The environmental indexes in a Joint Regression Analysis and their meaning

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Abstract

The phenotype of an individual is determined by the genotype and the environment in which it is embedded. Plant breeders, farmers and agronomists aim to determine a superior genotype over a wide range of environmental conditions, but also over time (multi-location trials). The basic cause of differences between genotypes and stability of its production in different environments is due to these two effects that are not simply additive, i.e., data show interaction between genotype and environment (GEI) (Kang and Gauch, 1996). The data of multi-location trials have three main objectives: (i) accurately predict and estimate the production based on limited experimental data, (ii) determine the stability of productivity and the standard response of genotypes in all environments, and (iii) to provide reliable guidance for the selection of the best genotypes or treatments for planting in subsequent years, and new locations. All of those activities lead to structuring GEI. From practical point of view the GEI usually exists (it is significant in test sense) and its structuring and understanding is the most important point of inference. Many statistical techniques have been adapted and used in an attempt to describe and analyze the GEI. The Joint Regression Analysis (JRA) (Finlay and Wilkinson, 1968; Pereira and Mexia, 2008) is one of the mostly used because of its graphical capability and theoretical evidence of its usefulness. One of the biggest open problems on JRA, in which there is still no consensus, is how to obtain and interpret the environmental indexes (Pereira and Mexia, 2009).

Besides of selecting the "best" genotypes (more productive, more riches in nutrients and more resistant to diseases) for various environments, it is also in the scope of this paper to identify a physical meaning for the environmental indexes. A case study with Spring Barley (*Hordeum vulgare* L.) and Winter Wheat (*Triticum aestivum* L.) from experiments in Czech Republic will be presented.

Keywords

Joint regression analysis, Environmental indexes, Genotype by environment interaction, Spring barley, Winter wheat.

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