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CULTIVAR AND FERTILIZATION INFLUENCE ON PRODUCTION AND QUALITY OF TOMATOES GROWN IN POLYETHYLENE TUNNELS IN ECOLOGICAL SYSTEM

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Abstract

The tomato assortment is varied. In the assortment there are cultivars with fruits of different color (most of them are red, but they are also green, brown, black, yellow, pink). The chemical composition of fruits differs significantly from one color to another. Lycopene content varies depending on cultivar and place of culture. For field cultures, lycopene content varies between 5.2-23.6 mg/100 g while in greenhouse cultivated tomatoes content is between 0.1-10.8 mg/100 g. Tomatoes production and quality are also influenced by fertilization type. Experiments were carried out during 2016-2017, in organic farm, in Husasau de Tinca, Bihor County. Experimental factors were represented by seven cultivars and three types of fertilization. Experimental crop was set up in polyethylene tunnel, in April with seedlings. Paper presents the influence of cultivar and fertilization type on early and total tomato production as well as the content of fruits in lycopene and carotene.

Key words: *tomatoes, ecological, production, lycopene, carotene*

INTRODUCTION

Tomatoes are used fresh or in culinary dishes (soups, sauces, pots, stuffed tomatoes, etc.). They are recommended as food in asthenia, chronic poisoning, congestive conditions, atherosclerosis, vascular diseases, arthritis, gout, rheumatism, biliary and urinary lithiasis, constipation, enteritis. They are industrially used in the production of tomato paste, tomato sauce, pickled (Muntean, 2003). Use of tomatoes reduces blood viscosity and thereby reduces the risk of thrombosis and atherosclerosis as well as cardiovascular disease. Tomatoes are an important source of antioxidants: carotenoids (lycopene, β-carotene), flavonoids, phenolic acids (chlorogenic acid, gallic acid) and ascorbic acid. These provide valuable protection for the human body. To prevent oxidative stress, a diet based on the consumption of antioxidants is required (Horotan et al., 2015).

Cultivation of tomatoes in polyethylene tunnels makes it possible to obtain earlier and safer productions, being less exposed to climatic accidents. Organic tomato culture system provides superior quality products without pesticide residues, being demanded by consumers in increasing quantities. Since production of vegetables in ecological systems must ensure economic profitability, it is necessary to obtain quantitative and qualitative productions to cover additional expenses necessary for organic production process (Apahidean et al., 2005).

For tomato cultivation in polyethylene tunnels, mainly F1 hybrids are used which generally provide large yields, but also have uniform fruits in size, with good storage stability but fruit quality, expressed by taste and chemical composition is in most cases deficient.

Tomatoes color is the most important factor in determining tomatoes quality, both from consumer's point of view and in its processing, and is determined by lycopene content (Shi et al., 2008) and represents 90% of total phenolic substance in fruit (Alba et al., 2000; Dumas et al., 2003). According to Bramley, (2002), tomatoes and tomato products are the main source of lycopene and other antioxidant substances in human diet.

Lately, particular attention is paid to the high content of antioxidant substances, as it has been shown that regular consumption of fruits and vegetables, especially tomatoes, can play an important role in preventing cancer and cardiovascular disease (Agarwal and Rao, 2000). Diet based on high consumption of tomatoes reduces the risk of prostate cancer due to anticancer effect of lycopene and other carotenoids (O'Donoghue et al., 2014). Tomato components, such as lycopene, phenolic substances, flavonoids and vitamins C and E, are the main responsible for the antioxidant action of these vegetables both fresh and processed (Steward et al., 2000, Toţa and Berar, 2009). In order to benefit from all antioxidant substances found in these vegetables, it is recommended to consume them with both skin and.

Studies by George et al., (2015) show a 5-14 mg/100 g content of lycopene at tomatoes cultivated in the field in India. Typically, lycopene content of crops in the field is higher, ranging from 5.2-23.6 mg/100 g, while at tomatoes cultivated in greenhouses, content ranged from 0.1-10.8 mg/100 g. This content may vary depending on the variety and ripening degree (Zanfini et al., 2007, Gomez et al., 2001, Ching-Hui et al., 2006).

