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MORPHOBIOLOGICAL AND AGRICULTURAL TRAITS OF THE TOMATO PROSPECTIVE LINES

ÎNSUŞIRILE MORFOBIOLOGICE ŞI AGROCHIMICE LA LINIILE DE PERSPECTIVĂ DE TOMATE

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Abstract. *The article presents the results of the evaluation of some tomato perspective lines developed at the Institute of Genetics, Plant Physiology and Plant Protection, Republic of Moldova. Testing on the basis of productivity, resistance to alternariosis and morphobiological characteristics of the fruit, and subsequent clusterian analysis, showed that the lines separated into three clusters differ on the basis of the fruit weight, fruit length, fruit diameter, mesocarp thickness, pericarp thickness, seminal lojes. Lines with increased productivity – L 304, L 306, L 309 and L 310 have been identified that can be included in the breeding programs. Lines L 304, L 306, L 308, L 310 exhibited a reduced degree and frequency of attack of alternarias and may be recommended as a source of resistance to disease.*
Key words: tomatoes, fruit characters, productivity, resistance

Rezumat. *Lucrarea prezintă rezultatele de cercetare asupra unor linii de perspectivă a tomatelor create la Institutul de Genetică, Fiziologie şi Protecţia Plantelor din Republica Moldova. Testarea pe baza agroproductivităţii, a rezistenţei la alternarioză, a caracteristicilor morfobiologice ale fructului şi analiza multiplă care a urmat au arătat că liniile separate din cele trei grupe diferă în funcţie de greutatea fructului, lungimea fructului, diametrul fructului, grosimea mezocarpului, grosimea pericarpului, lojelor seminale. Au fost identificate liniile cu productivitate crescută - L 304, L 306, L 309 şi L 310, acestea putând fi incluse în programele de multiplicare. Liniile L 304, L 306, L 308, L 310 au prezentat un grad şi o frecvenţă de atac reduse a alternariozei şi, ca atare, pot fi recomandate ca sursă de rezistenţă la agenţii patogeni.*
Cuvinte cheie: tomate, caracteristici ale fructelor, productivitate, rezistenţă

INTRODUCTION

Tomatoes (*Solanum lycopersicum* L.) are some of the most cultivated vegetables in the world, their fruits being a basic food source and a main component of dietary products in many countries (Munteanu, 2003; Borghesi *et al.*, 2011; Inculet *et al.*, 2017).

Classical plant improvement implies firstly the involvement of high biological value starting material in breeding programs, the determination of genetic variation, and the selection in the segregated or natural populations of

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forms of interest with the subsequent conservation of valuable genetic sources (Barrero and Tanksley, 2004; Gepts, 2002; Gepts P., 2006).

The limited genetic diversity of many agricultural crops necessitates the need to detect new sources of necessary characters / variations (Heywood V. *et al.*, 2007; Munteanu and Fălticeanu, 2008), in Solanaceae species the genetic diversity of genophores also being of great importance for the success of breeding programs (Ciobanu *et al.*, 2009, a; Albrecht *et al.*, 2010).

The ever-increasing requirements for newly created varieties require importers to use the contemporary methods of obtaining the original material and its use in hybridization and selection (Ciobanu *et al.*, 2016). A great interest is represented by the high-yielding native varieties and the forms coming from areas with similar conditions to those in the country in which they are to be implemented, thus offering high opportunities for their direct introduction into culture (Bai and Lindhout, 2007; Ciobanu *et al.*, 2009, b; Dar and Sharma, 2011).

Independent of the direction of breeding research, an important role is given to the characters of the fruit, as they often determine the ultimate goal of the improvement. The main characteristics of the tomato fruit are: the mass, the number of loaves, the thickness of the pericarp, the shape of the fruit, and the knowledge of the degree of their variability allows for more efficient use of the initial material in the ameliorative research.

