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Title:

The Analysis of Efficiency/Tolerance Trials: The Good, The BAD, and The Ugly

Abstract:

Efficiency and tolerance trials are common in plant breeding and are vital in determining plants responsiveness to known biotic and abiotic stressors. For example, Nitrogen and Phosphorus efficiency trials are performed where several fixed amounts of fertiliser, including a control, are applied to field plots and the plants responsiveness to the fertiliser are determined. Similarly, a tolerance trial involves the application of a stress treatment applied to the plants, such as heat, and traits are compared between control and heat treatments to determine varietal tolerance.

This talk has a broad focus on the Good, the Bad and the Ugly components of efficiency and tolerance trial design and analysis. Several examples are presented that showcase the spectrum of experimental designs and analysis that are performed for these trials. The talk has a major focus on an appropriate multi-environment linear mixed model analysis of efficiency/tolerance trial data. A fully correlated Treatment x Environment x Genotype interaction term for the variety genetic effects is included in the model as well as terms that capture extraneous environmental variation that might be present at each of the trials. A simple transformation is then applied to the variety effects at each environment that allows the calculation of a new genetic trait, the genetic responsiveness of the varieties to the application of the treatment. To exemplify the method several examples are presented and show the genetic attributes of the varieties can be easily interpreted through graphical displays. This model is then extended to include a whole genome marker data set and quantitative trait loci are discovered for genetic responsiveness.