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THE INFLUENCE OF CULTURE TECHNOLOGY UPON THE PHYSICAL QUALITY OF SOME EARLY TOMATOES VARIETIES

Constanţa ALEXE[1], Marian VINTILĂ[1], Simona POPESCU[1], Gh. LĂMUREANU[2], Lenuţa CHIRA[3]

[1]Research and Development Institute for Processing and Marketing of the Horticultural Products – HORTING Bucharest, No. 1A, Intrarea Binelui Street, District 4, 042159, Bucharest, Romania, Phone 40214610706, fax 0214600725, E-mail: ihorting@yahoo.com
[2]Research Station for Fruit Growing (R.S.F.G) Constanta, No.1, Pepinierei Street, 907300, Commune Valu lui Traian, Romania, Phone/Fax.+4024123187, E-mail: scpp_constanta@hotmail.com
[3]University of Agronomic Sciences and Veterinary Medicine of Bucharest, No. 59, Marasti Blvd, District 1, 011464, Bucharest, Romania, Phone: +40 21 318 25 64/232, Fax: + 40 21318 28 88 E-mail: lenutachira@yahoo.com

Corresponding author email: constanta_alexe@yahoo.com

Abstract

The quality of the Romanian vegetable production is currently of a great importance as far as alimentation, horticultural economy and commerce with such perishable products because that determines competition on both internal and external market and, implicitly, the maintaining of the market for Romanian products in the context of an open, competitive market. Our researches aimed to establish the most appropriate culture technological sequences for three varieties of early tomatoes ('Isalnita 29', 'Isalnita 50', 'Buzau 47') in order to obtain high quality fruit with suitable physical qualitative indicators. All tomatoes varieties that were tested benefited in culture for three different density variants (25,000 plants/ha, 40,000 plants/ha, 55,000 plants/ha) and two levels of fertilization (c1 = N:200 kg/ha; P2O5:100 kg/ha; K2O:100 kg/ha, c2 = N:300 kg/ha; P2O5:200 kg/ha; K2O:100 kg/ha). Immediately after harvesting, certain physical determinations were carried out concerning the main physical qualitative indicators of the fruit: average weight, thickness of the pericarp, specific weight and texture firmness. Results show that the physical qualitative indicators vary depending on variety, planting density and lightly on fertilizer dose of culture. Between the three varieties that were studied, the variety 'Buzau 47' is distinguished through the largest fruits (average weight=97.75 g), high specific weight (0.9726 g/cm3) and the thickness of the pericarp (6.66 mm). At the same time, the variety 'Buzau 47' has the fruits with the lowest firmness (145.87 PU), this indicator having values inversely proportional to the size of fruits. Regarding the planting density, this influences, according to the physical qualitative indicator, in a different way. As the density is lower, the average weight of the fruit has higher values. Between tested fertilization variants, at a level of nutrition below the limits of 300 kg/ha N, 200 kg/ha P2O5 and 100 kg/ha K2O, there are no essential differences in the values of the main physical qualitative indicators, beside the average weight of the fruits, which increases from 69.97 g in the case of fertilization variant c1, to 82.92 g in the case of fertilization variant c2.

Key words*: average and specific weight, firmness, level of nutrition, planting density.*

INTRODUCTION

Tomatoes are one of the most important vegetable species in our country, due to the fact that they can be consumed both fresh and processed in different ways (Stan et al., 2003).
Tomatoes are healthy and contain very few calories. They have a significant content of vitamin C, minerals (e.g.: potassium) and important micro-nutrients.
Supplying market with fresh tomatoes obtained in open field is possible beginning with the second half of June by performing early cultures. This type of culture, which occupies a significant share in our country, is practiced in the areas with more favourable climatic conditions for tomatoes, such as: Western Plain, Danube Plain, a part of Dobrogea.
Researcher Vînătoru (2006) affirmed that the Romanian tomato is tasteful, aromatic and beneficial for health, being cultivated on natural soil, not forced with chemical substances.

The cultivating method on unconventional substrata is still relatively new in Romania (Makobo and Du Plooy, 2008), so that the classical method, on soil, still occupies the largest part of the surface in our country destined for tomato cultures (Ciofu et al., 2004). The aim of the applied different culture technologies has to not only be the obtaining of large productions, but also to ensure a high quality, which means that the technological links have to take into account the destination of the production. From this point of view the fertilization system and regime have significant effects (Neata, 2002; Cioroianu et al., 2010; Anton, 2011; Cioroianu et al., 2011). Also at the creation of new varieties and hybrids should be taken into consideration the fact that they respond differently to both environmental conditions and technological links applied to the culture (Draghici and Pele, 2012).

