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DETERMINANT TOMATO ACCESSIONS – BIO-RESOURCE FOR THE HEALTHY NUTRITION

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Abstract: *Conservation of the genetic diversity of crops that we grow for food is a priority in the strategy for sustainable development and living in a healthy environment. In the period 2007-2010 63 determinant tomato accessions with a different geographical origin, grown in* ex situ *collection of IRGR-Sadovo, were studied. Some morphological and biochemical parameters responsible for the quality and nutritional value of the fruit were evaluated. The correlations show that fruits with high contents of vitamin C, sugars, total acidity and dry matter are with less mass. Accessions which are suitable for food processing and fruit with high yield were identified. A4000033 from Israel and the Bulgarian cultivar Trapezitsa are with best biochemical indicators and high dry matter content. The first accession is small-fruited, suitable for processing with high durability and transportability. The second is characterized by large fruit and is suitable both for fresh consumption and canning. Local accessions from expeditions are also characterized by high dry matter content of over 5%. The high values of variation coefficients for studied parameters showed high genetic diversity in the collection. This makes the accessions interesting genetic material for inclusion in breeding programs in response to changing consumer demands.*

Key words: *genetic resources, tomato fruit, nutritional value.*

1. Introduction

Conservation of genetic diversity of cultivated crops that we grow for food is a priority worldwide. The detailed strategy for sustainable development and life in healthy environment aims at preserving the natural resources for the future generations. This is a part of the activity of the Institute of Plant Genetic Resources - Sadovo related to the implementation of the National Programme for Plant Genetic Resources.

Agriculture is the main source of food in Bulgaria. The quality of the production is very important for people's health. Tomatoes are the main vegetable crop, which is determined by the excellent taste and nutritional qualities of the fruit (USDA. Tomato Crop Germplasm Committee Report, 2004). They are grown to be marketed nationally – for direct consumption and processing and also to be exported abroad (Ganeva, 2007).

Over the last few decades in other countries as well as in Bulgaria, the

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biological quality of the production has been decreased as a result of the intensive mineral fertilization, irrigation and the use of various plant-protection devices. In order to ensure environmentally friendly production of vegetables, along with the use of a balanced scientifically grounded mineral and organic fertilization, we need to develop a suitable cultivar structure. (Mitova et al., 2010)

Management of the genetic resources of tomato */Lycopersicon esculentum Mill./* includes: enrichment of the collection with valuable germplasm, passport data registration of the accessions, evaluation, documentation and *ex situ* conservation in the National Genebank.

Expeditions for old local varieties in more isolated parts of the country, where modern trends for introducing new cultivars have not been applied and the diversity of the crops has been preserved, were conducted (Krasteva et al., 2008). Through the international exchange with other centers for PGR valuable accessions, which are evaluated under the existing conditions in our country, were introduced (Krasteva et al., 2009).

To create a rich source of material for tomato breeding is required analyzing a large set of accessions with different eco-geographical origin. The taste of fresh tomatoes and processed products are complex characteristic depending on the optimum ratio of chemical components in the composition of the fruit. (Krasteva, 2005)

Vladimirov (1966) states that in order to be with a higher quality, tomatoes must contain optimally: dry matter content more than 6%, sugars content more than 3.3%, total acidity - no less than 0.4%, vitamin C content over 22 mg and the proportion of sugars and acidity must be no lower than 8%.

The purpose of this study is to evaluate the determinant tomato accessions for definite bio-resources with high quality and nutritional value of the fruit.

Material and Methods

The study was conducted in the experimental field of the Institute of Plant Genetic Resources - Sadovo in the period 2008 - 2010. The object of the study was 63 determinant tomato accessions from *ex situ* collection, included 45 introduced accessions, 15 local forms and 3 cultivars developed as a result of Bulgarian breeding programs. (Fig. 1)

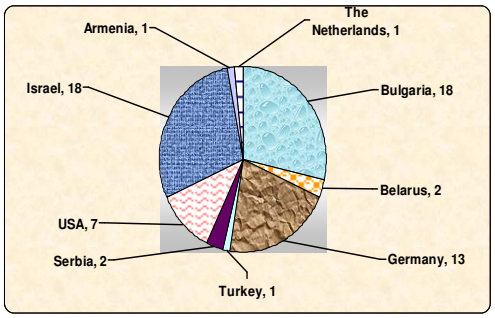

Fig. 1. *The origin of the determinant tomato collection*

The plants were grown based on a common technology for middle - early field production. (Krasteva et al., 2009)