This paper presents the results of the assessment of some tomato perspective lines created in the Institute of Genetics, Plant Physiology and Plant Protection on the basis of attributes of fruit, productivity and resistance to alternariose.

MATERIAL AND METHOD

Seven tomato lines selected from different intraspecific hybrids were used as study material, and Elvira native variety served as a control.

The establishment of the culture was carried out by seed without irrigation. The applied technology is approved for tomato culture in the Central Area of the Republic of Moldova (Eshova, 1978).

Genotypes were analyzed based on a set of quantitative characters valued at 10 plants taken at random for each genotype, according to the standards in force, according to the methods described in the work (Пухальский, 2005) and Test Guidelines for Tomato - UPOV (2011). In comparative competition cultures, the prospective forms were placed in randomized blocks (Dospehov, 1985).

The assessment of the frequency and degree of attack of alternariose was performed in field conditions, based on signs of disease (brown spots, ulcerations, necroses) in the 6-step scale, elaborated by the authors: 0 - healthy, immune (no signs of disease) 1 - High Resistance - RR (10-20%); 2 - resistant - R (21-30%); 3 - medium resistant - RM (31-40%); 4 - sensitive - S (41-50%); 5 - highly sensitive - SS (≥50% area with signs of disease).

Cluster analysis were performed by constructing dendrograms based on the agglomeration-iterational algorithm (the Ward method) and the *k*-mean method [355]. In the k-media method, 3 clusters were programmed after the possible values of the characters: small, medium and high. The main purpose of these procedures is to find

similarities and differences between objects (genotypes) according to the parameters used (fruit mass, fruit length, fruit diameter, mesocarp thickness, pericarp, number of seminal troughs) and their distribution in groups objects in the same group are similar, and those in different groups - special.

Statistical data was performed in the STATISTICA 7 software package.

RESULTS AND DISCUSSIONS

The climatic conditions of 2017 were unfavorable for the early ontogenesis of tomatoes in their growing by seed in connection with the snow that fell in the third decade of April. The crust that has formed at the surface of the soil has led to the uneven outflow of the plants, and in some forms low soil temperatures have influenced vegetative and reproductive growth of plants. Even under these conditions, some lines had a good development and recorded high productivity values (fig. 1).