In appreciation of the quality and nutritive-alimentary value of the fruits, is taken into consideration the physical and sensory characteristics (size, shape, colour, specific weight, texture firmness, flavour, taste etc), technological characteristics (storage capacity, transport and handling resistance, presence of diseases or pests attack, remanence of pesticides) and the biochemical properties: water content, dry matter, carbohydrates, acids, cellulose, vitamins, pigments, mineral salts (Salunkhe et. Kadam , 1998; Alexe et al., 2013).

This paper presents some aspects regarding the influence of variety, planting density and fertilization of early tomato culture upon the certain physical qualitative indicators of the fruits.

MATERIALS AND METHODS

The researches were conducted during period 2013-2014, using Romanian varieties of early tomatoes, obtained in a vegetable farm located in an area of the Romanian seaside.

The trial was organized as a trifactorial experience, with following experimental factors:

A – planting density (plants/ha)	**B – variety**	**C – ferilization level** (kg/ha)
a1 – 25,000	**b1**- Isalnita 29	**c1** – N:200; P_2O_5:100; K_2O:100
a2 – 40,000	**b2** - Isalnita 50	**c2** – N:300; P_2O_5:200; K_2O:100
a3 – 55,000	**b3** - Buzau 47	-

The observations and determinations regarding the main physical qualitative indicators (average weight, thickness of the pericarp, specific weight, texture firmness) were made at Research and Development Institute for Processing and Marketing of the Horticultural Products - Horting Bucharest and at University of Agricultural Sciences and Veterinary Medicine Bucharest. The determination of the fruit firmness was performed by means of a mass penetrometer OFD, the measurement being in penetrometer units (1PU = 0.1 mm) of the depth of the conical needle penetration (length = 24mm, diameter at base = 4 mm) in the pulp. Measurements were performed on a total of 25 fruit/variant, each fruit being penetrated in four points in the equatorial zone.

RESULTS AND DISCUSSIONS

The average weight of the fruit is a characteristic indicator for every variety. Between 3 varieties of early tomatoes that were studied, taking into account the average of variants, Isalnita 29 variety has the smallest fruits, with the average weight of 51.78 g, varying, depending on the distance of planting and fertilization variant, between 51.0 g and 53.3 g (Table 1).

Variety Isalnita 50, with the value of average weight of fruits of 79.80 g, has much larger variation limits depending on the variant of culture (67.0-93.1 g).

The largest fruits are found at variety Buzau 47, with the average weight of 97.75 g and variation limits between 76.0 g and 108.3 g.

Specific weight is high at all 3 varieties, the average value being between 0.9256 g/cm^3 at variety Isalnita 29 and 0.9726 g/cm^3 at the variety Buzau 47. Higher differences between variants were observed at variety Buzau 47, with limits from 0.8876 g/cm^3 to 1.1028 g/cm3, while the variety Isalnita 29 presented more constant values around the average (0.8903-0.9712 g/cm^3).

Table 1. The influence of variety upon physical qualitative indicators of early tomatoes

Variety	Variant	Average weight (g)	Specific weight (g/cm^3)	Thickness of pericarp (mm)	Firmness (PU)
b1	a1c1	52.1	0.9044	5.5	91.8
	a2c1	52.0	0.8916	5.5	108.3
	a3c1	52.0	0.8903	5.3	106.3
	a1c2	52.3	0.9941	5.5	102.5
	a2c2	51.0	0.9712	5.7	107.5
	a3c2	51.3	0.9021	5.8	92.0
	average	51.78	0.9256	5.55	101.40
b2	a1c1	80.9	0.9614	6.6	131.7
	a2c1	81.8	0.9404	6.5	140.3
	a3c1	67.0	0.9645	6.5	130.5
	a1c2	93.1	0.9761	6.6	130.4
	a2c2	88.1	1.0091	6.6	135.4
	a3c2	67.9	1.0041	6.4	103.5
	average	79.80	0.9759	6.53	128.63
b3	a1c1	108.3	0.8876	6.6	151.1
	a2c1	83.1	0.9334	6.6	147.5
	a3c1	76.0	0.9019	6.5	130.5
	a1c2	114.1	0.9881	6.8	148.3
	a2c2	108.3	1.0221	6.8	150.5
	a3c2	101.2	1.1028	6.7	147.3
	average	97.75	0.9726	6.66	145.87

The thickness of pericarp is, as well, a character of variety, being lower at Isalnita 29 variety, of 5.55 mm (which presents also the smallest weight of the fruits) and very close at the other 2 varieties (6.53 mm at variety Isalnita 50, respectively 6.66 mm at variety Buzau 47). There were not registered differentiated values within the variants.