Research on the use of fertilizers in polyethylene tunnel crops has resulted in recommendations based on different fertilization schemes and in which a diversified range of fertilizers are used, application methods are increasingly complex and diversified to increase fertilizers efficiency (Voicu, 2013). According to requirements of Reg.EU 834/2007, maximum quantity of N from organic and mineral fertilizers must not exceed 170 kg of active substance/hectare/year (Stoleru, 2013). Some research has highlighted the possibility of increasing tomatoes fruits quality by using foliar fertilization with microelements (Trejo-Tellez, 2007). Researches carried out under protected crop conditions have shown that foliar fertilizations with some microelements such as boron do not have the same efficiency as soil fertilization due to the low mobility of this element (Prado, 2013). Plant growth, quantitative and qualitative production was favorably influenced by combining chemical fertilizers (NP) with vermicompost (Posta, 200). Growth and production parameters reached maximum values in the case where 75% of NP requirements were completed with vermicompost, 11.25 t/ha. Most economical fertilization option was when 50% of mineral fertilizer with NF was replaced with 7.5 t/ha of vermicompost (Tesfu et al., 2017). The application of foliar treatments with humic acids enhances vegetative growth of plants, increasing production as well as increasing the average weight of fruit, number of fruits on plant and increasing vitamin C content in fruits (Yildirin and Taylor, 2007).

Using a fertilizer mixture consisting of 2/3 parts of organic fertilizer and 1/3 of inorganic fertilizer, resulted in the highest number of fruit/plant (73.7) and plant height reached 73.5 cm, with Roma VF variety not registering differences in fruits quality (Ashraful et al., 2017). Some authors have found that by organic fertilization, chemical and biochemical composition of fruit improves. Thus, pH value of fruits was 4.2 compared to 4.16 for the fertilization with chemical fertilizers. Acidity was 8.47 g malic acid/100 g fresh substance, compared with 8.10 g malic acid/100 g of fresh substance. Dry substance recorded values of 4.18/100 g and 3.82/100 g, respectively. Total sugar content was 2.83 mg/100 g in fresh substance for organic fertilization and 2.56 mg/100 g for mineral fertilization (Sereme et al., 2016).

MATERIALS AND METHODS

Experiences were located in Husasau de Tinca, Bihor County, 35 km from Oradea, Romania, in a private vegetable microfarm certified for organic production, where the experimental field was organized in 2016-2017.

Average multiannual temperature calculated from 1931 to 2014 is 10.6°C. Month with the highest average temperature is August with 21.6°C, and the month with the lowest average temperature is January -2.2°C. The average monthly multiannual temperature has positive values from February (0.3°C), reaches 5.9°C in March, in April 10.5°C, in May 15.8°C. In summer months the average monthly temperatures are high, being 19.1°C in June, 20.8°C in July and 21.5°C in August. From September, average monthly temperatures fall, but remain positive until December. Due to the constant intake of manure, the humus content was 4.53%. Soil pH is low alkaline. It is also worth mentioning a good soil supply in N, P, K.

Main objective of the research was to improve the technology of tomato cultivation in solariums, in ecological culture system, by identifying higher quality varieties, suitable for such cultures and establishing fertilization variants that allow obtaining sustainable yields with superior fruit quality.

Ananas, Potiron Ecarlate, Double Rich, Brandywine Pink, Merveille des Marchés, Caroten de Plovdiv, Estiva F1 and Blue Beauty cultivars have been used in the experience. Seeds used were produced by Kokopeli-Semences in France for organic crops. Cultivars used have differently colored fruits at maturity, ranging from red color of different nuances, and go to yellow, orange with different nuances, pink fruits and indigo mixed with red (Table 5).

