STATISTICAL MODELS IN AGRICULTURE: BIOMETRICAL METHODS FOR EVALUATING PHENOTYPIC STABILITY IN PLANT BREEDING

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ABSTRACT: This paper reviews the main concepts of several methods of phenotypic stability analysis and points out their advantages and limitations. It was concluded that the simple linear regression method of Eberhart & Russel (1966) and the bi segmented regression method of Silva & Barreto (1985) have only historical importance nowadays. Moreover, based on factors discussed in the paper, it is recommended that the regression models of Toler & Burrows (1998) and the Additive Main effects and Multiplicative Interactions (AMMI) model should be used simultaneously to study and to estimate phenotypic stability effects.

Key words: AMMI, non-linear statistical models, linear regression models.

MODELOS ESTATÍSTICOS NA AGRICULTURA: MÉTODOS BIOMÉTRICOS PARA AVALIAR A ESTABILIDADE FENOTÍPICA NO MELHORAMENTO DE PLANTAS

RESUMO: Este trabalho revisa os principais conceitos de diversos métodos de análise da estabilidade fenotípica e aponta suas vantagens e limitações. Conclui-se que os métodos de regressão linear simples de Eberhart & Russel (1966) e o de regressão bi-segmentada de Silva & Barreto (1985) têm apenas importância histórica nos dias atuais. Além disso, considerando-se os aspectos discutidos, recomenda-se que os modelos de regressão de Toler & Burrows (1998) e o modelo com efeitos principais aditivos e interação multiplicativa (AMMI) sejam usados simultaneamente para estudar e estimar os efeitos da estabilidade fenotípica.

Palavras-chave: AMMI, modelos estatísticos não-lineares, modelos lineares de regressão.

1 INTRODUCTION

In the last phase of plant breeding programs, candidate varieties with market potential should be evaluated under a range of conditions similar to the real conditions that they will experience when in use. To be successful, a new variety should have high productivity and high performance for agronomic traits over a wide range of environmental conditions. Plant breeders usually agree about the importance of high production stability, but not necessarily about the appropriate definition of stability.

The basic cause of differences among genotypes (varieties) in relation to production stabilities is the genotype x environment (GE) interaction, so that performance of the genotypes depends on the specific environmental conditions where they are grown. Part of the interaction can be explained by known environmental factors such as the incidence of disease or pests, annual rainfall, severity of dry-season, soil fertility, soil waterlogging, soil depth, photoperiod, etc. However, the most of GE interactions cannot be explained by these known factors.

Several methods have been developed by statisticians and applied by plant breeders to explain the GE interaction at the end of plant breeding programs. The main concepts of these methods are reviewed in this article and their advantages and limitations are pointed out.

2 BASIC CONCEPTS

In the last phase of plant breeding the new varieties are grown in several locations under different conditions of climate and soil fertility, and also in different seasons of the year (ACCIARESI & CHIDICHIMO, 1999; BECKER & LÉON, 1988). The different conditions, as defined by

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