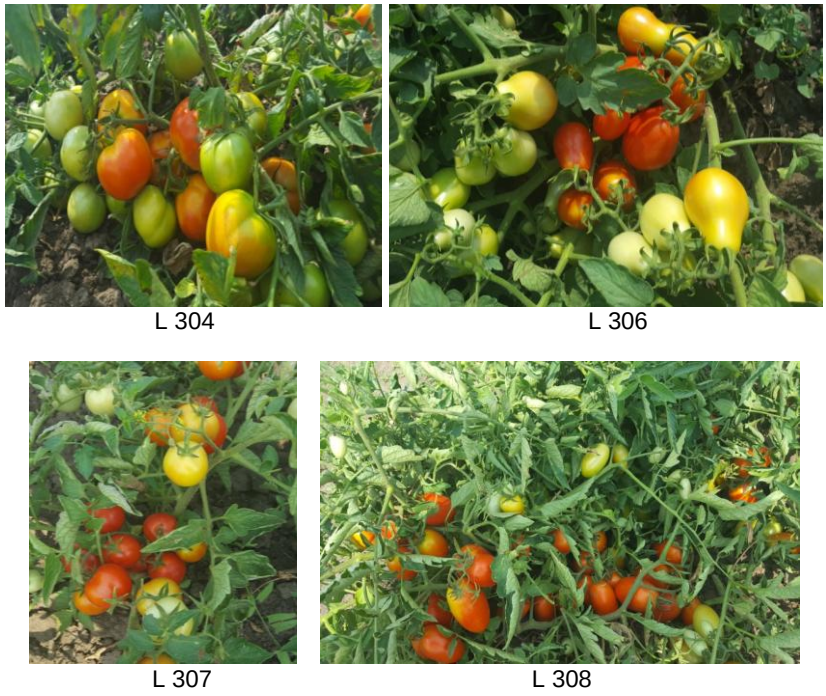


Fig. 1 Appearance of tomato perspective lines

As a result of the analysis of the number of fruits per plant (fig. 2), it was found to have a high variability in the perspective lines ranging from 6 ... 36 to the standard Elvira, L 304 – 16-45, L 305 – 17-32, L 306 – 32-98, L 307 – 47-87, L 308 – 52-99, L 309 – 49-92, L 310 – 34-68. The highest values were

recorded on lines L 306, L 307, L 308 and L 309, which indicates their suitability for breeding programs.

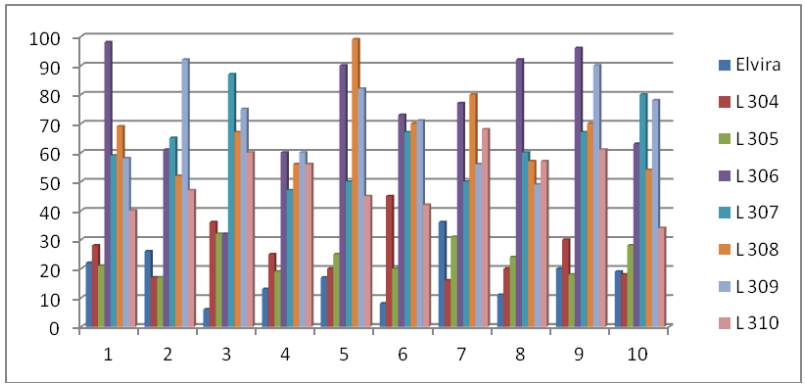


Fig. 2 Variability of fruits number per plant at the tomato perspective lines

The data showed essential differences of genotypes according to the fruit weight *per* plant (tab. 1). Two forms – L 309, L 310, were identified, where the fruit weight *per* plant was within the range of 2.01-3.94 kg. The highest values of the character were recorded at genotype L 306: 2.24 ... 5.39 kg.

Table 1

Variability of fruit mass per plant (kg) in tomatoes

Genotype	Plant number										$x \pm m_x$	V,%
	1	2	3	4	5	6	7	8	9	10		
Elvira, martor	1.98	2.24	0.96	1.36	1.60	1.23	3.10	1.54	1.90	1.71	1.71±0.20	36.8
L 304	2.67	1.73	2.38	2.12	1.96	2.75	1.60	1.90	2.10	1.89	2.12±0.12	18.0
L 305	2.08	1.90	2.11	1.62	2.45	1.22	3.10	2.28	1.26	2.88	2.09±0.20	29.7
L 306	4.41	3.23	2.24	3.48	4.59	4.96	5.39	4.88	4.42	3.91	4.15±0.30	22.9
L 307	1.18	1.17	1.31	1.03	1.15	1.14	1.05	1.14	1.34	1.28	1.18±0.03	8.50
L 308	2.35	1.82	2.21	1.90	2.77	2.31	2.32	2.05	2.45	2.00	2.22±0.09	12.6
L 309	2.32	3.13	3.37	2.10	2.87	3.27	2.41	2.21	2.61	3.28	2.76±0.15	17.7
L 310	2.16	2.40	2.58	2.80	2.29	2.10	3.94	2.74	2.87	2.01	2.59±0.18	21.6

By correlational analysis (tab. 2) we found a positive dependence with statistical support ($p \leq 0.05$) between the characters the number of fruits *per* plant - the fruit weight *per* plant and a negative correlation between the fruit weight *per* plant - the mass of the fruit, which is denoted that at the genotypes under study the fruit mass *per* plant depends on the number of fruits *per* plant rather than the mass of the fruit.