Red or pink color of fruit is due to carotenoid pigments contained in the pulp (lycopene that dominates β-carotene up to 13 times) over which fruit epidermis, yellow or colorless, overlaps. Lycopene determines red color and β-carotene, orange color (Munteanu, 2003). When fruits contain more β-carotene than lycopene, they are yellow or orange. Before ripening, fruit color is light green uniform or green with a darker shade around the peduncle. Persistence of yellow greenish area around the peduncle after ripening is a defect that degrades the quality of fruits (Lagunovschi, 2016).

For differentiated fertilization, Agriful (applied to the ground) and Tekamin Brix (foliar applied) were compared to a non-fertilized option. Agriful fertilizer contains N-4.5%, P_2O_5-1%, K_2O-1%, fulvic acids-25%, vegetal vitamins-25%, organic matter-45% and has a pH of 4-7. It is applied in 3-5 l/ha (up to 30-60 l/ha). Tekamin Brix foliar fertilizer contains K_2O-18%, B-0.2% and does not contain chlorine. It is applied at the beginning of fruit development in amount of 2-3 l/ha and the treatment can be repeated after 10-12 days. Combining the two experimental factors resulted in 24 experimental variants that were placed in three repetitions. Experience was placed in a polyethylene tunnel (fertilized with 40 t/ha of half decomposed manure in autumn), crop being started with seedlings produced by sowing in the first decade of February. The seedlings were planted in pots of 9x9x9.5 cm and planted in the polyethylene tunnel on 16.04.2016 and 15.04.2017.

During seedlings production, specific works as well as two treatments with nettle macerate (to fortify plants and prevent disease attack) have been applied. First treatment was performed immediately after emergence and second, 10 days after transplanting. During vegetation period, the usual maintenance work was carried out. To prevent disease attack, nettle treatments were done and two treatments to combat aphids were done during June, using a mixture of fern macerate and black soap (vegetable soap made from olive oil). Plant growth was stopped after 8 inflorescences. Fruit picking started in June and lasted until September.

Observations have been made on plant growth, quantitative and qualitative production, determining fruit content in carotene and lycopene.

RESULTS AND DISCUSSIONS

Harvesting started in June and lasted until end of September. In June, a maximum of 15% of total production was obtained, depending on the variant. In July, 42.11% to 54.38% was harvested, in August between 34.15% and 41.84% of total production.

Production harvested in September accounted for a maximum of 11.52% of total production. Soil fertilization with Agriful has favorably influenced the volume of harvested production in each stage, compared to the non-fertilized variant.

Early tomato production (considered until July 20) ranged from 3.25 kg/m^2 to 4.41 kg/m^2. Analyzing the unilateral influence of the cultivar on early production it was found that Double Rich variety exceeded experience average by 16.35%, difference in production being distinctly significant (Table 1). Estiva hybrid exceeded experience average by 15.03%, the difference in production being distinctly significant.

Early production was lower in Potiron Ecarlate and Caroten de Plovdiv cultures where production differences compared to experience average, were distinct significantly negative, respectively significantly negative.

Table 1. Unilateral influence of cultivar on tomato production (Husasău de Tinca, 2016-2017)

Cultivar	Early production		Difference to average kg/m^2	Total production		Difference to average kg/m^2
	kg/m^2	%		kg/m^2	%	
Ananas	3.81	100.52	0.02	8.70^o	93.44	-0.61
Potiron Ecarlate	3.25^{oo}	85.75	-0.54	9.76*	104.83	0.45
Double Rich	4.41**	116.35	0.62	9.07	97.42	-0.24
Brandywine Pink	3.90	102.90	0.11	8.64^o	92.80	-0.67
Merveille des Marchés	3.58	94.46	-0.21	8.89^o	95.49	-0.42
Caroten de Plovdiv	3.32^o	87.59	-0.47	8.76^o	94.09	-0.55
Estiva F1	4.36**	115.03	0.57	11.39***	122.34	2.08
Blue Beauty	3.69	97.36	-0.10	9.35	100.42	0.04
Average	3.79	100.00	-	9.31	100.00	-
LSD 5%	0.26			0.41		
LSD 1%	0.51			0.72		
LSD 0.1%	0.93			1.26		

