Maize genotypes expression in environments on southern Brazil

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Abstract
Brazil southern region is characterized by wide range of climatic and soil conditions. Cultivars performance varies, usually with the environments, so that a cultivar is better hardly in all crop conditions. This aim of work was to evaluate the maize genotypes adaptability and stability in Southern Brazil. The experiment was conducted on 2008/2009 crop season, 24 materials were evaluated in seven Municipal Districts in the states of Paraná (PR), Santa Catarina (SC) and Rio Grande do Sul (RS). Experimental design was a randomized block design with three replications. Each plot consisted of two crop lines with five meters each. The parameters were evaluated was yield adjusted to 13% humidity. Hybrids 9, 17, 3, 2, 10 and 20 showed high adaptability and stability, so this hybrid 11 showed better adaptability in the environment Capinzal - SC.

Key words: Zea mays, genotype, phenotype.

Introduction
Brazil southern region is characterized by climate conditions great diversity, such as a altitudes wide range, with soil organic matter different levels, variations in temperature, among others. Materials grown adaptability and stability in these environments are two major factors influence the final result, yield and area cultivated with maize. This, together with lack of data in literature makes it difficult cultivar recommendation.

According to Carvalho et al. 2 to assess the maize genotypes adaptability and stability in the Brazilian Northeast, more advantageous to assess the materials at various locations rather than evaluating them for several years, in addition, the authors obtained data showing a better hybrid material for varieties adaptation.

Vendruscolo et al. 13 argue that the cultivars performance varies, usually with the environment, so that a cultivar is hardly all culture conditions best. Different cultivars response to environmental variation is called a genotype x environment interaction, meaning that the genetic and environmental effects are not independent. For Carvalho et al. 1 the interaction genotype x environment must be carefully evaluated within the breeding program at the stages involving final evaluations and cultivars recommendations.

In the genotypes identification process it is important to know the genotype x environment (GxE). This can be obtained through adaptability and stability studies, based on knowledge of the behaviour of a species grown in various environments by GxE interaction. When a genotype does not present a significant GxE indicates adaptation on environmental conditions large number allowing the result of a single test can be extrapolated to other environments 8,11. Cultivars identification with greater phenotypic stability has been a widely used alternative to mitigate the genotype x environment interaction effects and make the recommendation process more secure cultivars 7. According to Costa et al. 4 the word adaptability refers to profitably take advantage ability to genotypes of the stimulus environment, while stability refers to the genotypes ability show a highly predictable behaviour as a function of stimulus from the environment.

To Bressan et al. 1 certain species adaptation refers to genetically determined resistance level acquired by a selection process over many generations. Selection to which the authors refer to may occur in nature, called natural selection, or may be exercised by man on particular interest species, as is done in breeding programs. Ferreira et al. 6 working with adaptation maize breeding to cultivation in wet environment, this environment creates a stressful situation the species, found significant relationships to increase the roots porosity and leaf area reduction, highlighting the adaptation of the material under study a stressful environment.

Facchi et al. 5 conducing an experiment aimed to evaluate the behaviour of 22 maize genotypes, in five different environments in the Brazil South region. The experiments were carried out in the agricultural year of 2007/2008, in the Cascavel and Quedas do Iguaçu Municiapal District in Paraná State, and Campos Novos, Santa Catarina State, Cruz Alta and Coxilha, Rio Grande do Sul State. The high grain output expresses the productive power of genotypes of this region. The HS 822, HS 814, HS 811, HS 805 showed a behaviour of general stability and high adaptation level in favourable environments. The HS 680 showed better adaptation and specificity in unfavourable environments.

The proposed experiment was to evaluated the adaptability and stability to environments found in Brazil South region.
Materials and Methods
The experiment was conducted under field conditions on December 2008. Were evaluated 24 maize hybrids on seven locals, represents Brazil South region, where maize crop was highlighted. Local soils are similar, an Oxisol Udic Dystrophic 10, 12.

Experiment local instaled were Cascavel, Clevelândia and Quedas do Iguaçu Municipal Districts on Paraná State (PR), Coxilha and Cruz Alta Municipal Districts on Rio Grande do Sul State (RS), Capinzal and Capão Bonito do Sul Municipal Districts on Santa Catarina State (SC), all of them in Brazil.

