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EFFECTS OF TOMATO VARIETY ON THE YIELD AND QUALITY OF FRUIT

SUMMARY

Selection of varieties of tomato for specific production areas is an essential factor for increasing productivity and yield quality. Achieving adequate quality characteristics of fruits that satisfy consumer and technological properties is a prerequisite for eligibility and scope of future production.

This paper presents the results of examination of biological characteristics of plants (stages of development, length of growing season), morphological characteristics of the fruit (colour, shape, weight) and chemical composition of fruits (dry matter, sugars, pH, acids) of two varieties of tomatoes: Novosadski Jabučar and Sarajevski Jabučar (local variety).

The research was conducted by field trials on the site Sarajevo-Butmir over a three-year period (2008, 2009 and 2010). Chemical analysis of fruit was made by appropriate laboratory methods. The yield results by varieties and years of trial were statistically analyzed. The varieties under research have the same length of growing seasons with slight variations over the years (2008-126 days; 2009 -133 days and in 2010-132 days).

The results show that the yield of fruit of Sarajevski Jabučar variety is significantly higher (by 37% on average during the three years). By year, the yields vary and are significantly higher by 10% (2008) to 57% (2010) compared to the yields of the variety Novosadski Jabučar.

The fruits of variety Novosadski Jabučar have a higher dry matter content (5.24%), lower percentage of total sugar content (6.80%), higher pH value (5.36%) and higher acid content expressed as malic acid (1.21 g in 100 ml of product).

Keywords: tomato, variety, yield, quality.

INTRODUCTION

Tomato is widespread. It is cultivated on about 2.5 million hectares worldwide. The major producers are former USSR, China and Egypt. In Bosnia and Herzegovina, tomato is grown on 3,573 ha, with a relatively low yield of 10.3 t/ha (Statistics Agency of Bosnia and Herzegovina 2010). It is grown most

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in Posavina and Herzegovina, as well as in the vicinity of larger consumer centres, with favourable natural conditions for growing.

Tomato fruit Popović (1984) has a fresh, sour-sweet taste and its biological value contributed to its widespreadness in nutrition. In European countries, tomato accounts for 5-10% of total vegetable consumption. There are more than a hundred ways of preparation and use of fresh and processed tomatoes. Enormous quantities of tomato are industrially and home- processed (juice, puree, concentrate, extract, peeled and dried).

Tomato fruit contains significant quantities of mineral matters (potassium, phosphorous, magnesium and iron). Of vitamins, it contains ascorbic acid, vitamins B_1, B_6 and PP vitamin.

The selection of varieties of high genetic potential when it comes to fruit yield and quality, along with application of contemporary agro-technical measures increases the yield per area and total tomato production.

Regardless of the data obtained from selectionists – breeders, new varieties need to be examined in detail in the local climatic conditions. Introduction of appropriate varieties in production based on research will provide much better opportunities for increase in yields and better quality.

The purpose of this paper is to determine the yield and quality of tomato fruit varieties in the area of Sarajevo.

MATERIAL AND METHODS

The research was conducted in the locality Butmir (elevation cca. 500m) in the course of 2008, 2009 and 2010 Varieties included in research were Novosadski Jabučar and Sarajevski Jabučar. The trial was set up as a randomized block design with five repetitions.

Trial elements:

-Length of the basic plot 5 m.
-Width of the basic plot 1.6 m.
-Basic plot area 8 m^2.
-Number of rows on the plot 2.
-Number of plants in a row 12.
-Number of plants on the plot 24.
-Distance between the rows 80 cm.
-Distance between plants in a row 40 cm.
-Number of plants per hectare 31,250.
-Distance between blocks 1 m.
-Seedlings with 4-5 well developed leaves.

Balanced soil, of a good structure and fertility was selected for setting up of the trial. Autumn deep tillage was done, while other soil preparation measures were conducted in spring, in line with the requirements for tomato.

Particular attention was paid to the forecrop preparation of the surface layer in order to create the most favourable conditions for a balanced development of tomato. In the Butmir site, the forecrop in 2009 was winter

barley and in 2010 and 2011 red onion. Forecrop and soil type were taken into consideration when it comes to fertilization. The effort was made to ensure conditions for plants that would enable achieving maximum fertility capacity of the variety concerned.

