PhD THESIS

The variability of some quantitative and qualitative traits of some maize genotypes (*Zea mays* L.)

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CONTENT

INTRODUCTION

Maize is one of the crops with particular historical, economic and cultural importance; the historical importance is related to the history of the two American continents; the economic one, from the fact that it is in second place on the world map from the point of view of cultivated areas, and in first place as a total production of cereals, with uses in human nutrition, animal feed, but also in industry.

From a cultural point of view, besides the fact that it appears in all the cultural representations of the Aztecs and Mayans, it was also a bridge between the New World and the old continent, through Christopher Columbus (TRITEAN, 2015).

It can be said that corn is a rich food due to its nutritional value, especially the energy value of 355 kcal per 100 g of flour with 15% moisture, compared to 352 kcal for wheat flour, 348 kcal for rye flour and 346 kcal for barley flour. Also, corn has a very good digestibility, the kcal losses in the digestion process being only 8.28% (CRISTEA, 2004). From the world corn production, most of it is used for animal feed (72%). In the case of developed countries, the utilization of corn production in animal products is almost 88%, while in developing countries this share reaches only 27.9% (CRISTEA, 2004; CâMPEAN, 2009).

Maize is an extremely diverse species, with many genetic and, implicitly, morphological and physiological differences. Maize is an allogamous plant, having male and female inflorescences located at different places on the stem; for this reason, cross-pollination is highly favored, being able to reach up to 100%. It is an easily adaptable plant, for example, the flowering date is a character that can be easily modified by breeding, it can be modified per selection cycle by 2-3 days (CARENA et al., 2010).

In general, attempts to improve grain quality are accompanied by some undesirable consequences such as reduced production capacity and resistance to diseases and pests. Therefore, it is necessary to take into account the achievement of a balance between production capacity and indicators of grain quality when choosing corn hybrids (SCOTT et al., 2006).

1.STRUCTURE OF THE DOCTORAL THESIS

The doctoral thesis entitled "Variability of some quantitative and qualitative traits of some maize genotypes", was written according to the standards and norms in force, being structured in two parts, the current state of knowledge and the personal contribution.

The current state of knowledge includes 2 chapters and a number of 34 pages, and brings into study both the improvement of the production capacity and the improvement for the quality of the grains.

The personal contribution includes 8 chapters, 68 pages. It is represented by the objectives pursued, the pedoclimatic conditions of the area where the experience was carried out, the results obtained and the related discussions, conclusions and recommendations.

The thesis includes a total of 60 tables, 5 figures and 218 bibliographic titles, summing a total of 133 pages.

2. RESEARCH OBJECTIVES

The priority objectives that were studied in order to evaluate the variability of some quantitative and qualitative characteristics of some maize genotypes are the following:

1. Evaluation of the phenotypic differences between the studied genotypes, being analyzed production characters, as well as some vegetative characters;
2. Evaluation of the determinism of quantitative and qualitative characters in the expression of genetic diversity and improvement value of the studied genotypes;
3. Evaluation of the genetic value of the inbred lines studied and the identification of valuable genotypes.

3. MATERIAL AND METHOD

The research was carried out between 2016-2018, in the natural setting provided by the experimental field of the Maize Breeding Laboratory at the Turda Agricultural Development Research Station (SCDA Turda).

The biological material analyzed in the present study is represented by 21 simple hybrids made in a cyclic system and 28 hybrids made in diallel crosses.

Within the cyclic system of crossings, 21 simple hybrids were experimented, resulting from crossing in the m x n type factorial system, 7 parental inbred lines with 3 elite-tester inbred lines (7x3).

Following the crossing of 8 inbred lines in a diallel crossing system, 28 simple hybrids resulted, 4 lines were obtained from the synthetic population TU SRR Comp. A and belong to the heterotic group BSSS and 4 lines from the synthetic population Tu SRR Comp. B, belonging to the Lancaster group.

4. RESULTS AND DISCUSSIONS

4.1 Results and discussions regarding the transmission capacity of some quantitative characters on the studied genotypes in a cyclic m x n crossing system

From the results regarding the analysis of grain production variances per surface unit, in the three experimental years, in a cyclic crossing system, it follows that this character is highly influenced by pedoclimatic conditions.

Also, the dry matter is distinctly significantly influenced by the experimental factor an, but also by the genetic factor.

The number of unbroken plants is another important attribute that contributes indirectly to the achievement of production. In the case of the analyzed genetic material, it seems that there are distinctly significant differences regarding this trait, a trait that is also significantly influenced by environmental conditions.