Total tomato production ranged from 8.64 kg/m^2 at Brandywine Pink cultivar and 11.39 kg/m^2 at Estiva F1 hybrid (Table 1). Compared to experience average, cultivars Ananas, Brandywine Pink, Merveille des Marchés and Caroten de Plovdiv produced lower yields below 9.00 kg/m^2, with differences in production compared to average being significantly negative. Potiron Ecarlate cultivar achieved a production of 9.76 kg/m^2, difference from experience average being significant and Estiva F1 cultivar registered a total production of 11.39 kg/m^2, production increase compared to average being 22.34 % and the production difference, was very significant (Table 1).

Unilateral influence of fertilization type applied in the experimental crop highlights the favorable effect on production of two supplementary fertilization variants, with Agriful and Tekamin Brix, accepted in ecological culture system. Total tomato production was 8.55 kg/m^2 for the unfertilized variant and 10.08 kg/m^2 for Agriful and 9.23 kg/m^2 for foliar fertilized variant (Table 2). By applying Agriful fertilizer to the soil, a production increase of 17.89% can be achieved and a very significant production difference compared to non-fertilized variant.

From data presented in Table 2 it is found that the differential application of fertilizers had favorably influenced early production of tomatoes, which ranged between 3.62 kg/m^2 and 3.99 kg/m^2. Application of fertilizers on the soil resulted in a production increase of 10.22%, production difference compared to variant not fertilized was significant. In foliar fertilized variants, production increase was 3.86%, production difference not being statistically assured.

Table 2. Unilateral influence of fertilization type on tomato production (Husasău de Tinca, 2016-2017)

Fertilization type	Early production		Difference to control kg/m^2	Total production		Difference to control kg/m^2
	kg/m^2	%		kg/m^2	%	
Unfertilized (Control)	3.62	100.00	-	8.55	100.00	-
Fertilized at soil with Agriful	3.99*	110.22	0.37	10.08 ***	117.89	1.53
Foliar fertilized with Tekamin Brix	3.76	103.86	0.14	9.23*	107.95	0.68
LSD 5%	0.31			0.56		
LSD 1%	0.58			0.92		
LSD 0.1%	0.96			1.34		

Table 3. Combined influence of cultivar and fertilization system on early tomatoes production, grown in an ecological system (Husasău de Tinca, 2016-2017)

Variant		Early production		Difference to control kg/m^2	Difference signification
Cultivar	Fertilization type	kg/m^2	%		
Ananas	Unfertilized (Control)	3.64	100.00	-	-
	Agriful	3.96	108.79	0.32	*
	Tekamin Brix	3.84	105.49	0.20	-
Potiron Ecarlate	Unfertilized (Control)	2.92	100.00	-	-
	Agriful	3.52	120.54	0.60	**
	Tekamin Brix	3.31	113.35	0.39	*
Double Rich	Unfertilized (Control)	4.25	100.00	-	-
	Agriful	4.67	109.88	0.42	*
	Tekamin Brix	4.32	101.64	0.07	-
Brandywine Pink	Unfertilized (Control)	3.60	100.00	-	-
	Agriful	4.13	114.72	0.53	*
	Tekamin Brix	3.97	110.27	0.37	*
Merveille des Marchés	Unfertilized (Control)	3.47	100.00	-	-
	Agriful	3.69	106.34	0.22	-
	Tekamin Brix	3.58	103.17	0.11	-
Caroten de Plovdiv	Unfertilized (Control)	3.29	100.00	-	-
	Agriful	3.44	104.56	0.15	-
	Tekamin Brix	3.25	98.78	-0.04	-
Estiva F1	Unfertilized (Control)	4.23	100.00	-	-
	Agriful	4.43	104.73	0.20	-
	Tekamin Brix	4.42	104.49	0.19	-
Blue Beauty	Unfertilized (Control)	3.59	100.00	-	-
	Agriful	4.10	114.21	0.51	*
	Tekamin Brix	3.40	94.70	-0.19	-