During the different stages of the crop development was made biometric measurements of 10 plants from all tested accessions. The biochemical evaluations of the fruit were performed in the Biochemistry Laboratory of the Institute of Plant Genetic Resources - Sadovo using an approved set of methods. (Stanchev, 1974)

Indicators characterized the quality of production: mass of the fruit, content of vitamin C, sugars, total acidity and dry matter content by weight were evaluated. (IPGRI. Descriptors for Tomato, 1996)

The obtained results were processed using statistical package SPSS 13.0. A variation and correlation analysis of the data was performed (Georgiev et al., 2008).

Results and discussion

The conditions of the environment, in particular the soil and climate conditions in that period were favorable and the continuous drought in July and August did not have a negative influence because the plants were grown on irrigated areas. This determines the general trend that there is no substantial difference between the average values of the indications during the years of the experiment and the results are scientifically authentic.

The variability of the evaluated morphological and biochemical indicators of the fruit proves the significant genetic diversity within the collection regarding the high values of the variation coefficients (Table 1).

Table 1

Characteristics of the determinant tomato collection by some morphological and biochemical indicators of the fruit

Descriptors	x	min	max	VC /%/
Mass of the fruit	117.841±5.974	69.000	277.000	38.610
Vitamin C content	26.778±1.047	12.820	51.210	29.778
Sugar content	2.930±0.092	1.230	5.070	23.942
Total acidity	0.448±0.015	0.290	0.798	26.202
Sugar – acidity coefficient	6.863±0.280	2.860	12.933	31.069
Dry matter content	5.445±0.142	1.110	9.140	19.839

The fruit mass is an important morphological characteristic of economic significance. The average value of the indicator is 118 g for the tested collection. The biggest fruit have a mass of 277 g and the smallest ones – 69 g. The size of the fruit has a relatively high variation coefficient /VC=38.61%/. The studied collection has the largest vitamin C content – on average 26.78 mg/%. The highest values registered were those of the accessions A7000116 from Germany /51.21mg/%/ and A4000033 from Israel /50.14 mg/%/. The variation coefficient of this indicator is also close to 30%. The sugar content is crucial for the calorific value and taste and is on average 2.93% as accession A4000033 from Israel /5.07%/ has the highest value. The indicator is substantially variable /VC=23.942%/. The acid content presented as total acids is 0.448% on average, varying between 0.290 and 0.798% for the accessions A7000110 from Germany and the local one A7E0170. The indicator is significantly variable /VC=26.202%/. The sugar/acid ratio is an important chemical and technological characteristic of the fruit and determines its taste. This indicator is 6.863% on average and for the tested accessions, the highest value obtained was 12.933% and the lowest one – 2.860%. The variation of the indicator is substantial – 31.069%. The Bulgarian cultivar Trapezitsa as well as A4000031 and A4000033 /Israel/, 91602056 and 91602056 /USA/ have a sugar-acid coefficient of over 10%. The dry matter content is one of the most important indicators determining the quality of the fruits and their suitability to be used in the canning industry. The study accessions have high dry matter content, measured by weight – 5.445% on average. The variation of this indicator is the slightest /VC=19.839%/. The accession A400033 /9.14%/ from Israel and the Bulgarian cultivar Trapezitsa /6.44%/ have a very high dry matter content.

The conclusions confirm what was established during the evaluation of the gene fund of determinant tomatoes made by Krasteva (1995). The tested accessions show a homogenous variation of almost all of the studied indications.

The local accessions from expeditions (Fig. 2) are also characterized by a dry

matter content of over 5%. According to a survey conducted by Krasteva et al. (2008), in addition to the dry matter content, they are also a valuable genetic donor for the tomato breeding and melioration activities concerning the following additional qualities: ecological plasticity, resistance to stress factors, resistance to diseases and pests. The scope of genetic variation and the excellent organoleptic qualities of the local accessions are due to the variety of the source forms, the specific agroecological conditions typical of every region and also the unpurposeful artificial selection of the farmers.