The following fertilizers were applied to the soil in the following quantities of pure nutrients:

Year 2009

58 kg /ha N, 116 kg/ha P_2O_5 and 175 kg/ha K_2O.

Year 2010

83 kg /ha N, 112 kg/ha P_2O_5 and 294 kg/ha K_2O.

Year 2011

83 kg /ha N, 112 kg/ha P_2O_5 and 294 kg/ha K_2O.

In early spring, NPK fertilizers were used. Fertilization was done before the first banking up.

Plots and rows were placed vertically from the tillage direction and the planting was done in that direction. Two equal distance rows were placed around the trial plot as a protective strip, in order to avoid the effects of border rows.

At the Butmir location, planting was done on 20 May 2009 and 14 May 2010 and 2011, by hand, into rows in line with the scheme and the plan done by the Federal Agro-Mediterranean Institute Mostar. During the growing season, appropriate care was provided, in line with the intensive tomato growing requirements.

During the research, the tomato fruit samples were taken in order to determine the qualitative properties of the varieties concerned:

-Dry matter (%) - by drying at the temperature 102-105^{0}C

-Acidity (%) – tirtimetry

-Total sugar - by Luff-Schoorl – gravimetry

Statistical processing of data obtained during the research was done by analysis of variance.

Table 1. Chemical properties of soil

Year	pH reaction in		Content in %			Mg in 100g of soil contains physiologically active	
	H_2O	KCl	Total N	$CaCO_3$	Humus	P_2O_5	K_2O_2
2008	6.27	5.40	0.13	2.75	-	4.4	18.9
2009	5.89	-	0.09	-	1.80	12.50	10.9
2010	6.02	-	0.08	-	1.80	8.45	14.20

The soil in Butmir is the brown valley soil. Compared to 2009 and 2010, the nitrogen and potassium content in soil was higher in 2008. The soil had a higher phosphorous content in 2009 compared to the other two years during the research. Multiannual average temperatures and precipitation data for the location are presented in the tables below.

Table 2. Mean monthly air temperatures (Cº) for 2008, 2009 and 2010

Year/Month	01	02	03	04	05	06	07	08	09
2008	0.6	2.9	5.7	10.2	15.5	19.1	20.3	20.7	14.2
2009	-0.5	1.0	4.7	12.2	16.2	17.8	20.6	20.4	16.6
2010	0.4	1.8	5.2	10.4	14.4	18.1	20.8	20.9	15.0
Multiannual average (1996-2005)	0.07	1.02	5.27	9.58	15.16	18.7	20	14.4	11.1

Table 3. Maximum monthly air temperatures (Cº) for 2008, 2009 and 2010

Year/Month	01	02	03	04	05	06	07	08	09
2008	15.6	21.7	21.5	26.0	31.9	33.3	34.0	37.9	36.1
2009	14.8	19.8	19.8	24.6	31.2	32.8	35.8	34.0	31.5
2010	15.4	14.2	22.4	25.2	28.0	34.4	34.9	20.9	15.0
Multiannual average (1996-2005)	16.7	19.6	26.6	29.8	32	34.2	38.2	37.4	30.8

Table 4.: Minimum monthly air temperatures (Cº) for 2008, 2009 and 2010

Year/month	01	02	03	04	05	06	07	08	09
2008	-15.3	-13.4	-5.4	0.3	2.3	7.8	9.3	7.4	1.6
2009	-14.4	-11.6	-4.6	3.5	4.8	8.7	9.5	11.8	7.2
2010	-11.4	-13.5	-9.5	1.4	5.6	5.7	9.4	20.9	15.0
Multiannual average (1996-2005)	-21	-16.4	-16.8	-6.2	0.5	2.5	5.4	5.5	2.8

Table 5. Monthly precipitation (l/m^2) for 2008, 2009 and 2010

Year/Month	01	02	03	04	05	06	07	08	09
2008	23.5	9.9	144.2	60.2	64.8	81.1	85.8	7.8	60.0
2009	102	54	84	61	64	155	93	53	20
2010	161.3	95.9	63.1	59.1	93.2	181.5	19.2	20.9	15.0
Multiannual average (1996-2005)	70	71.4	50.8	85.1	70.6	71.8	74.5	65.3	124

