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s področja kmetijstva, naravovarstva,
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6th Conference with international participation
on Agriculture, Environmentalism, Horticulture, Floristics, Food Production and
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»Raziskovalni izzivi in razvojne priložnosti«

»Research Challenges and Developmental
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3. sekcija: HORTIKULTURA IN FLORISTIKA
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Perspective tomato landraces for fresh consumption in the Republic of North Macedonia

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Abstract

Following long pepper, tomato is most widely cultivated vegetable in the Republic of Macedonia. It is mainly grown under tunnels and in glasshouses. Considerable portion of the production is intended for export during April, May and June, whereas the local markets are supplied with imports for the rest of the year. A survey has been carried out at the beginning of 2016 aiming to determine consumer preferences for fresh tomato among 50 fresh markets and distributors. It was concluded that consumers prefer to buy local landraces over hybrids. Landrace with apple shaped tomato fruit (Yabuchar) is favorite one for the buyers. In order to enrich the offer of the local tomato producers, 10 Yabuchar-type tomato landraces, collected from different villages and producers during 2016 have been tested for their productive and qualitative traits. Field trials were carried out in the villages of Drachevo and Lisiche, both in vicinity of the capital, Skopje. The landraces were grown in open field conditions following standard agricultural practices for this type of tomato. The characterization of the examined landraces was made by IPGR descriptor for tomato (*Lycopersicon esculentum* Mill.). Although all these landraces appear under the same name, significant distinctiveness has been recorded regarding morphological traits such as flower morphology, shape and size of the fruits, pericarp thickness, cracking and green zone of the fruits and mass of the fruits, as well as in the content of sugars. Main drawback for wider production of these landraces is generally short shelf live that might be improved in further breeding programs.

Key words: tomato, landraces, morphological traits, fruit quality

1. Introduction

Nearly 100% of the tomato hybrids on the Macedonian markets come from import. They are characterized by good appearance, but lack taste and aroma that are typical for the traditional landraces. Due to intensive genetic erosion that took place in the last few decades these landraces are preserved only in few home gardens and can be found on the green markets in summer time (Popsimonova and Ivanovska, 2009). Based on a questionnaire results that was distributed by the Company “Green Universe” among 50 markets in Skopje it was concluded that consumers prefer to buy local landraces especially the type called Yabuchar (apple-shaped tomato). Consequently we have selected 10 genotypes of this landrace from the Macedonian gene-bank that had good performance in previous research (Georgievski et al., 2015) to be characterized and promoted among the commercial growers.

2. Materials and methods

The examined tomato landraces are part of vegetables ex-situ collection at the Institute of Agriculture gene bank, collected during 2006 mission. In Table 11 the local names, the collection sites and their elevation are presented. For characterization of the main traits IPGRI descriptor for tomato was used. The field trial was placed in two villages in the vicinity of Skopje – Drachevo and Lisiche, with conventional cultivation technology for open field production. The experimental design was randomized block system with four replications, ten plants in each replication. Data obtained from both locations was compared by one-way ANOVA with one replication and it was concluded that there is significant difference between the cultivating locations. For that reason the morphological components are presented separately for each village. However, the differences in quantitative traits among different genotypes for each location were tested with LSD t-test. Flower components were measured by means of software Tomato Analyzer Version 3.0 on 10 flowers from medium clusters from each replicate.

Qualitative fruit traits and the shelf life were measured on mixed samples for each genotype from both locations. Total soluble sugar content was measured by portable refractometer (Carl Zeiss, Jena, Germany) on a mixed sample of 40 fruits each genotype from both locations. For assessment of the shelf life a sensory evaluation was carried out 7, 14 and 21 days after harvesting in red stage, as a percentage of deteriorated fruits out of 50 fruits from each genotype in total.

Table 11 Basic information for the examined landraces

Genotype	Local name	Collection site	Meters above sea level
1	Tomato for stuffing	v. Rajkova kukja - Kumanovo	353
2	Yabuchar dashak	v. Drachevo - Skopje	246
3	Red yabuchar	v. Drachevo - Skopje	246
4	Red yabuchar	v. Vartekica - Skopje	544
5	Yabuchar	v. Dolno Kolichani - Skopje	559
6	Red yabuchar	v. Zubovo - Strumica	198
7	Pink yabuchar	v. Chucher - Skopje	480
8	Pink yabuchar	v. Vsilevo - Strumica	235
9	Large tomato	v. Miletino - Tetovo	382
10	Tomato	v. Zelino - Tetovo	418

3. Results and discussion

Based on cluster analysis (Agic et al., 2012), the tomato genotypes from the Macedonian gene-bank (27 in total) were divided into four groups. The first group, divided on the highest hierarchical level from the other genotypes, consists of three accessions. The second group comprises seven accessions. The genotypes in the third and fourth group are relatively similar to each other. The fourth group is the largest; the genotypes included in it mostly differ in their fruit characteristics and are distinct on different hierarchical levels. The examined genotypes of Yabuchar belong to the last group.

