

INFLUENCE OF CULTIVAR AND FERTILIZATION MODE UPON EARLY PRODUCTION OF TOMATOES CULTIVATED IN AN ECOLOGICAL SYSTEM

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Abstract: Tomatoes are used in people diet, fresh or in different dishes (soups, sauces, pots, stuffed tomatoes, etc.). They are recommended as food for people suffering of asthenia, loss of appetite, chronic poisoning, congestive states, atherosclerosis, vascular diseases, arthritis, gout, rheumatism, azotemia, biliary and urinary lithiasis, constipation, enteritis. They are industrially used in the production of tomato paste, broth, canned, plain or spicy juice, pickled. The internal use of tomatoes results in a reduction in blood viscosity and thus reduces the risk of thrombosis and atherosclerosis as well as cardiovascular disease. In order to achieve early productions, the protected crop of tomatoes is used and cultivation with a shorter period of vegetation is used. Production time is also ensured through balanced nutrition. The experience was carried out during the year 2016, in an ecologically certified vegetable small farm in Husasau de Tinca, Bihor County. The experimental factors were cultivar and fertilization. Experimental culture was set up in a polyethylene tunnel in April.

Keywords: tomatoes, cultivar, fertilization, early production

INTRODUCTION

Tomatoes are an important source of many components with antioxidant properties: carotenoids (lycopene, β -carotene), flavonoids, phenolic acids (chlorogenic acid, gallic acid) and ascorbic acid (Ewelina Hallmann, 2012). They provide valuable protection for the human body. Because we live in a polluted environment, we are exposed to stress and we use a wrong diet, the body's ability to clean up free radicals is weakened and the body enters into an oxidative stress state. For this reason, many diseases associated with the negative effects of free radicals such as cancer, heart disease, Parkinson's or Alzheimer's may occur. To prevent oxidative stress, a diet based on the consumption of antioxidants is required (Horotan et al, 2015).

Dry matter content of ripe fruit ranges from 5.5-7.5%, with 3-4% carbohydrates in the form of glucose and fructose, 1-1.3% protides and 0.5-0.7% minerals, from the fresh substance. The richness and variety of vitamins make fresh tomato fruits as well as derived products (juice, paste) an important source of food. Fresh fruits contain vitamin C (15-30 mg/100 g), carotenoids (0.8 mg/100 g), vitamins of group B (B1 0.06 mg, B2 0.04 mg, B6 0.1 mg) and P, 24 mg/100 g). Tomato fruit has a high content of mineral substances and organic acids (0.3-0.5%), mainly represented by citric acid and malic acid. Favorable ratio of carbohydrates to acids gives tomato fruits and juice a pleasant taste and a refreshing effect.

Insufficient nutrients or pollutants that can cause food shortages are tomatine (4-7mg/100g) and purine (4mg/100g) as well as Cu and Hg residues on the surface of the fruit (Apahidean and Apahidean, 2016). Mineral nutrition of tomatoes has some peculiarities that must be taken into account when fertilizing. Thus, specific consumption is variable

depending on the system of cultivation, variety, production, degree of supply of soil with mineral elements (Indrea et al., 2012).

Tomato assortment is very varied and dynamic, and varieties and hybrids with superior agroproductive qualities are grown every year and can be cultivated in different systems. In the assortment there are cultivars with different color fruits (most of them are red, but they are also green, brown, black, yellow, pink or even tigrated). The chemical composition of fruits differs significantly from one color to another (Viorica Lagunovschi-Luchian, Vânătoru, 2016). In order to achieve early productions, the protected crop of tomatoes is used and also cultivars with a shorter period of vegetation are used. Production time is also ensured through balanced nutrition. Nitrogen nutrition should be controlled in such a way as to avoid excess because, especially under unfavorable conditions (insufficient light, poor supply of K and Mg), causes excessive foliar growth and delays the formation and maturation of the fruit (Ciofu et al., 2003). If in the conventional agricultural system the possibility of nutrition management is ensured by the diversity of fertilizers that have a complex composition with macro and microelements, in organic farming, organic fertilizers are mainly used for fertilization. According to the requirements of Reg. EU 834/2007, the maximum quantity of N from organic and mineral fertilizers must not exceed 170 kg a.s./ha/year (Stoleru, 2013).