Early tomato production was influenced by cultivar and fertilization mode, being between 2.92 kg/m^2 at Potiron Ecarlate, unfertilized and 4.67 kg/m^2 at Double Rich variety, fertilized on the soil with Agriful (Table 3). It was found that soil fertilization with Agriful had a better effect compared to foliar fertilization in all cultivars. Effect of ground fertilization with Agriful provided production increases ranging between 4.73% and 20.54% depending on the cultivar. Foliar fertilization provided production increases up to 13.35%.

Ananas, Potiron Ecarlate, Double Rich, Brandywine Pink and Blue Beauty fertilized with Agriful, recorded significant or distinct production differences, compared to unfertilized variants.

Total tomato production was influenced by the cultivar used and fertilization type (Table 4).

Table 4. Combined influence of cultivar and fertilization type on tomato production cultivated in an ecological system (Husasău de Tinca, 2016-2017)

Variant		Total production		Difference to control kg/m^2	Difference signification
Cultivar	Fertlization type	kg/m^2	%		
Ananas	Unfertilized (Control)	7.80	100.00	-	-
	Agriful	9.89	126.79	2.09	***
	Tekamin Brix	8.43	108.07	0.63	*
Potiron Ecarlate	Unfertilized (Control)	9.17	100.00	-	-
	Agriful	10.57	115.27	1.40	***
	Tekamin Brix	9.56	104.25	0.39	-
Double Rich	Unfertilized (Control)	8.24	100.00	-	-
	Agriful	9.98	121.11	1.74	***
	Tekamin Brix	9.00	109.22	0.76	*
Brandywine Pink	Unfertilized (Control)	7.58	100.00	-	-
	Agriful	8.93	117.81	1.35	***
	Tekamin Brix	8.52	112.40	0.94	**
Merveille des Marchés	Unfertilized (Control)	8.23	100.00	-	-
	Agriful	9.67	117.50	1.44	***
	Tekamin Brix	8.76	106.43	0.53	*
Caroten de Plovdiv	Unfertilized (Control)	8.35	100.00	-	-
	Agriful	9.27	111.02	0.92	**
	Tekamin Brix	8.66	103.71	0.31	-
Estiva F1	Unfertilized (Control)	10.59	100.00	-	-
	Agriful	12.24	115.58	1.65	***
	Tekamin Brix	11.34	107.08	0.75	*
Blue Beauty	Unfertilized (Control)	8.44	100.00	-	-
	Agriful	10.10	119.67	1.66	***
	Tekamin Brix	9.53	112.91	1.09	**
LSD 5%		0.48			
LSD 1%		0.83			
LSD 0.1%		1.33			

Additional soil fertilization with Agriful provided production increases ranging from 15.27% to 26.79% depending on the cultivar, production differences being very significant at Ananas, Potiron Ecarlate, Double Rich, Brandywine Pink, Merveille des Marchés, Estiva F1 and Blue Beauty and distinctly significant at Caroten de Plovdiv. Additional fertilization with Tekamin Brix provided lower production yields, below 10% except Brandywine Pink, and Blue Beauty, with a production increase of 12.40% and 12.91% respectively.

Higher total production at fertilized soil variants with Agriful was recorded at Estiva cultivar of 12.24 kg/m^2, followed by Potiron Ecarlate and Blue Beauty with yields above 10.00 kg/m^2. Total production of the Tekamin Brix leaf fertilized variants was higher for Estiva cultivar, of 11.34 kg/m^2 followed by Potiron Ecarlate variety with a production of 9.56 kg/m^2.

In experimental years 2016-2017, lycopene and carotene content in tomato fruits varied widely enough depending on the fertilization type and tomato fruit color at maturity (Table 5).