The year 2016 was a favorable year for grain production, ensuring a significant difference of +1043.2 kg/ha, compared to the experimental average, but less favorable for dry matter, the differences compared to the control being very significantly negative (-3, 80 %).

In 2017, a year with normal temperatures but with a reduced rainfall regime in July and August, there was a decrease in grain production, the differences compared to the control being distinctly significantly negative (-2134.9 kg/ha), Dry matter and the number of unbroken plants did not show significant differences.

In 2018, due to the favorable conditions of temperature and precipitation, a significant increase in grain production was recorded +1091.73 kg/ha compared to the average of the 3 years. It seems that the dry matter was also influenced by the pedoclimatic conditions this year, ensuring a very significant increase of +4.04%.

4.2 Diversity analysis at the level of additive and non-additive genetic variances, in the cyclic system of m x n crosses

By analyzing the phenotypic variances for the hybrids included in the cyclic crossing system, the variances corresponding to the additive and non-additive genetic variances that control the genetic determinism of the studied characters as well as their significance were separated.

From the variance analysis, significant and distinctly significant differences were found between the three years of experimentation in the analyzed characters, with the exception of the number of grains per row.

Regarding maternal inbred lines (m) and tester lines (n) the differences were distinctly significant for all characters analyzed.

From the genotypes x years interaction, it can be seen that there are no significant differences for the characters analyzed, with the exception of the production character, which is significantly influenced by the interaction of these two factors.

Following the analysis of the additive genetic effects of the tester inbred lines, the TC 385 A line stands out, which favors the increase in the weight of the cob and the grains, the number of grains/row, having of course favorable effects on the production as well, while for the vegetative characters it causes some negative differences.

The values of the non-additive genetic effects for production characters are

- for grain production, the highest values of non-additive genetic effects were estimated for the hybrid combinations TE 317 x TC 385A (+880.84 kg/ha);

- for unbroken plants, the highest values of non-additive genetic effects were reported for the combination TE 383 x TE 289 (+7.91%);

- for cob weight, the combination TA 470 x TE 335, where the highest values of non-additive effects were obtained (+17.56 g), as well as TA 452 x TC 385 A (+11.13 g).

- for cob diameter, the highest values of non-additive effects were obtained with the combination TA 470 x TE 335 (+0.13 cm),

- for the cob insertion height for the combination TA 470 x TE 289 (+4.26 cm), and negative values for the combinations TE 383 x TE 335 (-4.11 cm);

- for the non-additive genetic effects, higher values were recorded for panicle ramifications at the TE 317 x TE 335 combination (+1.29 ramifications), and negative values at the TE 383 x TE 335 combination (-1.97 ramifications);

4.3 Results regarding the transmission of qualitative characteristics in a cyclic system of crosses

From the results regarding the analysis of the variances regarding the protein content in the three experimental years, in the cyclic crossing system, it follows that this qualitative character was distinctly significantly influenced both by the experimental factor year, genotype, and by the interaction between year and genotype.

As far as fats, starch and fibers are concerned, all these qualitative characters were distinctly significantly influenced by the two experimental factors and the interaction between them.

Some maternal lines were identified that transmitted a higher biochemical content, standing out as follows: the TE 447 line, a line that very significantly influenced the protein, fat, fiber and NDF content, the TA 452 line with a very significant influence for the content in fibres, NDF and ADF. Maternal line TE 342 stood out for transmitting a high percentage of protein, starch and ADF. TA 470 influenced starch, NCGD and ADF very significantly. A high starch and NCGD content is transmitted by the TE 383 and TA 468 lines, and the TE 317 line stands out for its high protein, fat, fiber and ADF transmission potential.

4.4 Results regarding the transmission of quantitative traits in a p(p-1)/2 diallel crossing system

Production capacity is based on several factors, which under the influence of environmental conditions and genetic material contribute directly or indirectly to the increase in grain production.

From the results regarding the analysis of the variances regarding grain production in the three experimental years, in the diallel system, it follows that this character was distinctly significantly influenced by both the pedoclimatic conditions and the genetic material, but was not statistically significantly influenced by the interaction between these two factors.

The dry matter and the percentage of unbroken plants registered distinctly significant differences for the factors year and genotype, but also for the interaction between them.

The year 2016 is noteworthy, which had a very significant negative influence on the dry matter, a significant negative impact on the percentage of unbroken plants and an insignificant impact on grain production. The year 2017 negatively influenced grain production, and for the other characters analyzed there were no statistically significant influences.