The materials were sowing in different location complying with the particularities of each, depending on climate, soil and crop zoning in the region, that influenced the times of sowing and spacing. The population used was 65,000 plants per hectare. Cruz Alta and Cascavel and the plots consisted of two lines with five meters spaced 0.7 m, in other localities the plots consisted of two lines with five meters spaced 0.8 m.

Materials used in the experiment are not commercial, but four witnesses P 30 F 53 (control 1), R 32 R 22 (control 2), MAXIMUS (control 3) and DKB 240 (control 4), because even if are being the maximum potential. Conditions were performed according to the crop nominees, to witness P 30 F 53 (control 1), R 32 R 22 (control 2), MAXIMUS lines with five meters spaced 0.8 m.

The population used was 65,000 plants per hectare. Cruz Alta and Cascavel and the plots consisted of two lines with five meters spaced 0.7 m, in other localities the plots consisted of two lines with five meters spaced 0.8 m.

Means followed by the same letter in the column do not differ by Tukey test at 5% probability. VC = Variation coefficient.

Table 1. Maize yield mean comparised by local and joint.

<table>
<thead>
<tr>
<th>Genotypes</th>
<th>Cascavel</th>
<th>Quedas do Iguaçu</th>
<th>Coxilha</th>
<th>Clevelândia</th>
<th>Capinzal</th>
<th>Cruz Alta</th>
<th>Capão B. do Sul</th>
<th>Joint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control 1</td>
<td>10,087</td>
<td>8,515</td>
<td>5,214</td>
<td>9,322</td>
<td>8,030</td>
<td>9,038</td>
<td>7,283</td>
<td>8,329</td>
</tr>
<tr>
<td>Control 2</td>
<td>10,087</td>
<td>8,515</td>
<td>5,214</td>
<td>9,322</td>
<td>8,030</td>
<td>9,038</td>
<td>7,283</td>
<td>8,329</td>
</tr>
<tr>
<td>Control 3</td>
<td>10,087</td>
<td>8,515</td>
<td>5,214</td>
<td>9,322</td>
<td>8,030</td>
<td>9,038</td>
<td>7,283</td>
<td>8,329</td>
</tr>
<tr>
<td>Control 4</td>
<td>10,087</td>
<td>8,515</td>
<td>5,214</td>
<td>9,322</td>
<td>8,030</td>
<td>9,038</td>
<td>7,283</td>
<td>8,329</td>
</tr>
</tbody>
</table>

Yields ranged from 12,302 kg ha\(^{-1}\) in Clevelândia Municipal District - PR and 3,990 kg ha\(^{-1}\) in Coxilha - RS. It is observed that the genotype corresponding to hybrid 9 showed good overall stability and high adaptability to different environments, as this is proven by the fact that this material did not differ statistically in all areas measured, the treatments that had the highest average.

It also appears that the hybrid had an average high 11 environment only found in Capinzal - SC did not differ significantly from the treatments with the highest average, showing its high to this environment adaptability.

On the locations average appear highlighted hybrids 9, 17, 3, 2, 10 and 20 which did not differ significantly from the controls 3, 4 and 1, which had the highest average.

These data show the strong genotype x environment interaction, as also reported by Costa et al. 4 to assess the maize hybrids adaptability and yield stability in Acre State (Brazil). Observe that the variation coefficient, with the Cruz Alta exception, was close to ten, this index shows the data quality. Sangoi et al. 5 attribute this variation to the genetic material basis, the management and environmental factors to which the hybrid is submitted.

Facchi et al. 5 experiment concluded on the high grain output expressions the genotypes productive power of this region. The HS 822, HS 814, HS 811, HS 805 showed the behaviour of general stability and high adaptation level in favorable environments. The HS 680 showed better adaptation and specificity in unfavorable environments.

Conclusions
High yield of 9, 17, 3, 2, 10 and 20 hybrids showed the potential to use on Brazil South region, with high adaptability and stability. Hybrid 11 showed adaptability to Capinzal Municipal District constitutes a feasible alternative for this micro-region.
References