Firmness of the pulp presented values inversely proportional to the size of fruit, being the lowest at variety Buzau 47 (145.87 PU), the highest at variety Isalnita 29 (101.40 PU) and with intermediary values at variety Isalnita 50 (128.63 PU).

The results presented in Table 2 show that the planting density is also influencing some physical qualitative indicators of fruits. The average weight is higher at a lower planting density.

At a planting density of 25,000 plants/ha, average weight had the average value of 82.31g, while at a planting density of 55,000 plants/ha, this was only 76.16 g. However from table 2 results that the indicator average weight is influenced by the culture density only at varieties Isalnita 50 and Buzau 47, whose fruits are smaller as the density increases.

Table 2. The influence of planting density upon physical qualitative indicators of early tomatoes

Planting density	Variant	Average weight (g)	Specific weight (g/cm^3)	Thickness of pericarp (mm)	Firmness (PU)
a1	b1c1	52.1	0.9044	5.5	91.8
	b2c1	80.9	0.9614	6.6	131.7
	b3c1	98.3	0.8876	6.6	151.1
	b1c2	52.3	0.9941	5.5	102.5
	b2c2	93.1	0.9761	6.6	130.4
	b3c2	117.2	0.9881	6.8	148.3
	average	**82.31**	**0.9519**	**6.27**	**125.96**
a2	b1c1	52.0	0.8916	5.4	108.3
	b2c1	81.8	0.9404	6.5	140.3
	b3c1	93.1	0.9334	6.6	147.5
	b1c2	52.3	0.9712	5.5	102.5
	b2c2	88.1	1.0091	6.6	135.4
	b3c2	114.1	1.0221	6.8	150.5
	average	**80.23**	**0.9613**	**6.23**	**130.75**
a3	b1c1	51.0	0.8903	5.3	116.3
	b2c1	76.0	0.9642	6.5	148.5
	b3c1	94.5	0.9019	6,7	155.3
	b1c2	51.3	0.9021	5.8	112.0
	b2c2	75.9	1.0041	6.4	143.5
	b3c2	108.3	1.1028	6.7	157.3
	average	**76.16**	**0.9609**	**6.23**	**138.81**

The average weight of fruits from variety Isalnita 29 presented constant values, regardless of the culture density. This variety allows therefore higher culture densities, without being affected the uniformity of production, while, at the other 2 varieties, the density of 55,000 plants/ha may lead to unevenness of average weight and implicitly of production.

The firmness of fruits, which is a variety distinctiveness, presents a great importance for a superior valorification, for which it is necessary to be given attention in the application of technological links of culture. This indicator is influenced by the planting density. The fruit firmness decreased from the value of 125.96 PU at variant a1 to 130.75 PU and respectively to 138.81 PU in case of variants a2 and a3 respectively. The softest

fruits at harvest are met therefore at the culture density of 55,000 plants/ha, at variety Buzau 47. The thickness of pericarp is also a physical indicator of a great importance, which, in the case of mechanical conditioning, should be taken into consideration. This indicator did not presented significant modifications along with the increasing of planting density.

Specific weight and thickness of the pericarp was less influenced by planting density. However, variant a1 presented a slight decreased value of specific weight (0.9519 g/cm^3) comparatively with variant a2 (0.9613 g/cm^3) and variant a3 (0.9609 g/cm^3).

The influence of fertilization levels upon physical indicators is represented in Table 3.

The average weight of fruits is influenced by the level of fertilization doses, that increasing, from 69.97 g in the case of fertilization variant c1, to 82.92 g in the case of fertilization variant c2, considering the average of variants planting density x variety. It is observed repeatedly the stability of Isalnita 29 variety, to whom the modifications from c1 to c2 are insignificant.