In regard to flower elements that have been measured (

Table 12), it can be noticed that beside the difference between locations there is large variation among the examined genotypes. Largest diameter of flowers was observed both in the village of Drachevo and the village of Lisiche for the Genotype 9 (32.90mm) with level of significance of 5%. The same Genotype had the lowest variation of 5.60, compared to Genotype 1 in the village of Lisiche with an average flower diameter of 19.60mm.

Table 12 Dimension of flower components (mm)

Genotype	Locatio n	Flower diameter			Stamen length			Style length		
		\bar{x}	σ	CV	\bar{x}	σ	CV	\bar{x}	σ	CV
1	Drachevo	21.10	1.79	8.53	8.20	0.42	5.14	7.30	0.67	9.24
	Lisiche	19.60	1.85	8.08	9.10 ^A	0.56	6.15	8.10	0.75	9.26
2	Drachevo	23.00	3.74	16.26	8.90	0.87	9.84	6.50	1.27	19.53
	Lisiche	22.70	3.89	17.13	8.50	0.71	8.32	7.10	1.41	20.20
3	Drachevo	23.70	4.16	17.57	8.60	0.84	9.80	6.70	0.67	10.07
	Lisiche	24.80	1.77	7.15	7.90	0.64	8.11	7.90	0.85	10.76
4	Drachevo	24.60	1.84	7.47	8.10	0.74	9.22	7.00	0.94	13.47
	Lisiche	24.10	1.90	7.88	7.00	0.75	10.71	7.60	0.85	11.18
5	Drachevo	26.20	2.90	11.06	8.50	0.71	8.32	6.90	1.10	15.95
	Lisiche	28.10	3.44	12.26	8.60	0.51	6.00	8.20 ^a	0.83	10.18
6	Drachevo	25.20	2.62	10.38	8.00	0.94	11.78	6.30	0.82	13.07
	Lisiche	23.50	3.02	12.85	8.40	0.85	10.12	7.40	0.97	13.11
7	Drachevo	25.70	2.41	9.36	8.60	0.52	6.00	6.50	0.53	8.11
	Lisiche	27.90	2.25	8.07	9.00	0.75	8.40	6.90	0.99	14.41
8	Drachevo	24.70	3.02	12.23	8.30	1.11	13.40	6.40	1.06	16.57
	Lisiche	26.30	2.35	8.93	8.90	0.98	11.01	7.00	1.10	15.71
9	Drachevo	32.20	5.45	16.93	7.60	0.97	12.71	7.40	0.52	7.03
	Lisiche	28.80	3.17	11.00	8.70	1.30	14.94	6.90	0.73	10.58
	Drachevo	32.90 ^a	1.83	5.60	9.50 ^A	1.08	11.37	8.30 ^a	0.48	5.82
10	Lisiche	30.40 ^a	4.02	13.13	8.40	0.85	10.12	7.60	0.68	8.95
Drachevo	LSD			LSD						
	0.01 ^A	13.16		0.01 ^A	1.83		LSD 0.01 ^A	2.12		
Lisiche	LSD 0.05 ^a	9.08		LSD 0.05 ^a	1.26		LSD 0.05 ^a	1.46		
	LSD			LSD						
	0.01 ^A	11.43		0.01 ^A	0.85		LSD 0.01 ^A	1.71		
	LSD 0.05 ^a	7.88		LSD 0.05 ^a	0.63		LSD 0.05 ^a	1.18		

Basic parameters that determine the total yield are number of fruits per plant, fruit mass and pericarp thickness. They are presented in Table 3. Yabuchar tomato belongs to the group of determinate plants that grow up to five or six clusters. The fruits are large, and usually not more than three fruits are set per cluster. It can be observed that the genotypes with fewer fruits per plant have formed larger fruits. Such is the case with the Genotype 4 that had only 12 fruits in average per plant, but the fruit mass is near 300g, whereas the Genotype 1, or Genotype 7 had 15 and 13 fruits per plant respectively, but the average fruit mass was lowest compared to the rest of the genotypes (140g). This correlation has been reported by other authors (Brewer et al., 2007; Naz et al, 2013). The pericarp thickness varied from 3.10mm for

the Genotype 8 grown in the village of Lisiche, up to 6.10 for the Genotype 5 grown in the same village, with relatively low variability within the examined genotypes. Largest percent of variation was recorded for the Genotype 8 (23.87-25.53).

