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STUDY OF SOME TOMATOES BREEDING LINES FOR DEVELOPMENT OF NEW VARIETIES AND HYBRIDS

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INTRODUCTION

Improvement of the assortment of tomato hybrids and cultivars is permanently needed, in order to satisfy the market request. The main motivation of breeding is determined by the fact that in culture, genotype, represented by variety or hybrid, remains the main factor responsible for yield and yield's quality increase (Muresan, 1972). By the improvement of characteristics regarding the resistance to diseases, pests and unfavorable environmental factors, the possibility of pollution of the obtained food product and of the agricultural ecosystem is strongly diminished.

The goals of tomato breeding programmes vary widely depending on location, need and resources. In general, breeding goals in tomato have gone through four phases: breeding for yield in the 1970s, for shelf-life in the 1980s, for taste in the 1990s and for nutritional quality currently. To be successful, growers must produce a high yield of high-quality fruit, while holding production costs as low as possible.

Therefore, many of the breeding goals focus on characteristics that reduce production costs or ensure reliable production of high yields with high-quality fruits (Yuling, Lindhout, 2007). Nowadays an increased interest is registered on healthy food, preservation on environment and breeding for organic vegetables become a solution to challenges related human health, clan environment and climate change.

It is well known that crop productivity can be increased by the use of hybrids, achieved by crossing pure, homozygous lines, with traits defined as being agro-productively important. Pure lines are traditionally generated by techniques based on classical reproductions, through successive rounds of self-pollination and selection.

This requires a considerable amount of time and resources. In this context, in recent years, the biotechnological alternative has become far more efficient and sustainable than traditional methods. The haploidy phenomenon was also part of the category of discoveries, but less explored in the past. In-depth knowledge of this phenomenon has revealed that it can be used successfully in genetic analysis as well as in tomato breeding. While classical breeding methods involve inducing genetic variability through sex recombination, a number of relatively new techniques allow a high degree of genotypic and phenotypic variability to be achieved through asexual recombination, involving manipulations at the molecular and cell levels.

To obtain genitors with high biological and economic combinative value, different breeding methods are suitable to be applied.

Repeated self-pollination of tomato parents ensures their homozygosity, because the recombination take place with the participation of the same genetic material. Strict autogamy leads to the appearance of "pure lines" and reduced variability.

In fact, in the populations that constitute the cultivated varieties there is genotypic variability, determined by the mutations or by a small percentage of allogamy, sometimes accentuated by the climatic conditions. Under such conditions, "repeated individual selection" may be a breeding method, which can be used to create genitors and varieties. The same method will be used in the case of stimulation of variability through sexual hybridization, applying either the genealogical or late selection.

Stimulation of variability is possible in tomatoes by experimental mutagenesis. Mutants obtained from tomatoes, with the help of radiation or chemicals, are valuable in the process of breeding. In case of detecting valuable mutant forms, they are subsequently verified in comparative cultures or used in hybridizations. New combinations of genes can be obtained in tomatoes by genetic engineering methods, by embryogenesis or *in vitro* cultures of cells and tissues.

At tomatoes, in particular, the hybrid force is used in practice, because the hybrids that show heterosis are far superior to both varieties in field conditions, especially for protected spaces.

In order to obtain a greater intensity of the heterosis phenomenon in tomatoes, in the work of creating the F1 hybrids, the greatest attention must be paid to the choice of parents.

Establishing the principles of choosing parents is the aim of numerous researches, concerning: 1) the significance of genetic differentiation; 2) the importance of ensuring the ecological and geographical differentiation; 3) establishing the combinatorial capacity of parents; 4) the importance of ensuring morphological, physiological and biochemical differences when choosing parents; 5) manifestation of the heterogeneous phenomenon according to the position of the hybridization partner; 6) the economic value of the varieties and lines used as parents.

Thanks to high demands for healthy food and economic efficiency, ecological culture system has become popular and wanted by beneficiaries of organic horticultural products. In this view new generation of germplasm featured by resistance to biotic and abiotic stress is needed. (Brezeanu, 2011)

As a rule, in the first three generations (C1 - C3) the selection of the inbred lines is made according to the established breeding objectives (productivity, precocity, quality, resistance to environmental factors, etc.). The lines retained based on the breeding objectives are tested for the general and specific combination capacity, for the fact that they will enter the structure of the new hybrids based on the favorable reaction at the cross. The overall combined capacity of the improved lines is determined in C3 - C4 by crossing them with the same parent called tester.

This kind of crossing is also called top-cross or cyclic hybridization. The tester can be a variety, an inbred line or a simple hybrid. If, for example, we have the parent lines (A, B, C, D) by cyclic hybridization with the "T" tester, 4 hybrid combinations will result, namely: A x T; B x T; C x T; D x T. The resulting hybrids are examined in comparative cultures, where the production differences between them are due to the general ability to combine inbred lines.

