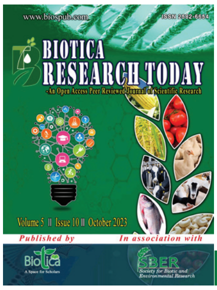

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Popular Article

Line × Tester Analysis in Agriculture

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Abstract

Line × Tester analysis is a valuable tool in agricultural research, enabling the evaluation of combining ability and interaction effects between different genotypes. It has diverse applications in hybrid development, parental selection, trait mapping, combining ability estimation, gene action studies and environmental adaptation. This article develops basic understanding of Line × Tester analysis and its possible application in various fields of agriculture.

Keywords: Diallele cross, GCA, SCA, Trait mapping

Introduction

Kempthorne (1957) introduced the Line × Tester analysis and it is a statistical method applied to agricultural research, notably in plant breeding and genetics. To assess the combining potential and interaction effects of various genotypes, a set of varied lines known as testers is crossed with a set of particular lines. It is modified case of the top cross method, although the latter utilise just one tester. Several studies have emphasized the importance of selecting appropriate testers, as they significantly influence the interpretation of Line × Tester interactions. Panwar (2005) investigated Line × Tester analysis for combining ability in rice crop (*Oryza sativa* L.). Vidhyavathi *et al.* (2005) studied Line × Tester analysis in sesame crop (*Sesamum indicum* L.). Abrha *et al.* (2013) studied Line × Tester analysis of inbred lines of maize for grain yield. Furthermore, the incorporation of molecular markers and genomic techniques in Line × Tester analysis has shown promise in enhancing the precision and efficiency of breeding programs.

Line × Tester Analysis

The fundamental idea behind Line × Tester analysis in plant breeding and genetics is to examine how different genotypes interact and their potential for combining traits. This method entails mating a variety of specific lines with a designated group of lines (referred to as testers) to assess how they perform and understand the genetic interactions between them.

Key Components of Line × Tester Analysis

Lines

Lines refer to the specific lines or varieties that are being evaluated or tested. These lines can be breeding lines, cultivars, or other genotypes that are of interest to the breeder or researcher.

Testers

Testers are a set of genetically diverse lines or varieties that possess known characteristics or traits. These testers are chosen based on their contrasting traits or desirable attributes. The primary purpose of using testers is to evaluate their performance when crossed with the lines of interest.

Stages Involved in Line × Tester Analysis

Lines Selection: A number of diverse lines with well-known features or qualities are chosen to serve as tests. To construct a sequence of crosses, these testers have been crossed with a certain set of lines.

Cross Combinations: There are several cross combinations

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created when each particular line is crossed against each tester line.

Performance Evaluation: The hybrids produced by the crossings are assessed for a variety of desirable features, including yield, disease resistance, desirable qualities, *etc*.

Statistical Analysis: Statistical techniques are used to calculate the general combining abilities (GCA) of lines and the special combining abilities (SCA) of Line × Tester interaction. Various statistical models, such as the Griffing's method, analysis of variance (ANOVA) and mixed-model approaches have been employed for Line × Tester analysis. These models account for the GCA and SCA effects, enabling estimation of their contributions to phenotypic variation. Software packages like SAS, R and GenStat have been used for data analysis, providing researchers with a range of tools for Line × Tester analysis.

Features of Line × Tester Analysis

• *mf* crosses are used in Line × Tester analysis, where *m* is the number associated to male parents and *f* is the number associated to female parents.

• Results are quite precise.

• In comparison with diallele and partial diallele analysis, analysis is simpler.

• Only direct crosses are used in Line × Tester analysis.

• A significant number of germplasm lines may be analysed for GCA and SCA variations and effects.

• A mating design is also the analysis of the Line × Tester.

• The analysis of a Line × Tester does not use a graphical method.

• Unlike in a diallel cross, each parent does not possess an equal probability of mating with the other parents. Similar to diallele and partial diallele crosses, this method also aids in the identification of promising general combiners and specific cross combinations.

• This technique also helps in selection of breeding method for enhancing the genetic traits controlled by multiple genes.

• This approach can be applied even when the inbred line exhibit self-incompatibility or male sterility.

• Line × Tester analysis can help to check inbreeding depression if F_2 population is available.

Use of Line × Tester Analysis in Field of Agriculture

Line × Tester analysis has several applications in agriculture, including:

• *Hybrid Development*: One of the main uses of Line × Tester analysis is in hybrid crop development. By evaluating the performance of different crosses, breeders can identify combinations that exhibit desirable traits and high heterosis (hybrid vigour). These superior hybrids can then be further evaluated and selected for commercial production.

• *Parental Selection*: Line × Tester analysis aids in the recognition of lines having higher GCA. Lines showing positive GCA are considered good general combiners, meaning they contribute favourably to the performance of hybrids across multiple crosses. Such lines can be selected as parents for hybrid seed production to enhance the chances of obtaining high-performing hybrids.

• *Trait Mapping*: Researchers have used Line × Tester analysis to map quantitative trait loci (QTLs) associated with various traits of interest. This approach helps in understanding the genetic basis of traits and facilitates marker-assisted selection in breeding programs.

• *Combining Ability Estimation*: Line × Tester analysis allows breeders to estimate both GCA and SCA effects. GCA estimation helps in identifying lines with consistent performance across different crosses, indicating their potential for broad adaptation and stability. SCA estimation helps in identifying specific combinations that exhibit favourable interactions, which may be useful for targeting specific environments or traits.

• *Gene Action Analysis*: Line × Tester analysis provides insights into the genetic mechanisms controlling trait inheritance. By assessing the GCA and SCA effects, breeders can determine whether the traits of interest are mainly influenced by additive (GCA) or non-additive (SCA) gene effects. This information is valuable for understanding the genetic basis of traits and designing appropriate breeding strategies.

• *Environmental Adaptation*: Line × Tester analysis is applied to assess performance of different genotypes across diverse environments. It aids in identifying lines with broad adaptation and stability across multiple environments, contributing to the development of region-specific cultivars.

Overall, Line × Tester analysis is a valuable tool in agricultural research and plant breeding. It aids in hybrid development, parental selection and combining ability estimation ultimately contributing in the development of improved crop varieties with desired traits and increased productivity.

Conclusion

Line × Tester analysis plays a pivotal role in modern agriculture and plant breeding, offering a versatile set of tools for the development of improved crop varieties with enhanced traits and productivity. Its applications are diverse and encompass various aspects of crop breeding, from the creation of high-performing hybrids to the understanding of the genetic basis of traits. This technique empowers breeders and researchers to make informed decisions, select superior parental lines, and tailor their breeding strategies to specific goals.

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