Table 5. Lycopene and carotenoid content of tomato fruits produced in ecological farming in polyethylene tunnels (Husasău de Tinca, 2016-2017)

Variant		Fruit color at physiological maturity	Fruit content in lycopene mg/100 g fresh produce	Fruit content in carotene mg/100 g fresh produce.
Cultivar	Fertilization type			
Ananas	Unfertilized	Yellow orange with red tones at the base of the fruit	4.653	1.381
	Agriful		5.168	1.764
	Tekamin Brix		5.880	1.649
Potiron Ecarlate	Unfertilized	Pink	19.140	2.553
	Agriful		19.383	2.665
	Tekamin Brix		20.430	2.414
Double Rich	Unfertilized	Red	22.108	4.483
	Agriful		22.474	5.822
	Tekamin Brix		23.829	4.584
Brandywine Pink	Unfertilized	Pink	22.487	6.499
	Agriful		23.847	7.624
	Tekamin Brix		23.593	6.894
Merveille des Marchés	Unfertilized	Red	13.081	2.662
	Agriful		13.564	3.214
	Tekamin Brix		14.691	2.917
Caroten de Plovdiv	Unfertilized	Orange	10.760	10.565
	Agriful		12.722	11.086
	Tekamin Brix		12.382	11.553
Estiva F1	Unfertilized	Light red	17.230	2.855
	Agriful		18.090	3.724
	Tekamin Brix		21.369	5.138
Blue Beauty	Unfertilized	Mixture of red and indigo	15.273	1.900
	Agriful		16.474	2.521
	Tekamin Brix		17.305	3.636

Largest amount of lycopene was recorded at Double Rich and Brandywine Pink varieties in all three fertilization systems, with the indication that in unfertilized variants these varieties had a lower content of lycopene compared to fertilized variants. Thus, amount of lycopene in the unfertilized version of Double Rich variety was 22.108 mg/100 g fresh produce, in fertilized soil version with Agriful was 22.474 mg/100 g. fresh produce and in foliar fertilized variant with Tekamin Brix, the amount of lycopene was 23.829 mg/100 g fresh produce (Table 5). At Brandywine Pink variety, amount of lycopene in unfertilized variant was 22.487 mg/100 g fresh produce, in the fertilized soil version with Agriful was 23.847 mg/100 g fresh produce and in the foliar fertilized variant with Tekamin Brix was 23.593 mg/100 g fresh produce. Generally in all cultivars, fertilized variants with Agriful recorded a higher content of lycopene followed by foliar fertilized variants with Tekamin Brix.

In research carried out by Nikolova et al., (2017) six cultivars of tomatoes originating in Bulgaria lycopene levels measured were between 14.91 and 97.16 mg/100 g fresh produce. Beta-carotene values were between 15.45 and 32.52 mg/100 g fresh produce.

In Italy, Frusciante et al. (2007) determined the antioxidant content of 20 tomato genotypes. Lycopene content ranged between 2.33 and 16.9 mg/100 g fresh produce and carotene was between 3.87 and 18.5 mg/100g fresh produce, values that are lower than those obtained in this experience.

Ananas variety had the lowest level of carotenoids, being between 1.381 mg/100 g. (unfertilized variant) and 1.764 mg/100 g fresh produce (fertilized variant with Agriful). Caroten de Plovdiv variety measured the highest content of carotenoids in all three fertilization types (Table 5). Highest amount of carotenoids was recorded at Tekamin Brix foliar fertilized variant, 11.553 mg/100 g fresh produce, followed by fertilized soil variant with Agriful that had a carotenoid content of 11.086 mg/100 g fresh produce and in unfertilized version, carotenoid content was 10.565 mg/100 g fresh produce.

Fruit content in carotene was higher in all cultivars that were foliar fertilized with Tecamin Brix, followed by variants fertilized with Agriful.