Cultures of tomatoes in protected spaces are carried out between March 25 and September 15, with the aim of producing early productions starting with the end of May under a lower cost price than the greenhouse cultivation (Stan et al., 2003).

MATERIAL AND METHOD

The experience was carried out in 2016, being located in an ecologically certified vegetable small farm from Husasau de Tinca in Bihor County, in the western part of Romania.

The purpose of the experience was to determine how some tomato cultivars behave in different fertilization systems, cultivated in polyethylene tunnel, under conditions specific to organic farming. Objectives were to determine the dynamics of early production and production. The following cultivars were used: Ananas, Potiron Ecarlate, Double Rich, Brandywine Pink, Merveille des Marchés, Caroten de Plovdiv, Estiva F1 and Blue Beautz, the seed being produced for organic crops. For fertilization, Agriful (applied to the ground) and Tekamin Brix (foliar applied) were applied and compared to unfertilized variant. By combining the two experimental factors resulted in 24 experimental variants that were placed in three repetitions.

Ananas is highly appreciated by consumers for the qualities it has: it has few seeds, the pulp is firm, dense, sweet, juicy, very fragrant and with an incomparable flavor. Color of the pulp resembles that of the pineapple. The fruits are large (200-400 g, sometimes they can reach 1 kg) yellow marked in red. It is a late variety, with indeterminate growth, with leaves similar to potatoes.

Potiron Ecarlate grows indefinitely, with large fruits of 250-600g, red in mixture with a little yellow, dense, acidic, tasty, very fragrant pulp, ideal for filling.

Double Rich is an cultivar with indeterminate growth, adapted to short summers or cooler summers. The fruits of 300-500g, are red, firm pulp, with few seeds and sweet sour taste. They have double the content of vitamin C than the average of other tomato varieties.

Brandywine Pink is a very old variety considered to be one of the best varieties, with undetermined growth, with potato-like leaves. The fruits are large (500-900g), slightly flattened, dark pink, with a very fine flavor. Fruits are sensitive to cracking.

Merveille des Marchés is a very old variety with undetermined growth, vigorous and compact growth, with large fruit production. The fruits are red, with pink pulp, medium-sized (180-200g) with few seeds.

Caroten de Plovdiv is a variety obtained in Bulgaria by researchers from the Maritza Institute of Vegetable Culture in Plovdiv.

Estiva F1 is an undetermined growth hybrid, producing medium fruits (180-220g), red in colour, tasty fruits.

Blue Beautz is a variety with undetermined growth that produces fruit weighing 200-250g with dense pulp. Color is a mixture of red and indigo. The fruits are resistant to cracking and sunburn. Fruits are rich in anthocyan with antioxidant capabilities.

Experience was placed in a polyethylene tunnel (fertilized in autumn with 40 t/ha of half decomposed manure), crop being set up with seedlings produced in biofuel heated shelter, sowing was done on February 6, 2016. Seedlings were transplanted in pots of 9x9x9.5 cm and planted in the tunnel on 16.04.2016. During the production of seedlings, specific works were carried out as well as two treatments with nettle macerate (to fortify plants and prevent the attack of diseases). The first treatment was carried out immediately after the emergence and after 10 days after transplanting. During the vegetation period, the usual maintenance work was carried out. To prevent disease attack, nettle treatment was performed and two treatments were done during June to combat aphids using a mixture of fern macerate and black soap (vegetable soap made from olive oil). Plant growth peak removal was performed after 8 inflorescences. Fruit harvesting started in June and lasted until September.

Observations have been made on plant growth, quantitative and qualitative production.

RESULTS AND DISCUSSION

From the data presented in Table 1 it can be seen that the harvesting of fruits started at some cultivars in June and in others from July. First ripened fruits were harvested from Double Rich, Brandywine Pink, Merveille des Marchés. By fertilizing on the ground with Agriful, a more favorable harvesting dynamic was ensured in all cultivars. Foliar fertilization with Tekamin Brix ensured a better dynamics of harvested production compared to unfertilized variants but lower compared to variants fertilized with Agriful.

