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STUDY OF GERMOPLASM RESOURCES USEFUL FOR BREEDING AND NEW GENOTYPES CREATION OF SWEET CORN

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INTRODUCTION

The breeding of sweet corn has begun to be practiced empirically since ancient times. Cultivators have chosen as seed for their crops, grains from the most developed and healthiest cobs, thus reaching at formation of more populations and local varieties. Mass selection is a method of systematic breeding that dates from the mid-nineteenth century, when REID, in the US, used it to create varieties (JUGENHEIMER, 1976). The individual selection was first used by Hopkins in 1896 (SPRAGUE G.F., 1977). As a method of breeding, hybridization began by creating hybrids between varieties. In 1893, MORROW and GARDNER developed the F1 hybrid seed production process, but the hybrids had a rather low spread (JUGENHEIMER, 1976). The most effective method of corn breeding is consanguination, for the creation of simple hybrids between inbred lines, developed by SHULL in 1908-1909. This method is still being used. Although very performing, the first simple hybrids of sweet corn have not expanded into production.

Sweet corn germplasm used by breeders becomes valuable when it meets two basic conditions: genetic variability and own performance.

Allogamy pollination determined the apparition of a pronounced variability. Cultivation in America since ancient times, but also the very rapid expansion in culture in Europe has led to the emergence of a number of local populations. These forms are very valuable for the breeding process as they have a high degree of adaptability being the owners of some complex genes of resistance to disease attack, but which also manifest a good combinational capacity, essential element in the creation of hybrids.

MATERIAL AND METHODS

As sources of initial biological material, we used local populations and Romanian or foreign varieties cultivated or removed from culture as well as inbred lines as parental forms. These are forms that are easier to improve, the usual progress being faster.

A particular category of the initial material was represented by special sources of genes. These are inbred lines that have special genes for quality improvement, waist reduction or for androsterility. From these sources the respective genes are transferred to the inbred lines, the parental forms under breeding.

As breeding methods, we used:

Mass selection, where the average value of some characters has been shifted in certain directions, depending on the purpose. With this type of selection, the characters related to the plant size, the vegetation period or the shape and color of the grains have been improved. Mass selection has had less effectiveness on production capacity or quality.

Hybridization was a method used to combine valuable characters from different genitors. When compared with selection, the variability created by hybridization produces new combinations of characters. Hybrid populations will be processed by selection, similar to populations with natural variability. Genealogy selection and recurrent selection are very useful methods that make better use of variability. As genitors, varieties and local populations are used in hybridization. Cultivation of hybrids between varieties is not recommended, the production increase being reduced.

In establishing the breeding objectives, we considered the fact that at sweet corn both varieties and hybrids are grown. The advantage of growing hybrids is that they have a much larger and more stable production capacity than varieties.

The studies presented in the paper focused on the following objectives:

- breeding of the production capacity, a very complex character, the main components of the production at the surface unit were the number of plants per hectare and the production on a plant.
- the number of plants per surface unit is dependent on some morphological and physiological characteristics: plant habitus, growth rhythm, assimilation capacity and light requirements.
- the productivity of the plant is based on several morphological components, the most important being: the number of corn cobs on plant, the weight of the cobs, the yield of grains and the mass of 1000 grains.

- the number of cobs per plant is a character with a pretty good variability. Both in the species and within the related genus there are forms with several female inflorescences. From this point of view, there are two possibilities for breeding. There are sources for the creation of prolific hybrids with more than 2 cobs per plant. The disadvantage is that it does not support shading, so the densities that can be applied are reduced. The critical phase for shading is during the blooming, at this time the plants are also very high.

Another direction, and the most favourable, is the creation of semi-proliferating hybrids, with 2 cobs per plant. They can achieve a normal cob even in unfavourable environmental conditions, and they also support high densities.

In the process of selecting some productive forms, correlations that are established between production and some morphological characters should be considered. These correlations are different at inbred lines toward hybrids.

At inbred lines, the most important correlations for the selection are those between the plant size and the grain yield, or those between the number of cobs per plant and the size of the cobs.

In the case of hybrids, other correlations are used in the selection, namely the production capacity and the late blooming, the size of the plants, the number of internodes under the cobs, the number of cobs per plant, the size of the grain and the grain yield.

In the process of quality breeding we focused on: increasing the percentage of soluble carbohydrates, starch and protein in grains, and improving the quality of the protein.

The percentage of protein in corn grain usually has values of 9-11%. Breeding is aimed at exceeding the maximum threshold, but also the qualitative improvement of the protein because it is deficient in certain essential amino acids (lysine and tryptophan). The percentage of the protein in the grain is determined poligenetically, as it is known that a low percentage is dominant over the high percentage. In order to increase the percentage of protein in grain, it is recommended, that in hybridizations, the form with the highest content in protein should be used as a mother form because 2/3 of the endosperm originates from the maternal genitor.

