Analysing genotype by environment interaction by curvilinear regression

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Abstract

This paper deals with the analysis of the Genotype by Environment Interaction (GEI). The purpose of such analysis is to select genotypes that are consistently high-yielding over the range of observed or potential environments. Usually, the GEI is non-orthogonal. In the literature there are papers dealing with many statistical techniques in this area. In this paper, regression analysis is used to make inferences about GEI.

In regression analysis we should have two sets of variables, the first characterizing genotypes, and the second characterizing environments. The so-called adjusted means (or some other genotype characteristics) for genotypes usually constitute observations of the dependent variable. The problem is how to model the environmental indexes, these being the observation of independent variable. In the paper we use the environmental indexes obtained by an iterative ("zig-zag") algorithm based on the joint regression approach.

The data considered here is usually used to: (i) to predict and estimate the yield; and (ii) to provide reliable guidance for selection of the best genotypes for planting over environments. An inference concerning these problems is based on adapting two tests: (A) a test for parallelism of regression curves; and (B) a test of coincidence (regression functions are identical).

The first step should be the estimation of the regression functions (linear or curvilinear) independently for all genotypes. We recommend beginning searching for an optimal response curve in the class of non-linear functions. Since GEI is usually present in the data, the test (A) will probably reject the respective hypothesis. Using this test repeatedly for subsets of genotypes we can find the genotypes with similar responses to environmental conditions. This group is worth considering with respect to a breeding program and with respect to use in practice. In case of failure to reject the hypothesis, it is worth applying test (B).

Keywords