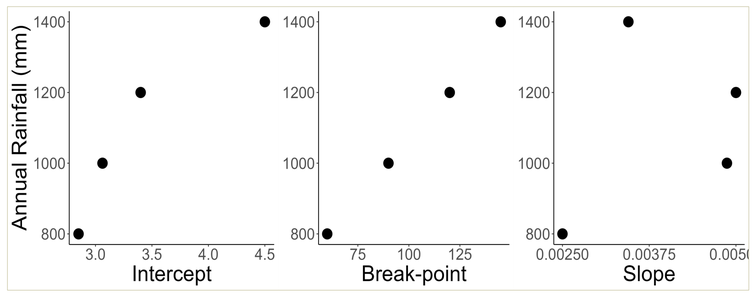

Figure S2. Relationships between the covariate rainfall and the parameters of the linear-plateau model

CONCLUSIONS

- **It is more likely** (~20%, Table 1) **to identify interactions** between the break-point (CSTV) and the covariate **with absolute yield (Figure 1)**
- **Relative yield** was slightly better at fitting data to a linear-plateau model, but the **results were more likely to be non-significant (Table 1)**

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