The negative correlation between the number of fruit per plant and the weight of the fruit recorded on most lines (L 304, L 306, L 307, L 308) indicates

that the increase in yields of tomato plants in the studied forms can only be carried out on the basis of one of those characters.

Table 2

Correlational analysis of tomato productivity characters

Genotype	Correlation coefficient	
	Number of fruits per plant - fruit weight per plant	***Number of fruits per plant - the mass of the fruit***
Elvira, control	0.98*	-0.82*
L 304	0.88*	-0.92*
L 305	0.75*	-0.32
L 306	0.79*	-0.69*
L 307	0.82*	-0.93*
L 308	0.94*	-0.89*
L 309	0.65*	-0.59*
L 310	0.89*	-0.37

*-p≤0,05.

Among the many attributes of the fruit, its mass is one of the most important, as it is not only a biological feature but also an economic importance of the genotype. The improvement direction for this character is quite different, driven by consumer preferences and usage specifics.

According to the fruit mass, the lines were classified in three categories: very small fruit: 20.7 g – line L 307; small: 32.9 and 43.0 g, respectively, lines L 308, L 309; medium fruit: 88.9; 101.1; 57.3 and 54.6 g, respectively, lines L 304, L 305, L 306, L 310. Thus most of the lines created had an average level of the fruit weight (tab. 3).

Table 3

Phenotypic variability of some fruit characters at the tomato perspective lines

Line	Fruit weight		Fruit length		Fruit diameter		Mesocarp thickness	
	$x \pm m_x$, g	V,%	$x \pm m_x$, mm	V,%	$x \pm m_x$, mm	V,%	$x \pm m_x$, mm	V,%
Elvira, martor	122.5±6.2	22.5	54.7±1.2	9.6	60.4±1.0	7.4	45.5±1.2	12.2
L 304	88.9±4.3	21.7	49.9±0.8	6.7	55.7±0.9	7.3	39.9±1.0	11.5
L 305	101.1±4.7	20.8	56.7±1.1	8.3	50.0±1.0	8.5	42.9±1.0	10.3
L 306	57.3±2.4	18.4	60.7±0.7	4.8	43.1±0.7	6.9	26.0±0.7	11.4
L 307	20.7±0.9	19.0	32.0±0.9	12.9	32.3±0.7	10.2	24.6±0.4	7.8
L 308	32.9±1.4	18.9	53.2±1.1	9.0	33.3±0.6	8.1	22.2±0.3	6.8
L 309	43.0±1.8	18.4	55.3±1.3	10.4	35.2±0.6	7.0	22.7±0.4	7.3
L 310	54.6±1.4	11.6	44.7±0.6	6.1	47.5±0.9	8.1	32.9±0.8	10.5
Mean for lines:	56.9±11.0		50.4±3.6		42.4±3.4		30.2±8.5	

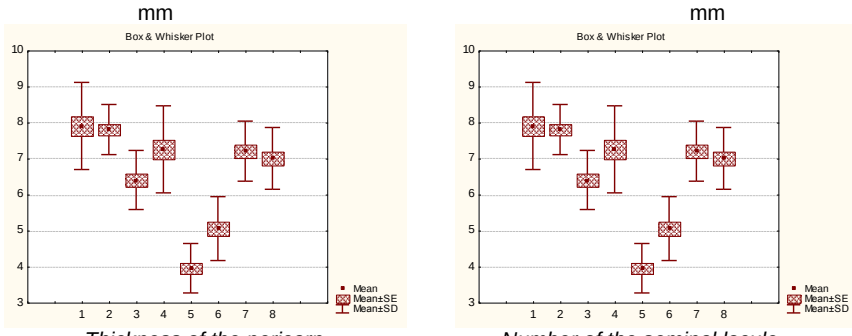
The shape of the fruit depends on its length and diameter. The data obtained (tab. 3) indicates the insignificant variability of this character, all the researched lines being denoted by its pronounced genetic determinism.