Therefore, lines where the crossings with the same tester gave the highest yields are considered featured by a good ability to combine, the rest of the lines are eliminated. The parent lines that reacted strongly with the tester variety will cross (two) with each other and result in simple hybrids, which are examined in comparative cultures regarding the yield and the specific combinatorial capacity.

MATERIAL AND METHODS

The involved methodology used specific modern methods and techniques, as genetic selection, inbreeding and inheritance mechanisms of the main quantitative and qualitative traits. Genetic studies on the mechanisms of heredity and homozygosity of genes responsible for manifesting the main characteristics of productivity and resistance, hybridization and and hybrid analysis specific to tomatoes were undertaken.

The working techniques used are the specific technique for self-pollination in the works of consanguinity, selection, hybridization and hybrid analysis. In order to obtain new varieties of tomatoes, local populations were used as starting material for different genetic recombination have been used.

The research method used was repeated individual selection in homozygous advanced hybrid populations (Pot1og A., Velican V., 1971).

The knowledge of the morphological and physiological characteristics of tomato parents is an essential condition for breeding. After a careful investigation of the main characteristics, from the field of collection, which included over 250 cultivars, 4 parents, with determined growth (SP +) were promoted.

The promotion of parents from the base field to the working field was made on the basis of the genetic stability of the main characteristics pursued in the process of breeding. Four improved lines that met the characteristics that we stabilized over time, using as a comparison the control Unibac variety, within the breeding program carried out at S.C.D.L. Bacau.

Biometric measurements and observations were performed at all parents promoted in the field of work, using UPOV criteria as assessment standards.

RESULTS AND DISCUSSIONS

Tables 1 to 5 present important characteristics of lines as follows: plant morphological investigations, morphological observation and phenological investigations on tomato fruits.

Table 1. Morphological characterization of the studied assortment

No	Plant investigations				
	Height (cm)	Steams no	leaves after first inflorescence	total no of leaves	Type of inflorescence
L18	62	7	3	28	bifurcate
L15	64	8	4	50	partly uniparous,
L 6	60	8	5	35	partly multiparous
L 3	82	8	6	52	bifurcate

The predominant fruit shape was recorded after the fruits turn color, according to tomato IPGRI descriptors (Fig. 1).

Inflorescence type observed the 2^{nd} and 3^{rd} truss of at least 10 plants was both (partly uniparous, partly multiparous) at two lines, L15 and L6 and generally multiparous at L18 and L3. Plant's height varied from 60 to 82 cm, total number of leaves 28 to 52 and leaves under the first inflorescence between 3 at L18 and 6 at L3

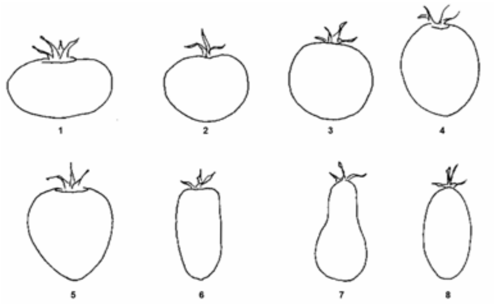

Fig. 1. Predominant fruit shape according IPGRI descriptors: 1 Flattened (oblate), 2 Slightly flattened, 3 Rounded, 4 High rounded, 5 Heart-shaped, 6 Cylindrical (long oblong), 7 Pyriform, 8 Ellipsoid (plum-shaped)

Table 2. Morphological observation and phenological investigations on tomato fruits

line	Fruit investigations					
	Shape	H (cm)	Ø (cm)	Color at techn. maturity	Colour at phisiological maturity	Surface
L18	high rounded	5.0	5.5	light green	red	very weak
L15	high rounded	6.0	6.0	light green	dark red	weak
L 6	slightly flattened	4.5	5.5	light green	red	very weak
L 3	round	5.0	6.5	dark green	dark red	interme diate

Table 3. Morphological observation related yield on investigated tomato lines

line	Fruits investigation			
	Fruit's weight (g)	Total weight of fruits per plant (kg)	Fruit no on the plant	Fruit firmness
L18	110	5,9	27	good
L15	130	4,5	21	very good
L 6	115	5,1	28	good
L 3	125	5,0	25	good
Control	95	3,9	25	good

Ribbing at calyx end was appreciated using as reference varieties as follows very weak (Cerise), weak (Allround), intermediate (Saint-Pierre) and strong (Supermarmande). L18 and L6 were appreciated at very week ribbing at calix, L15 weak and L3 intermediate. (Table 2)

From the data presented (tables 1-5), it appears that all four lines promoted for breeding exceeded the control variety, both in terms of productivity, quality, and resistance to attack by pathogens. Fruit weight varried from 95 to 130 g, and total yield - average value from 80 to 95 (t ha^{-1}) (fig. 2). All four breeded lines registres superiour relative yield comparing control (fig 3).

