Tomato Production Influenced by Variety, Irrigation and Organic Fertilization

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Abstract

Tomato (*Solanum lycopersicum* L.) is one of the most cultivated crops in the world, offering many opportunities for research and marketing also. High productions, in conditions of economic sustainability and assured food safety, can only be achieved through the rational use of cultivation technologies, irrigation, fertilization and use of some cultivars with potential genetically performances. To achieve this goal, the present experiment focused on studying the influence of four tomato cultivars (Siriana F₁, Minaret F₁, HTP F₁ and Inima de bou), in two irrigation regimes (5200 respectively 7800 m³) under chicken drops fertilizer compared with a non-fertilized control. The treatments used induced the increase of the fruit number per plant, ranging from 18 to 65%, statistically significant results ($p < 0.05$) being obtained with the organic fertilizer on Minaret cultivar and the higher water quantity, compared to the control version. The highest production was obtained in the HTP F₁ cultivars under organic fertilization and 7800 m³/ha irrigation.

Keywords: chicken manure, yield, cultivars, water regime

Introduction

Tomatoes are the most cultivated and consumed vegetables worldwide. High consumption is determined by the fact that these vegetables are the most balanced from a nutritional point of view (Guil-Guerrero and Reboloso-Fuentes, 2009; Butnariu and Butu, 2014; Jędrszczyk and Ambroszczyk, 2016). Although they are the most appreciated vegetables, studies and researches on this species have not fully constructed the correlation of production with the physical and biochemical quality of the yield, under organic farming conditions (Gonzales and May, 1994; Stoleru *et al.*, 2007).

Tomatoes which are consumed fresh, must have a special taste and colour, some firmness of the pulp and sometimes a certain size of fruit according to the preference of the consumer (Ciofu *et al.*, 2004).

If for conventional tomato crops are established means and techniques of obtaining products, for organic farming many of the inputs that supply nutrients are missing. In accordance with EU Regulation 834/2007 all synthetic products are prohibited in organic farming.

In recent times, special attention is given to cultivation with a high duration of fresh fruits. Not the same criteria are required for industrialization where size and shape are of reduced importance, low husks and seeds, a high dry matter, and a low acidity should be requested instead (Toor and Savage, 2004; Toor *et al.*, 2006; Jędrszczyk and Ambroszczyk, 2016). Although countless researches have been done with regard to the quantitative and qualitative improvement of the tomato yield, there still remain undefined the technological measures, which ensure consumer safety and sustainability of the producer. The

Table 1. Tomato plant height (n=3)

No.	Treatments	Plant height (cm)	Fruit per plant	Fruit weight (kg)
1.	S x O x IR5200	199.45±3.12 ab	21.41±2.1 a	0.160±0.001 a
2.	S x O x IR 7800	208.26±5.26 b	23.04±3.32 a	0.174±0.002 b
3.	S x Mt x IR 5200	191.31±1.4 a	13.56±1.08 a	0.168±0.001 b
4.	S x Mt x IR 7800	197.5±4.02 ab	15.52±1.56 a	0.171±0.002 b
5.	M x O x IR 5200	152.64±4.15 b	22.00±1.9 ab	0.162±0.002 a
6.	M x O x IR 7800	159.76±3.3 b	24.78±1.45 b	0.178±0.002 b
7.	M x Mt x IR 5200	133.31±3.16 a	17.04±2.34 ab	0.160±0.001 a
8.	M x Mt x IR 7800	148.97±2.01 b	15.00±1.61 a	0.165±0.002 a
9.	HTP x O x IR 5200	170.78±3.96 a	24.63±2.47 a	0.184±0.001 a
10.	HTP x O x IR 7800	175.69±7.82 a	25.26±1.41 a	0.209±0.009 b
11.	HTP x Mt x IR 5200	167.06±3.7 a	20.74±2.22 a	0.173±0.001 a
12.	HTP x Mt x IR 7800	171.97±5.05 a	19.52±2.01	0.183±0.001 a
13.	IB x O x IR 5200	201.48±7.66 a	19.59±1.78	0.188±0.002 a
14.	IB x O x IR 7800	228.96±5.01 b	20.44±1.41	0.191±0.006 a
15.	IB x Mt x IR 5200	198.78±5.06 a	14.67±1.1	0.181±0.002 a
16.	IB x Mt x IR 7800	214.49±3.92 ab	15.52±1.57	0.175±0.003 a

Note: Means within each column followed by the same letters are not significantly different according to Tukey test. Standard errors are given after mean data.

S-‘Siriana’ F₁; M-‘Minaret’ F₁; HTP-‘HTP’ F₁; IB-‘Inima de bou’; O-chicken manure; Mt-control. unfertilized; IR5200-irrigation regime 5200 m³/ha; IR7800- irrigation regime 7800 m³/ha

data from the scientific literature highlights the fact that in organic tomato crops, the number of fruits per plant, plant weight and yield are 30-70% lower than in conventional farming (Bilalis *et al.*, 2018; Albino *et al.*, 2018).