Table 13 Quantitative yield components

Genotype	Location	No. of fruits per plant			Fruit mass [g]			Pericarp thickness [mm]		
		\bar{x}	σ	CV	\bar{x}	σ	CV	\bar{x}	σ	CV
1	Drachevo	17	4.15	24.40	125.00	22.24	17.79	6.00	0.80	13.61
	Lisiche	13	3.10	23.80	113.00	18.41	16.29	5.00	0.82	16.33
2	Drachevo	14	5.36	38.30	208.00	76.38	36.72	5.20	0.42	8.09
	Lisiche	12	4.05	43.70	154.00	55.24	35.87	4.80	0.82	17.08
3	Drachevo	18	6.70	37.20	147.00	34.82	23.61	5.20	0.63	12.16
	Lisiche	14	5.13	36.60	132.00	19.78	14.92	3.80	0.61	16.05
4	Drachevo	12	3.80	31.60	271.00 ^a	110.92	42.13	5.50	1.35	24.62
	Lisiche	8	2.61	32.60	240.00	104.77	43.33	6.00	0.82	13.66
5	Drachevo	15	3.04	20.30	160.00	79.16	49.47	6.20 ^a	1.03	16.66
	Lisiche	11	2.71	24.60	179.00	92.75	51.82	6.10 ^a	0.99	16.23
6	Drachevo	16	6.25	39.10	215.00	79.96	37.19	5.40	0.70	12.95
	Lisiche	12	4.12	34.30	179.00	58.93	32.92	5.60	0.97	17.32
7	Drachevo	19	6.54	34.40	125.00	42.57	34.06	4.20	0.67	15.95
	Lisiche	13	4.21	32.40	155.00	46.94	30.28	4.60	0.52	11.30
8	Drachevo	20 ^a	5.70	28.50	122.00	28.93	23.67	3.40	0.96	25.53
	Lisiche	16 ^A	4.15	25.90	162.00	106.31	65.62	3.10	0.74	23.87
9	Drachevo	17	6.30	37.00	242.00	81.21	33.47	4.50	1.08	24.00
	Lisiche	13	4.17	32.10	260.00 ^a	81.88	31.49	4.50	0.53	11.77
10	Drachevo	16	5.80	36.20	198.00	45.77	23.05	5.70	0.82	14.44
	Lisiche	12	4.02	33.50	200.00	60.55	30.28	5.30	0.82	15.53
Drachevo		LSD			LSD			LSD		
	LSD 0.01 ^A	8.24	LSD 0.01 ^A	184.77	0.01 ^A	3.00				
	LSD 0.05 ^a	5.69	LSD 0.05 ^a	127.50	LSD 0.05 ^a	2.07				
Lisiche		LSD			LSD			LSD		
	LSD 0.01 ^A	7.19	LSD 0.01 ^A	158.93	0.01 ^A	3.29				
	LSD 0.05 ^a	4.96	LSD 0.05 ^a	109.68	LSD 0.05 ^a	2.27				

The Genotype 5 was characterized in both locations with thickest pericarp of 6.20mm in the village of Drachevo and 6.20mm in the village of Lisiche, with a difference among other genotypes on significance level of 5%.

The morphological traits influence on the appearance and attractiveness of the fresh product (Table 14). Among the examined genotypes only Genotype 1 is distinguished with yellow color and the rest are pink or red. It is difficult to find the ideal combination of color, firmness, absence of malformation such as green shoulder, cracking and cat face, on one hand and good taste that is represented by high content of sugars as mentioned in similar research (Bota, J. et al., 2014). In this trial, the best results regarding the morphological traits of the fruit were obtained for Genotype 10 that had good firmness and relatively small amount of misshaped fruits, with high content of sugars (10.8⁰Brix). The Genotype 1, beside the color, was characterized with highest content of sugars that can be explained by the fact that the fruits are almost shallow. Thus is the local name – tomato for stuffing.

Table 14 Morphological and qualitative fruit traits

Genotype	Color	Firmness*	Cracking**	Green shoulder**	Cat face**	Sugar content [°Brix]
1	yellow	3	0	3	5	11.8
2	red	5	0	0	0	11.2
3	red	7	3	3	3	8.6
4	red	5	0	3	3	10.2
5	red	5	0	0	0	10.4
6	pink	7	0	0	0	8.2
7	pink	7	0	0	0	9.8
8	pink	3	0	0	0	8.6
9	red	3	0	0	3	11.2
10	red	3	0	0	3	10.8

*3 soft– 7 firm

**0 absence of malformation – 7 severe malformation

Table 15 Evaluation of shelf life (% of deteriorated fruits)

Genotype	Days after harvesting		
	7	14	21
1	0	0	100
2	60	40	0
3	0	40	60
4	50	50	0
5	45	55	0
6	10	90	0
7	5	90	5
8	55	45	50
9	100	0	0
10	100	0	0

For the same reason, this genotype had the longest shelf-life, despite the fact that the initial firmness after harvesting was among the lowest. All of the harvested fruits remain intact after three weeks (Table 15). Shortest shelf-life was recorded for the Genotypes 9 and 10 where complete fruit deterioration was observed only few days after harvesting.

4. Conclusion

The results obtained show high level of variation between and among the examined genotypes. They are all characterized with exceptional qualities, such as good taste, large fruits, and relatively fresh and acceptable appearance. However, further breeding process is required for improvement of the individual traits. Currently they represent a good material for cross-breeding and development of new tomato cultivars, as well as a basis for further development, protection and commercialization of the Yabuchar

tomato cultivars that are subjected to this research. The significant difference between the two cultivating locations indicates that the recommend genotypes should be grown and multiplied in their place of origin.

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