Table 4. The main characteristics of tomato fruit at parents SP

line	Fruit observations			
	Skin colour	Flash colour	Resistance at the crack	Seeds no in fruit
L18	red	red	very good	207
L15	red	dark red	very good	165
L 6	red	red	good	190
L 3	dark red	red	good	280

Table 5. Results related yield and resistance of investigated lines

line	Yield		Diffrence from control	Significance of difference	Deasise restistance	Post resistance
	t ha^{-1}	%				
L18	95	119	+ 15	***	Very good	Very good
L15	89	111	+9	***	Very good	Very good
L 6	93	116	+13	***	Very good	Very good
L 3	92	115	+12	***	Very good	Very good
control	80	100	-		Very good	Very good

Dl 5% = 2,9 t ha^{-1}
Dl 5% = 3,9 t ha^{-1}
Dl 5% = 5,1 t ha^{-1}

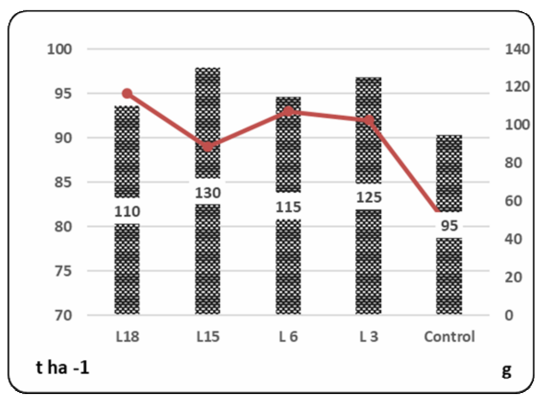

Fig. 2. Fruit weight (g) and total yield - average value (t ha^{-1})

Until now the achievements in tomato breeding are based on classical breeding-genetic methods and also, an essential change in the accelerated introduction of useful traits in the cultivars is not made. It is believable that conventional breeding wouldn't allow the increase of productivity in the future. The significant progress in molecular genetics and use of molecular marker techniques are established. Therefore, the combined application of traditional breeding and contemporary plant biotechnology methods including selection based on molecular markers marker-Assisted Selection might be valuable tools for tomato breeding. (Fentik, 2017)

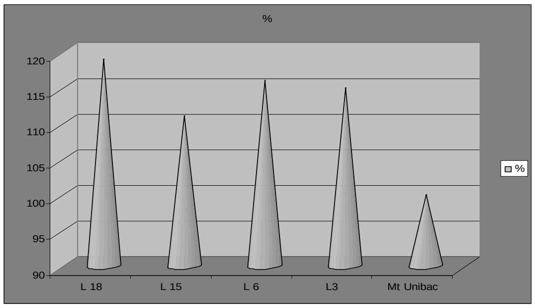

Fig. 3. Relative yield of breeded lines (%)

CONCLUSIONS

The combining capacity of parents is one of the most important traits that ultimately determines the value of newly created cultivars.

In our research, the effect of crossovers between a large number of improved parents was sought, in order to establish their combinative capacity and correlations between the factors that contribute to obtaining valuable varieties.

The study has shown that parents who gave the best results by crossing with the analyzing parent proved to be the best at crossover. Compared to the control (Unibac variety), all four homozygous advanced lines achieve total production of over 80 t ha^{-1}. The lines exhibit increased resistance against to the attack of pathogens.

ABSTRACT

The preference of farmers is usually influenced by the economic benefits gained by using traditional varieties that are productive but can also survive to environmental adversities. Old, local varieties perfectly adapted to environmental conditions, featured by increased productivity, can represent a starting breeding material. The market request/ preference in terms of taste, flavor, colour, size and shape. Romanian consumers prefer red, big and sweet fruits (high content of soluble solids, uniformity of fruits shape and color, shape index around 1, average weight 150 g fruit, with high lycopene content). The knowledge of the morphological and physiological characteristics of tomato parents is an essential condition for breeding. In the present study, after a careful investigation of the main characteristics, from the field of collection, which included over 250 cultivars, 4 parents, with determined growth (SP +) were promoted. The promotion of parents from the base field to the working field was made on the basis of the genetic stability of the main characteristics pursued in the process of breeding. Four improved lines that met the characteristics that we stabilized over time, using as a comparison the control Unibac variety, within the breeding program carried out at S.C.D.L. Bacau. Biometric measurements and observations were performed at all parents promoted in the field of work, using UPOV criteria as assessment standards. The study has shown that parents who gave the best results by crossing with the analyzing parent proved to be the best at crossover. Compared to the control (Unibac variety), all four homozygous advanced lines achieve total production of over 80 t ha^{-1}. The lines exhibit increased resistance against to the attack of pathogens.

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