Fruit content in lycopene and carotene is influenced by the area where the crop is grown, but also by crop system (protected or unprotected). Thus, in experiments carried out in Spain by Asensio et al., (2018), 5 tomato genotypes revealed a lycopene content between 21.91 and 64.95 mg/g fresh produce and for beta-carotene, values were between 1.37 and 6.41 mg/g fresh produce. Zamana et al., (2018) determined the content of tomato fruits from organic crops fertilized with organic bioproducts made in Russia (Moscow region) and recorded values between 2.70 and 7.11 mg/100 g fresh produce and for carotenoids the values were between 3.05 and 8.01 mg/100 g fresh produce. By applying some fertilizers (Vitis vinifera, humic acids + extract of the seeds of Vitis vinifera and humic acid, humic acids + extract from the seeds of Vitis vinifera + Boron) during plant growth, in three cultivars of tomatoes, Dinu et al., (2015) determined carotene values between 0.85 and 2.62 mg/100 g fresh produce, in another part of Romania, in protected culture.

CONCLUSIONS

Unilateral influence of cultivar on early tomato production (considered until July 20) showed that it ranged between 3.25 kg/m^2 and 4.41 kg/m^2. It was found that Double Rich variety exceeded the average of the experience by 16.35% and Estiva hybrid exceeded experience average by 15.03%

Differential application of fertilizers favorably influenced early tomato production. The application of fertilizers on the soil resulted in a production increase of 10.22% and in foliar fertilized variants the production increase was of 3.89%.

Early tomato production ranged from 2.92 kg/m^2 at Potiron Ecarlate, unfertilized and 4.67 kg/m^2 at Double Rich, fertilized on the ground with Agriful. Ground fertilization with Agriful had a better effect compared to foliar fertilization in all cultivars. Ground fertilization with Agriful provided early production increases ranging from 4.73% to 20.54% depending on the cultivar. Foliar fertilization provided early production increases of up to 13.35%.

Total tomato production ranged from 8.64 kg/m^2 at Brandywine Pink cultivar and 11.39 kg/m^2 at Estiva F1 hybrid. Potiron Ecarlate cultivar achieved a production of 9.76 kg/m^2

and a production of 11.39 kg/m^2 was recorded at Estiva F1 cultivar, production increase compared to average being 22.34%

Unilateral influence of fertilization system applied in the experimental culture highlighted the favorable effect on production of the two supplementary fertilization variants, with Agriful and Tekamin Brix respectively, accepted in ecological culture system. By applying the Agriful fertilizer to the ground, a production increase of 17.89% can be achieved compared to non-fertilized option.

Highest total production from fertilized soil variants with Agriful was recorded at Estiva F1 hybrid 12.24 kg/m^2, followed by Potiron Ecarlate and Blue Beauty with yields above 10.00 kg/m^2.

Additional soil fertilization with Agriful provided production increases ranging from 15.27% to 26.79% depending on cultivar, production differences being very significant at Ananas, Potiron Ecarlate, Double Rich, Brandywine Pink, Merveille des Marchés, Estiva F1 and Blue Beauty and distinctly significant at Caroten de Plovdiv.

Additional fertilization with Tekamin Brix provided lower production yields, below 10% with the exception of Brandywine Pink, and Blue Beauty, with a production increase of 12.40% and 12.91%, respectively.

In experimental years 2016-2017, content of lycopene and carotenoids in tomato culture varied within wide limits depending on the fertilization system and the color of tomato fruit at maturity.

Largest amount of lycopene was recorded at Double Rich and Brandywine Pink varieties in all three fertilization systems, with the indication that in unfertilized variants these varieties had a lower content of lycopene compared to fertilized variants on the soil with Agriful and foliar with Tecamin Brix.

Caroten de Plovdiv variety differed from other cultivars of tomatoes in terms of carotenoid content in all three fertilization systems. Highest amount of carotenoids was recorded at Tecamin Brix foliar fertilized variant of 11.553 mg/100 g of fresh substance, followed by the fertilized soil variant with Agriful with a carotenoid content of 11.086 mg/100 g and in the unfertilized version the carotenoid content was 10.565 mg/100 g of fresh substance.

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