Fig. 2. *Local plant genetic resources*

On the ground of the obtained results, the correlation analysis (Table 2) shows the following dependence between the indicators determining the quality of the fruits. The vitamin C content is in a direct positive correlation with the content of sugars and dry matter content. The correlation coefficients /R/, 0.574% and 0.641% respectively, have been established with a degree of freedom of 0.01. The vitamin C content is in a positive correlation with the total acidity. The correlation coefficient of 0.330% has been established with a degree of freedom of 0.05. The sugar/acid ratio and the content of dry matter content have a positive influence on the sugar content. The correlation coefficients, 0.600% and 0.633% respectively, have been established with a degree of freedom of 0.01. The total acidity is in a negative correlation with the sugar-acid coefficient and in a positive correlation with the content of dry matter content. The correlation coefficients, -0.581% and 0.516% respectively, have been established with a degree of freedom of 0.01. When characterizing the dependence, it is obvious that the fruit mass is negatively influenced by the higher content of vitamin C, sugars, total acidity and dry matter content. Therefore, the bigger fruit within the collection produce lower content of vitamin C, sugars, total acidity and dry matter content.

Table 2

Correlation coefficients between some morphological and biochemical indicators of the fruit

Descriptors	Mass of the fruit	Vitamin C content	Sugar content	Total acidity	Sugar - acidity coefficient	Dry matter content
Mass of the fruit	1	-0,18214	-0,091120	-0,127570	0,010389	-0,20755
Vitamin C content		1	0,574337**	0,330216*	0,177338	0,641133**
Sugar content			1	0,257248	0,600187**	0,663763**
Total acidity				1	-0,581070**	0,516341**
Sugar – acidity coefficient					1	0,151279
Dry matter content						1

** Correlation was demonstrated with the degree of freedom 0.01.

* Correlation was demonstrated with the degree of freedom 0.05.

As a result of comprehensive study of the plant genetic resources was definite initial material, depending on the aspect of tomato breeding. Accessions with valuable economical traits and high fruit yield are identified, suitable for the food industry. (Table 3)

Conclusion

Accession A400033 from Israel and the Bulgarian cultivar Trapezitsa have the best biochemical indicators and high dry matter content. The first one has small fruit suitable to be processed and is characterized by long durability and transportability. The second one has larger fruit and is very suitable for both direct consumption and canning.

The local forms from expeditions also have a dry matter content of over 5%.

The studied correlations prove that the fruit with a high content of vitamin C, sugars, total acidity and dry matter content have a lower mass.

The high values of the variation coefficients of the studied indicators show the substantial genetic diversity within the collection. This is what makes the accessions an interesting genetic material to be included in various breeding programmes in response to the changing requirements of consumers regarding healthy food. This guarantees the preservation of diversity with regards to the global challenges: the provision of food supply and the forthcoming climatic changes.

The data base containing the results from the study is an accessible source of information about the biodiversity preserved in the collection. This gives the farmers the opportunity to improve the type and the culture structure in vegetable growing.

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Table 3

Gene sources determinant tomatoes with high biochemical indicators

\			High Vitamin C content			High sugar content			High total acidity			High sugar - acidity		
Cat.№ / Accession name	**Origin**	**% weight**	**Cat.№ / Accession name**	**Origin**	**mg/%**	**Cat.№ / Accession name**	**Origin**	**%**	**Cat.№ / Accession name**	**Origin**	**%**	**Cat.№ / Accession name**	**Origin**	**%**
A4000033	Israel	9.14	A7000116	Germany	51.21	A4000033	Israel	5.07	A7000110	Germany	0.798	Trapezitsa	Bulgaria	12.933
A7000110	Germany	8.36	A4000033	Israel	50.14	A7000110	Germany	4.98	A7E0170	Local Bulgaria	0.780	A4000031	Israel	12.006
A4000025	Israel	7.12	A7000110	Germany	46.81	A7000162	Germany	3.92	A7000109	Germany	0.741	91602056	USA	11.474
91602057	USA	6.72	A7000112	Germany	41.18	A4000031	Israel	3.89	A0000008	Israel	0.690	A4000033	Israel	10.541
Trapezitsa	Bulgaria	6.44	Trapezitsa	Bulgaria	39.14	Trapezitsa	Bulgaria	3.88	A7000113	Germany	0.611	91602057	USA	10.438