Following the analysis of temperatures, it can be stated that temperatures in the period when the tomato trial was conducted (2008, 2009 and 2010) were satisfactory, compared to the multiannual average. Compared to the multiannual average, the mean monthly temperatures were higher in March, May, June, July, August and September 2008, in April, June, July, August and September of 2009, as well as in April, July, August and September 2010. The maximum temperatures were somewhat lower, and minimum temperatures somewhat higher in 2008, 2009 and 2010 compared to the multiannual average. During the growing season, the precipitation was low in April, May, August and September 2008 and 2009 and in April, July, August and September 2010. The high

precipitation was noted in May 2010 and June in all three years of trial. The low precipitation was compensated by drip irrigation.

RESULTS AND DISCUSSION

The varieties were even by vigour, and crops were balanced by growth. There were no differences among plants within a variety. A 100% plant density was achieved.

Table 6. Plant density on the trial plot

Properties	Sarajevski Jabučar	Novosadski Jabučar
Code	1	2
Average no. of plants on the plot	24	24
Achieved no. of plants on the plot	24	24
Percentage achieved	100	100

Table 7. Significant dates in plant growth 2008, 2009 and 2010

Properties	Sarajevski Jabučar			Novosadski Jabučar		
	2008	2009	2010	2008	2009	2010
Planting date	20/05	14/05	14/05	20/05	14/05	14/05
First truss forming	19/06	04/06	24/06	19/06	10/06	24/06
Final harvest date	22/09	25/09	23/09	22/09	25/09	23/09
Growing season	126	133	132	126	133	132

We used five trusses in the varieties and standards in this research and following the fifth truss, the vegetative top was cut off. The growing season in 2008 lasted for 126 days, in 2009 it was 133 and in 2010 it lasted for 132 days.

The number of fruit and individual fruit weight are variety properties. Large fruit varieties have a lesser number of fruit per plant and in the cluster of flowers, and vice versa Takač(2001).

During the three-year trial, Sarajevski Jabučar had a higher fruit weight compared to Novosadski Jabučar. Average fruit weight ranged from 70 to 100 grams in Novosadski Jabučar, which is somewhat lower than obtained by Kostić (2006) under the conditions in Vojvodina. Fruit weight in Sarajevski Jabučar ranged from 120 to 260 grams.

Table 8. Morphological characteristics of the fruit

Characteristic	Sarajevski Jabučar			Novosadski Jabučar		
	2008	2009	2010	2008	2009	2010
Fruit colour	Red	Red	Red	Red	Red	Red
Fruit shape	Oblate	Oblate	Oblate	Round	Round	Oblate
Fruit weight (g)	120	260	184	70	100	93

Table 9. Effects of variety and year factor on yield (t/ha)

Variety	Year					
	2008		2009		2010	
	t/ha	Rel.	t/ha	Rel.	t/ha	Rel.
Sarajevski Jabučar	49.15**	110	55.38**	154	47,22**	157
Novosadski Jabučar	44.50	100	35.86	100	29,92	100
LSDp=5%	1.07		1.22		2.24	
LSDp=1%	1.69		1.91		3.52	

Table 10. Effect of variety factor on yield (t/ha)

Variety	Yield	Relative %
Novosadski Jabučar	37.76	100
Sarajevski Jabučar	50.38*	137
LSDp=5%	12.02	
LSDp=1%	22.07	

Table 11. Effect of the year factor on the yield (t/ha)

Year	Yield	Relative %
2008	46.82	121
2009	45.62	118
2010	38.57	100
LSDp=5%	14.72	
LSDp=1%	27.00	

The yield of Sarajevski Jabučar was highly significantly higher in 2008, 2009 and 2010 compared to Novosadski Jabučar. In 2008, the yield of Sarajevski Jabučar was higher by 10%, in 2009 by 54% and in 2010 by 57 % compared to Novosadski Jabučar.

The biological potential of specific plant species an varieties for organic matter synthesis is genetically controlled Sarić (1984).

The yield of the variety analysed was significantly higher than the standard. The yield of the variety analysed was by 37 % higher compared to the standard.