Breeding of vegetation period. This objective is present in most species. Although it is known that the high production capacity of sweet corn is correlated with a long vegetation period, the creation of early hybrids remains a goal of breeding due to some of the advantages it brings. The condition of creating such hybrids is that of combining good production capacity with a short period of vegetation. Forms with 90-120 days of vegetation allow the expansion of the sweet corn in the hilly areas. Areas characterised by drought period of the summer must be avoided, leading to a weak bonding of the flowers and the appearance of the phenomenon of scattering. Such hybrids are also good precursors to autumn crops, releasing the field earlier.

RESULTS AND DISCUSSIONS

The quality is a very complex trait at sweet corn. The biochemical content of the grains may be influenced by different genes:
- the genes '*sh*' (*shrunken*) increase the sugar content in the endosperm, leading to the formation of barren grains;
- the genes '*fl*' (*floury*) increase the essential amino acid lysine and tryptophan content, producing flour-like endosperm;
- the genes '*o*' (*opaque*) have the same influence as '*fl*' leading to the apparition ofhalf flour-like endosperm;
- the genes ''*su*' (*sugary*) lead to an increase in the polysaccharide content of 8 to 10 times, and in monosaccharides twice, resulting in the appearance of the translucent and barren endosperm;
- the genes '*wx*' (*waxy*) produce a waxy endosperm, rich in amylopectin;
- the genes '*ae*' (*amylose extender*) lead to increased amylose content.

Our morphological study, presented in table 1, included investigation of plant height with a variation from 3,5 m to 4,2 m, number of days from to sprout to the spur, with a variation from 60 to 70 days. Milk phase occurred from 3,37 to 3,98 days from sprout.

Table 1. Morphological characterization of the studied assortment

Variant	Plant height (m)	No days from the sprout to the spur	No days from sprout to the milk phase
LP - 16	3,5	62	3,98
LP - 6	3,8	60	3,96
LP - 3	3,9	63	3,95
LP -11	4,2	65	3,37
LP -29	3,5	68	3,98
LP -5	3,7	65	3,96
LP - 1	3,8	69	3,97
LP - 12	3,9	70	3,99
LP - 18	4,2	55	3,98
LP - 20	3,7	58	3,97

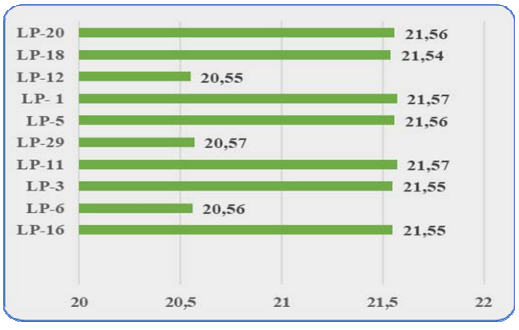

Fig. 1 Variation of % soluble carbohydrates in the milk phase - wax% at investigated material

In order to investigate the seed quality, we studied the variation of % soluble carbohydrates, content in vitamin C and protein content in the milk phase at is it presented in figure 1 and figure 2. The soluble carbohydrates in the milk phase varied from 20,55% at LP-12 to 21,57% at LP-1 and LP-11, figure 1.

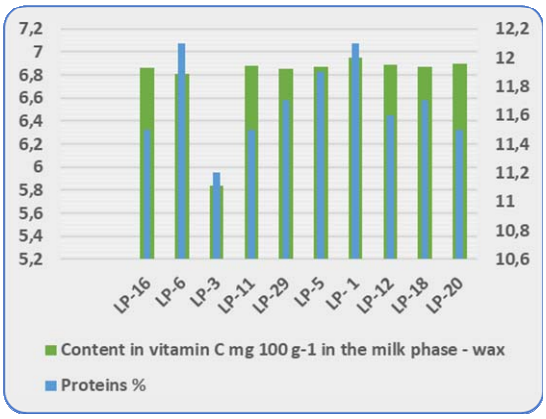

Fig. 2 Variation of vitamin C and protein content at investigated material

Figure 2 presents the variation of vitamin C content and protein. LP-3 registered the lowest level of proteins and vitamin C.

The production capacity is a determined polygene character, the number of the involved genes, as well as the component characters, being high, and the interactions between them of different types. It behaves as dominant characters: large cobs, a large number of rows on the cobs, red coloured rash, yellow and dentate grains. There was additive interaction between genes for the characters: length and diameter of the cobs, the weight of the cobs and the duration of the vegetation.

In the corn (alogamous species), each elite chosen in F1 on obtain one family, from which a new extraction of elites is made. Each family is isolated, ensuring a "sib" pollination (among the individuals that make it up). As a result of the pollination of "sib" or between different families, individuals with unwanted recessive characters may appear. These are eliminated in the next generation by biological purification. Selection continues until the descending families are made up of similar plants. Sometimes there may be a reduction in vigour due to inbredness, which can be combated by multiplying them with other families with which they have a common ascendant.

Figure 3 presents the scheme of repeated individual selection for alogam plants, used in our study for homologation and introduction in culture, respective by National Institute for Testing and Variety Registration.