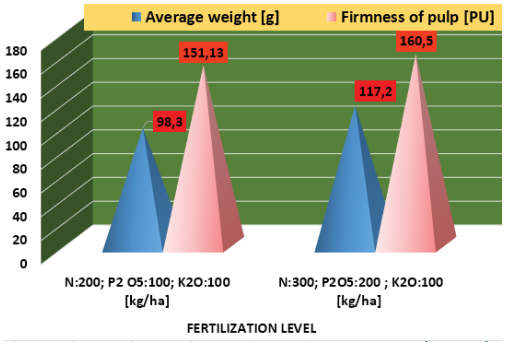
Table 3. The influence of fertilization level upon physical qualitative indicators of early tomatoes

Fertili-zation level	Variant	Average weight (g)	Specific weight (g/cm^3)	Thickness of pericarp (mm)	Firmness (PU)
c1	a1b1	52.1	0.9044	5.4	91.8
	a1b2	71.9	0.9614	6.6	131.7
	a1b3	98.3	0.8876	6.8	151.1
	a2b1	52.0	0.8916	5.4	108.3
	a2b2	70.8	0.9404	6.6	140,3
	a2b3	84.1	0.9334	6.6	147.5
	a3b1	51.0	0.8903	5.3	106.3
	a3b2	66.0	0.9642	6.5	130.5
	a3b3	83.5	0.9019	6.6	145.3
	average	69.97	0.9194	6.18	128.09
c2	a1b1	52.3	0.9941	5.5	107.5
	a1b2	93.1	0.9761	6.6	130.4
	a1b3	117.2	0.9881	6.9	160.5
	a2b1	51.3	0.9712	5.7	109.5
	a2b2	88.1	1.0019	6.6	135.4
	a2b3	114.1	1.0221	6.7	148.3
	a3b1	51.0	0.9021	5.8	115.0
	a3b2	75.9	1.0041	6.4	143.5
	a3b3	103.3	1.1028	6.7	157.3
	average	82.92	0.9958	6.32	131.93

Concerning the specific weight, thickness of the pericarp and firmness of the pulp, there are no essential differences between the 2 levels of fertilization. It is observed however a slight increase of the average values of specific weight and pericarp thickness and a small decrease of the fruits firmness in the case of variant c2 beside c1.

Results concerning the interaction of factors A x B x C show that the fertilization acts independently of variety and planting density, but in both variants, variant c1 and variant c2, the higher value of average weight (98.3 g respectively 117.2 g), thickness of the pericarp (6.8 mm, respectively 6.9 mm), and texture firmness (151.3 PU, respectively 160.5 PU) was recorded at variant a1b3 (a1: planting density=25,000 pl/ha; b3: variety Buzau 47), proving the influence of variety and planting density (Figure 1).

Fig. 1. The influence of interaction of the factors variety (Buzau 47), planting density (25,000 pl/ha) and fertilization level upon some physical qualitative indicators of the early tomatoes



CONCLUSIONS

The main physical qualitative indicators (average weight, thickness of the pericarp, specific weight, texture firmness) varies depending on variety and culture technology conditions.

Between the three varieties that were studied, the variety Buzau 47 is distinguished through the largest fruits (average weight=97.75 g), high specific weight (0.9726 g/cm^3) and the thickness of the pericarp (6.66 mm). At the same time, the variety Buzau 47 has the fruits with the lowest firmness (145.87 PU), this indicator having values inversely proportional to the size of fruits.

Regarding the planting density, this influences, according to the physical qualitative indicator, in a different way. As the density is lower, the

average weight of the fruit has higher values. From this point of view, the tomatoes that came from culture with plantig density of 25, 000 plants/hectars recorded the best results. However the average weight of fruits from variety Isalnita 29 presented constant values, regardless of culture density. This variety allows therefore higher culture densities, without being affected the uniformity of production, while, at the other 2 varieties the density of 55,000 plants/ha may lead to unevenness of average weight and implicitly of production. Along with the increasing of density, the firmness decreases, the softest fruits at harvest are meeting at the culture density of 55,000 plants/ha.

In the case of different fertilization level, at a nutritional level below the limits of 300 kg/ha N, 200 kg/ha P_2O_5 and 100 kg/ha K_2O, there are no essential differences in the values of the main physical qualitative indicators, beside the average weight of the fruits. This increases, from 69.97 g in the case of fertilization variant c1, to 82.92 g in the case of fertilization variant c2, having into consideration the average of the variants planting density x variety. It is observed repeatedly the stability of Isalnita 29 variety, to whom the modifications from variant c1 to variant c2 are insignificant.

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