The yield in 2008 was higher by 21%, and in 2009 by 18% compared to 2010.

Table 12. Chemical composition of tomato fruit

Parameter	Sarajevski Jabučar	Novosadski Jabučar
Dry matter	4.14	5.26
Saccharose	7.34	6.80
Fruit pH	5.26	5.36
Acid expressed as acetic acid (g/100ml of the product)	1.39	1.41

The chemical-technological analysis of tomato samples was done in 2008. The fruit of Sarajevski Jabučar had a higher percentage of saccharose, lower pH value and lower acidity, which gives a specific pleasant flavour to the fruit. The fruit of Novosadski Jabučar had higher dry matter content, higher pH value and acidity.

The content of acids influences, to a large effect, the technological value of tomato. High acid content (low pH) determines the method of preservation of the tomato product (pasteurisation, not sterilisation as in other vegetable species). The content of acids in tomato varies depending on the variety and maturity of the fruit Krstić (2006).

CONCLUSIONS

During the three-year trial (2008, 2009 and 2010) the varieties Sarajevski Jabučar and Novosadski Jabučar were under research. After analysing the data on temperatures, it can be stated that temperatures in the period of conducting the trial on tomatoes (2008, 2009 and 2010) were satisfactory compared to the multiannual average. The lack of rainfall was compensated by drip irrigation.

The crop had vigour and there were no differences within the variety. The plants of the same variety were quite even.

The tomato fruit yield varied depending on the variety and year. The effect if the variety and year factors on yield were highly significantly higher in 2008, 2009 and 2010 in Sarajevski Jabučar compared to Novosadski Jabučar.

The yield in 2008 was by 21% higher and in 2009 by 18% higher compared to 2010 (the effect of year factor on yield).

The effect of variety factor on tomato yield was significantly higher – by 37% - in the variety analysed compared to the standard.

In all three years of research the variety Sarajevski Jabučar had a higher fruit weight compared to Novosadski Jabučar.

Sarajevski Jabučar had a higher percentage of saccharose, lower pH value and lower acidity in the fruit, which gives a specific pleasant taste. Novosadski Jabučar had a higher dry matter content, higher pH value and higher acid content.

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UTICAJ VARIJETETA PARADAJZA NA PRINOS I KVALITET PLODOVA

SAŽETAK

Odabir sorata paradajza za pojedina proizvodna područja je osnovni faktor povećanja produktivnosti i kvaliteta prinosa. Postizanje odgovarajućih kvalitetnih osobina ploda koje zadovoljavaju konzumna i tehnološka svojstva je preduslov prihvatljivosti i obima buduće proizvodnje.

U ovom radu dati su rezultati ispitivanja bioloških karakteristika biljaka (faze razvoja, dužina vegetacije), morfoloških karakteristika ploda (boja, oblik, masa) i hemijskog sastava ploda (suha materija, šećeri, pH, kiseline) dvije sorte paradajza: Novosadski jabučar i Sarajevski jabučar (domaća sorta).

Ispitivanja su obavljena izvođenjem poljskih ogleda na lokalitetu Sarajevo-Butmir u periodu tri godine (2008, 2009 i 2010). Hemijske analize ploda su rađene odgovarajućim laboratorijskim metodama, a rezultati prinosa po sortama i yearma izvođenja ogleda su statistički obrađeni. Ispitivane sorte su jednakih dužina vegetacije uz neznatna variranja po yearma (2008 - 126 dana, 2009 – 133, a 2010 godine - 132 dana).

Rezultati su pokazali da je prinos ploda sorte Sarajevski jabučar signifikantno viši (za 37% u prosjeku za tri godine), a po yearma prinosi variraju i signifikantno su viši za 10 % (2008) do 57% (2010) u odnosu na prinose sorte Novosadski jabučar.

Plodovi sorte Novosadskog jabučara imaju više suhe materije (5,24%), niži procenat sadržaja ukupnih šećera (6,80%), višu pH vrijednost (5,36%) i viši sadržaj kiseline izražene kao jabučna (1,21g u 100 ml proizvoda).

Ključne riječi: paradajz, sorta, prinos, kvalitet