Early production (considered until second decade of July) was between 3.35 kg/m² for cultivar Potiron Ecarlet and 4.40 kg/m² for Double Rich. Compared to experience average, Double Rich, Brandywine Pink and Estiva F1 had larger yields, with an increase in production between 7.71% and 17.02% (Table 2). Production differences in these varieties were significant (Brandywine Pink and Estiva F1), and distinctly significant (Double Rich). Compared to the average of the experience, cultivars Potiron Ecarlate and Caroten de Plovdiv had lower yields, with production differences being significantly negative.

Additional fertilizations with Agriful and Tekamin Brix provided 8-9% increase in early production, statistically assured (Table 3). Early tomato production was influenced by the cultivar used and the fertilization mode (Table 4). Soil and foliar fertilization provided production increases of over 14%, with distinct significant differences in the Potiron Ecarlate variety and significant in Ananas, Brandywine Pink and Blue Beauty

Table 1

Production dynamics of tomato cultivated in polyethylene tunnels (kg/m²)

Variant		Month										Total production
Cultivar	Ferti-lization	June/ Decade		July/ Decade			August/ Decade			September/ Decade		
		II	III	I	II	III	I	II	III	I	II	
Ananas	NF	-	-	1.44	1.95	0.78	0.87	0.98	1.11	0.70	-	7.82
	FS	-	-	1.44	2.11	1.60	1.08	1.41	1.11	0.66	-	9.73
	FF	-	-	1.37	2.33	0.89	0.97	1.01	1.25	0.57	-	8.34
Potiron	NF	-	-	1.00	2.10	1.18	1.27	1.33	1.28	0.50	-	9.25
Ecarlate	FS	-	-	1.24	2.30	2.23	1.38	0.99	0.92	0.91	0.49	10.44
	FF	-	-	1.75	2.30	1.41	1.07	1.53	1.14	0.79	0.32	9.59
Double Rich	NF	-	0.67	1.43	2.20	1.18	0.98	1.27	0.60	-	-	8.33
	FS	0.13	0.88	1.49	1.40	1.50	0.51	1.11	1.03	0.66	-	9.87
	FF	-	0.72	1.78	1.86	1.12	1.05	1.42	0.98	0.24	-	8.90
Brandywine	NF	-	0.59	1.61	1.68	1.01	1.14	1.41	0.32	-	-	7.75
	FS	0.25	0.53	1.50	1.63	1.54	1.24	1.11	0.82	0.40	-	9.26
Pink	FF	0.12	0.77	1.57	1.66	1.28	1.16	1.35	0.55	-	-	8.35
Merveille des	NF	-	-	1.56	2.02	1.31	1.20	1.10	0.96	0.46	-	8.60
	FS	-	-	1.42	2.06	1.66	1.20	1.21	1.14	0.70	0.40	10.09
Marchés	FF	-	0.13	1.39	2.17	1.81	1.00	1.06	0.78	0.37	-	8.87
Caroten de	NF	-	-	1.55	1.76	1.46	0.95	1.07	0.89	0.36	-	8.03
	FS	-	-	1.48	1.88	1.89	0.92	1.31	0.98	0.54	0.14	9.13
Plovdiv	FF	-	-	1.40	1.94	1.30	1.30	0.96	1.01	0.47	-	8.32
	NF	-	0.46	1.60	1.98	1.02	1.78	1.30	1.08	0.43	-	10.72
Estiva F1	FS	-	0.33	1.75	2.03	2.39	1.73	1.67	1.16	0.75	0.17	11.96
	FF	-	-	1.80	2.40	1.79	1.82	1.45	1.22	0.48	-	11.01
	NF	-	-	1.61	1.94	1.47	1.10	1.38	0.58	0.24	-	8.54
Blue Beautz	FS	-	-	1.57	2.31	1.97	1.30	1.30	1.03	0.78	-	10.26
	FF	-	-	1.60	1.17	1.88	1.41	0.93	1.06	0.49	-	9.53

NF - no fertilization, FS – Soil fertilization with Agriful, FF – Foliar fertilization with Tekamin Brix