The thickness of the pericarp is of great importance for determining the appearance and quality of the fruit. Lately, the interest of breeders is aimed at obtaining tomato fruits with medium or thick pericarp, which ensures their transportability at great distances.

Forms evaluated on the basis of the pericarp thickness were very different, the index ranging from 3.9 to 7.9 mm (figure 3), and the coefficient of variation of character showed an average variability of 14.3%. The number of locules varied from one species to another – between 2-3 and 5-9. Thus, depending on the amount of tomato seed required, small or large varieties of seedlings may be created. The symmetry and the topography of the seminal locules in the fruit showed a regular settlement, the number of them ranging in the limits 2-5, and the variability of the character constituted 10.7-20.8%, the average being 16.0% (fig. 3).

Cluster analysis based on distribution dendrograms revealed similarities and differences of the tomato lines in the competition sector (fig. 4), and clustered *k*-mean analysis (centroid method) demonstrated that as members of cluster 1 were: Elvira, L 304, L 305, which recorded the highest values of the characters studied; cluster 2: L 306, L 309, L 310 – medium values of the characters; cluster 3: L 307 L 308 – smallest values.

The analysis of the alternariose attack frequency on the perspective lines compared to the standard Elvira variety highlighted a high variability that ranged from 18.2 to 88.5% (fig. 5). Note that only 4 lines – L 304, L 306, L 308 and L 310 recorded a lower frequency of 30%. L 309, L 305, L 306, L 308, L 310 lines showed a reduced degree and frequency of alternariose attack and may be recommended as sources of resistance to disease in the breeding programs.



Thickness of the pericarp *Number of the seminal locule*

Fig. 3 Morphobiological characters of the tomato fruit

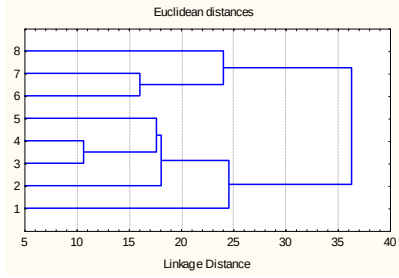
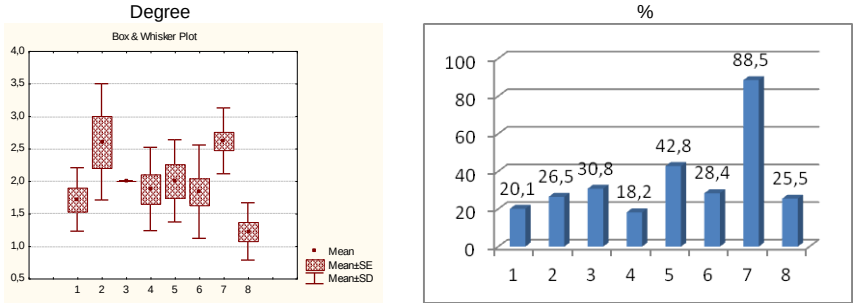


Fig. 4 The dendrogram of the tomato lines distribution based on some fruit characters



A B

Fig. 5 Degree (A) and frequency (B) of alternariose attack on tomato prospective lines (seed culture)
1 - Elvira, 2 - L 304, 3 - L 305, 4 - L 306, 5 - L 307, 6 - L 308, 7 - L 309, 8 - L 310

CONCLUSIONS

1. Cluster analysis has shown that the lines separated in three clusters differ on the basis of fruit mass, fruit length, fruit diameter, mesocarp thickness, pericarp thickness, and number of seminal locule numbers.

2. Testing of comparative competition crops based on productivity labels has made it possible to identify L 304, L 306, L 309 and L 310 lines with increased productivity, which can be recommended for homologation, implementation and inclusion in breeding programs.

3. The lines L 304, L 306, L 308, L 310 have shown a reduced degree and frequency of attack of the alternariose and can be recommended as a source of resistance to this disease in the improvement programs.

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