Of all the three experimental years, 2018 influenced very significantly the percentage of dry matter and significantly the percentage of unbroken plants.

4.5 Analysis of genetic variances in the diallel system of crosses

From the analysis of these data it follows:

• grain production is transmitted at a positive additive level by the line TC 385A (811.4) and TC 399 (680.8),

• the dry matter is transmitted at a positive additive level by the TD 337 line, and the TA 426 line transmits a lower percentage of dry matter;

• cob weight, grain weight and cob length do not register significant transmission values at the additive level;

• for the additional transmission of the length of the cob, the TC 399 line can be noted;

• the TD 337, TA 426 and TA 422 lines are sources for obtaining hybrids with a tall plant size and the TC 384A and TC 398 lines transmit a reduction of the same character;

• the higher cob insertion height is transmitted by the TD 337 lines, while a lower cob insertion height can be transmitted especially by the TC 385A and TC 398 lines;

• a smaller number of panic branches is transmitted by the TC 398 line;

• line TA 422 transmits at the additive level a reduced value regarding the leaf surface.

4.6 Results regarding the transmission of qualitative traits in a diallel system of crosses p (p-1)/ 2

The year 2016, a good year for the maize crop, with a high production compared to the average of the years, thanks to the favorable climatic factors, also influenced the quality of the grains, so that statistically significant increases can be

observed in terms of protein, fat, starch and NCGD. There is a significant increase of 0.55% in the case of protein and 0.20% in the case of starch, compared to the average of the three years. Regarding fibers, NDF and ADF, significant decreases can be observed, compared to the average of the experimental years.

The year 2017, an unfavorable year for the maize crop, especially due to the drought in June, was also unfavorable for the accumulation of protein, fat, starch and NCGD content. In the month of August, extreme temperatures were recorded, associated with a lack of precipitation, negatively influencing the accumulation in grain of the previously mentioned index, standing out with statistically significant decreases, especially starch (-0.43%) and NCGD (-1, 06%). In the case of fibers, NDF and ADF were calculated, however, significant increases compared to the average of the years, of 1.06%, 1.80%, and 1.55%, respectively.

The year 2018 was also a favorable year for corn cultivation, the protein content of the studied hybrids exceeded the experimental average by 0.46%. Increases were also estimated in the case of fats and NCGD, which recorded an increase in the value of 0.24 and 0.52, respectively, compared to the 3 years studied.

5.CONCLUSIONS AND RECOMMENDATIONS

From the analysis of the variances regarding grain production in the cyclic system, it follows that this character is highly influenced by pedoclimatic conditions and genetic material and has a fairly low heritability.

The number of unbroken plants contributes indirectly to the achievement of production, and in the case of the genetic material analyzed, distinctly significant differences were calculated, due to both the genotype and the environmental conditions.

The dry matter is distinctly significantly influenced by the experimental factor an, but also by the genetic factor.

In the diallel system, grain production, dry matter, percentage of unbroken plants, cob and grain weight, number of grains per row, plant height, insertion height and panicle ramifications were distinctly significantly influenced by both pedoclimatic conditions and of genotype.

The TA 452 line can be recommended to be used as a parental form or as a source of improvement of other lines for high production capacity, as well as a higher insertion height. It is a favorable source for obtaining hybrids with a high plant height.

Also, for higher productions, the lines TA 447, TA 470, TA 468 and TC 385A are recommended.

To obtain genotypes with a high plant height, the lines TA 447, TE 335 can be recommended.

The dry matter is transmitted positively by the TD 337 line, so this line is recommended for predicting some genotypes.

The maternal inbred line TA 447 can be recommended in valuable combinations, because it significantly influences both the weight of the grains and the weight of the cob.

6. ORIGINALITY AND INNOVATIVE CONTRIBUTIONS OF THE THESIS

The doctoral thesis entitled "Variability of some quantitative and qualitative characteristics of some maize genotypes" aims at the transmission of agronomically interesting characters of some inbred lines from the germplasm collection of SCDA Turda.

Knowing the behavior of these parents is of particular importance for the improvement of maize, the most detailed knowledge of the biological material being essential in the process of creating inbred lines and hybrids.

The crossing systems and the methods of experimentation and data processing, bring a touch of originality through the results obtained, which come to clarify whether the existing phenotypic differentiation between the analyzed inbred lines also exists at the level of genetic determinism of some characters of agronomic interest.

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