Table 2

Unilateral influence of cultivar on early tomato production

Cultivar	Production		Difference to culture average (t/ha)	Significance of the difference
	kg/m ²	%		
Ananas	3.61	96.01	-0.15	-
Potiron Ecarlate	3.35	89.09	-0.41	o
Double Rich	4.40	117.02	0.64	**
Brandywine Pink	4.05	107.71	0.29	*
Merveille des Marchés	3.57	94.94	-0.19	-
Caroten de Plovdiv	3.33	88.56	-0.43	o
Estiva F1	4.11	109.30	0.35	*
Blue Beauty	3.73	99.20	0.03	-
Average (Mt)	3.76	100.00	-	-
DL P 5%		0.25		
DL P 1%		0.52		
DL P 0.1%		0.84		

Table 3

Unilateral influence of fertilization on production of early tomatoes

Fertilization	Production		Difference to culture average (t/ha)	Significance of the difference
	kg/m ²	%		
No fertilization	3.53	100.00	-	-
Soil fertilization with Agriful	3.86	109.34	0.33	*
Foliar fertilization with Tekamin Brix	3.82	108.21	0.29	*
DL P 5%		0.28		
DL P 1%		0.45		
DL P 0.1%		0.72		

Table 4

Combined influence of the cultivar and the fertilization system on the early production of tomatoes grown in an ecological system

Cultivar	Variant Fertilization system	Production		Difference to culture average (t/ha)	Significance of the difference
		kg/m ²	%		
Ananas	No fertilization	3.39	100.00	-	-
	Agriful	3.77	111.20	0.36	*
	Tekamin Brix	3.67	108.25	0.28	*
Potiron Ecarlate	No fertilization	3.04	100.00	-	-
	Agriful	3.54	116.44	0.50	**
	Tekamin Brix	3.47	114.14	0.43	**
Double Rich	No fertilization	4.30	100.00	-	-
	Agriful	4.57	106.27	0.27	*
	Tekamin Brix	4.35	101.16	0.05	-
Brandywine Pink	No fertilization	3.88	100.00	-	-
	Agriful	4.16	107.21	0.28	*
	Tekamin Brix	4.11	105.92	0.23	*
Merveille des Marchés	No fertilization	3.58	100.00	-	-
	Agriful	3.48	97.20	0.10	-
	Tekamin Brix	3.67	102.51	0.09	-
Caroten de Plovdiv	No fertilization	3.30	100.00	-	-
	Agriful	3.36	101.81	0.06	-
	Tekamin Brix	3.34	101.21	0.04	-
Estiva F1	No fertilization	4.04	100.00	-	-
	Agriful	4.11	101.73	0.07	-
	Tekamin Brix	4.20	102.18	0.16	-
Blue Beauty	No fertilization	3.54	100.00	-	-
	Agriful	3.89	109.88	0.35	*
	Tekamin Brix	3.77	106.49	0.23	*
DL P 5%		0.22			
DL P 1%		0.38			
DL P 0.1%		0.65			

CONCLUSIONS

On the basis of the results obtained from the research carried out on tomatoes in polyethylene tunnel, in the specific conditions of West of Romania, using cultivars: Ananas, Potiron Ecarlate, Double Rich, Brandywine Pink, Merveille des Marchés, Caroten de Plovdiv, Estiva F1 and Blue Beautz, additionally fertilized with Agriful and Tekamin Brix, the following conclusions were drawn:

- the harvesting of fruits began at some cultivars in June and at others in July. First matured fruits were harvested from the cultivars Double Rich, Brandywine Pink, Merveille des Marchés;
- Agriful fertilization on the ground has ensured a more favorable harvesting dynamics for all cultivars. Foliar fertilization with Tekamin Brix ensured a higher production compared to unfertilized variants but lower compared to variants fertilized with Agriful;
- early production (considered until second decade of July) was between 3.35 kg/m² for cultivar Potiron Ecarlet and 4.40 kg/m² for Double Rich;
- additional fertilization with Agriful and Tekamin Brix provided 8-9% increase in the early production, statistically assured;
- soil and foliar fertilization provided production increases of over 14%, with distinct significant differences at Potiron Ecarlate variety and significant in Ananas, Brandywine Pink and Blue Beauty.

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