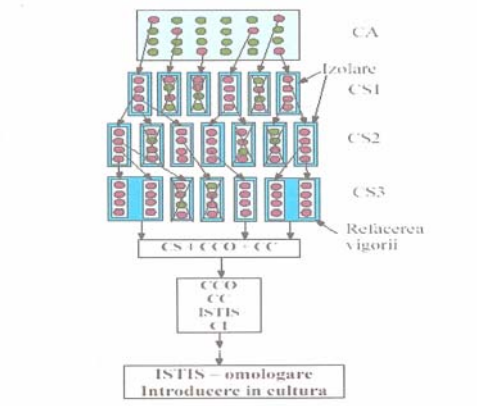

Fig. 3. Repeated individual selection scheme for alogam plants

Table 2. Characterization of the studied assortment - the main elements of productivity

Variant	Cobs per plant	Length of cob (cm)	Diameter of cob cm
LP - 16	3	18	4,5
LP - 6	2	18	4,8
LP - 3	2	19	5,0
LP -11	2	20	5,6
LP -29	2	21	5,4
LP -5	3	21	5,8
LP - 1	3	22	5,5
LP - 12	3	22	4,9
LP - 18	3	21	5,7
LP - 20	2	20	5,0

Table 2 presents our results on features related to productivity. The number of cobs plant is a pretty good character. Both in the species and within the related genus there are forms with several female inflorescences.

From this point of view, there are two possibilities for breeding. There are sources for the creation of prolific hybrids with more than 2 cobs per plant. The length cob varied from 18 to 22 cm and the diameter from 4,5 to 5,8 cm.

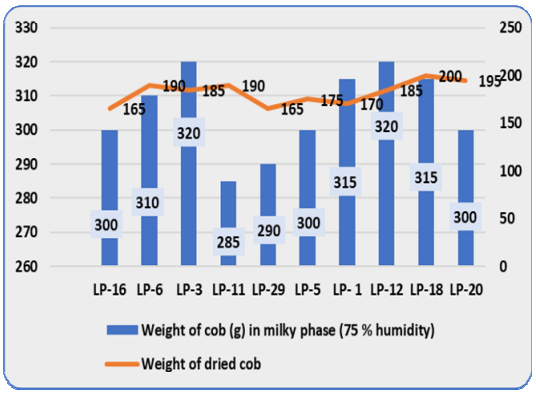

Fig. 4 Variation of cob humidity in different stages of maturation

Figure 4 presents a variation of cob humidity in different stages of maturation. Our investigations were accomplished in two different phases, milk phase and at dried cobs. According to our study during the maturation and drying processes the cobs lost between 95 and 145 g water.

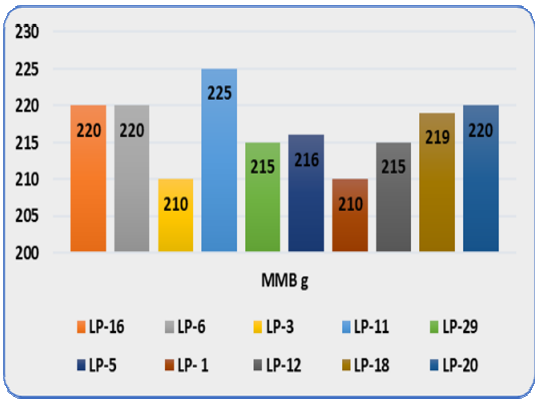

Fig. 5 Variation of weight of 1000 seeds

The total weight if 1000 seeds registered a small variation from 210 g at LP-3 to 225 g at LP-11, as it can be observed in figure 5.

CONCLUSIONS

In the process of selecting some productive forms, correlations that are established between production and some morphological characters should be considered. These correlations are different at inbred lines toward hybrids.

At inbred lines, the most important correlations for the selection are those between the plant size and the grain yield, or those between the number of cobs per plant and the size of the cobs.

In the case of hybrids, other correlations are used in the selection, namely the production capacity and the late blooming, the size of the plants, the number of internodes under the cobs, the number of cobs per plant, the size of the grain and the grain yield.

As a result of the developed studies, VRDS BACĂU has approved and patented a new variety of sweet corn named Deliciosul, which meets all the amelioration objectives that we have pursued.

ABSTRACT

The corn is characterized by a high biological plasticity, climatic factors, temperature and humidity, exerting a great influence on its growth and development. Being a plant of origin in southern and warm regions, the stages of development are generally short, except for late varieties whose light stage is longer.

In order to break the correlation between productivity and tardiness, we have applied a very rigorous selection of the genitors, but also a special selection for the very fast traverse of the flowering vegetation phases. Hybrids must present a larger number of leaves in the late forms, increasing their character from 8-10 leaves, as in early forms at nearly 20-24 leaves, as in late forms.

Varieties and hybrids intended for cultivation in irrigated areas must have specific features. Thus, it has to support high densities at the surface unit. For this, they must be resistant to falling, less demand of light, very resistant to disease attack, and able to valorise high doses of fertilizer.

Sugar corn is also important through its production, especially through the productivity of hybrids created by breeding. It is a plant of great biological capacity.

The importance of the sweet corn breeding in our country results both from the pedoclimatic conditions that are favourable for its culture and from the necessity to create hybrids with an ever-increasing production capacity and better quality. The use in production of hybrid seeds and the application of the most suitable agro technical methods provide year-to-year higher yields.

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