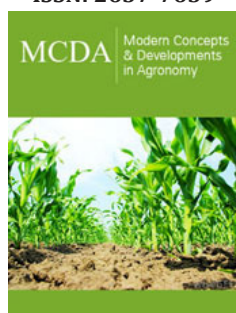# Fixed, Random and Mixed Statistical Models for Field Experimentation

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Abstract

One of the stages of the experimental planning phase is the determination of statistical models. To do this, it is important to understand the nature of the sources of variation. The determination of fixed and random factors auxiliary directly in the previous choice of statistical models, as well as in the experimental design. The prior choice of statistical models in field experiments is important for otimizate representativeness and accuracy of the data.

Keywords: Statistical models; Fixed model; Random model; Mixed model

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Introduction

Several strategies for selecting families and individuals recommend that the tests be carried out on experimental bases located in different producing regions. Therefore, one of the first steps to carry out the experiments is the determination of the statistical model for the sources of variation evaluated. Statistical models can be divided into fixed, random or mixed. The factors that are controlled at all levels are generally called fixed. However, when the factors are samples obtained randomly from a population, that is, having no representation of all levels, the factor is random. The model will be considered fixed, when all the parameters that constitute it, except the experimental error, have a fixed effect. The model will be considered random, when all the parameters that constitute it, except the average, have a random effect. Finally, the model will be mixed when parameters of fixed and random effects are involved [1].

Nature of the sources of variation in field experiments

In experiments conducted in the field, the effect of the "Repetition" source of variation will always be considered random, as infinite repetitions in one location are possible. It should be noted that such repetitions represent a sample of the various possible repetitions. As a result, the results obtained allow inferences to be made for that experimental station or location [1]. Determining the nature of the "Local" effect in fixed or random is more subjective. However, in tests carried out over several years and in different locations, the data obtained from the experiments in the chosen locations must represent a producing region or even a state. In this way, the "Local" effect should be considered random [1]. If the edaphoclimatic conditions of the place, as well as the conditions of cultural management, do not represent the reality of a region or state, the "Local" effect should be considered fixed, the results being related only to the local condition.

The "Years" effect will be considered random, when the climatic conditions during the several years of conducting the experiments represent the predominant climate in the region. Otherwise, it must be considered fixed [1]. The effect of families, lineages, progenies, or cultivars will depend on how the material involved in the experiment was obtained. The

progeny effect will be considered random, when the progenies are samples from a population and the information obtained can be generalized to the parental population, thus representing the estimate of the genetic variance among the members of the population. This type of model is widely used when characteristics controlled by several genes are involved, allowing the estimation of the genotypic value of the parents or the population sampled based on the performance of their descendants [1-3].

However, the progeny effect should be considered fixed, when the progenies are the result of the selection for a certain characteristic, such as color, growth habit, height, diameter, among others, which means that the information obtained cannot be generalized to population [1]. Regarding the joint analysis of experiments, the sources of variation should be distributed according to the same reasoning. Thus, "Repetition" should be considered random to represent the location; "Local" should be considered random when representing a region or state; "Progeny" should be considered fixed, when the objective is to compare and recommend the best progenies; the effect of the "genotype x environment interaction"

should be considered random, since it is a multiplicative vector that quantifies the effects between fixed and random variables [4].

Final considerations

Note that these recommendations make several field experiments commonly of a mixed nature. Thus, to evaluate the data obtained from populations with high genetic complexity and some variables that present effects considered fixed and others random, regardless of the mean and the error, mixed models can be used, which result in more precise and accurate inferences, the which increases the efficiency of breeding programs.

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