The purpose of the research was to study the influence of varieties, irrigation regime under organic fertilization on the tomato crop, in protected area compared to untreated version, to promote new technics for organic farming.

Materials and methods

The experience was carried out during 2017 within the experimental station of UASVM Iasi, in subdivided plots with three replications for each version. Each experimental plot comprised 20 harvested plants. Cultivars were represented by: ‘Siriana’ F₁, ‘Minaret’ F₁, ‘HTP’ F₁ and ‘Inima de bou’. The fertilization regime consisted of organic fertilized (O) and untreated versions (Mt).

The seedlings used to set up the crop were produced in greenhouses, under controlled conditions, in pots of 8 cm diameter and 55 days of age, with a density of 31,250 plants/ha. The setting up of the experience was made around April 15, in an individual solar, on a cernozome cambic soil.

The organic factor represented by chicken manure drops - Orgevit® 1000 kg/ha, was applied to soil in a quantity of 500 kg at bed preparation and the rest of 500 kg in two phases of 250 kg/

ha during the first inflorescence and the third inflorescence appearance.

The irrigation regime was represented by two norms, 5200 and 7800 m³/ha with 26 times, with an irrigation quantity of 200 m³/ha respectively 300 m³/ha, applied by drip irrigation, norms considered optimal for protected area crops (Colla *et al.*, 1999; Ciofu *et al.*, 2004).

Cultural measures and plant protection were applied according to organic farming scientific literature (Stoleru *et al.*, 2014; Munteanu, 2003).

The experimental data processing was carried out using specific mathematical and statistical methods. All analyses were carried out in the three replications. Standard deviation ($\pm$ SD) was calculated for each data series as an indicator of DataSet scatter (n = 3). For the calculation of the difference in values compared to the control variants the Tukey test was used for a confidence degree of 95% (p < 0.5) using SPSS version 20.

Results and Discussions

Regarding the height of plants we have the lowest value for ‘Minaret’ F₁ control, irrigated with 5200 m³ and the maximum for ‘Inima de Bou’ organic irrigated with 7800 m³.

The lower average height of the ‘Minaret’ is determined genetically, the F₁ ‘Minaret’ being a hybrid with semi-determined growth. According to this aspect, even within the cultivation, the

Figure 1. Mean of tomato yield (means $\pm$ standard errors. $n=3$)

Means within each column followed by the same letters are not significantly different according to Tukey test.

S-‘Siriana’ F_1 ; M-‘Minaret’ F_1 ; HTP-‘HTP’ F_1 ; IB-‘Inima de bou’; O-chichem manure; Mt-control unfertilized; IR5200- irrigation regime 5200 m^3/ha ; IR7800- irrigation regime 7800 m^3/ha

smallest height was in the case of the unfertilized version where the lowest amount of water was used to irrigate.

The most stable hybrid that was not significantly influenced in the height of the plant, regardless the fertilization and irrigation factor was represented by ‘HTP’ F_1 , where the differences were very small between the experimental versions (Tab. 1).

The number of fruits per plant varied according to cultivar, irrigation and fertilization regimes. The smallest value have been obtained in the cultivar ‘Siriana’ $F_1 \times Mt \times 5200 m^3 - 13.56$ and the highest in version ‘HTP’ $F_1 \times organic \times 7800 m^3 - 25.26$ of organically fertilized cultivation. The smallest value of the growing ‘Inimă de bou’ $\times organic \times 5200 m^3 - 19.59$ and from the control evidence the highest value obtained of ‘HTP’ $F_1 \times Mt \times 5200 m^3 - 20.74$ (Tab. 1). The only hybrid that ensured statistical differences between control and fertilized variants was ‘Minaret’ F_1 .

In general, the average fruit weight increased between 1 and 14% in organically fertilized variants irrespective of the amount of water except for the ‘Siriana’ variety at which the values were lower for the organically fertilized variant and the low water dose as compared to the control variant (Tab. 1). Significant differences ($p < 0.05$) were obtained in organically fertilized variants and high water regime in ‘Minaret’, ‘Inima de bou’ and ‘HTP’ cultivars’ (8, 9 and 14% respectively).

The highest total yield was achieved by ‘HTP’ F_1 fertilized with chicken drops under 7800 m^3/ha irrigation regime with 176.18 t/ha and the highest yield in control was obtained by ‘Siriana’ F_1 cultivar under 5200 m^3/ha , respectively 76.02 t/ha.

Organic fertilization increased total production of tomatoes in both irrigation regimes (30 to 79%), a more pronounced increase being observed in high water quantity which increased production in organic fertilized variant statistically significant ($p < 0.05$) at both doses of water compared to the control variants.

However higher values were obtained at the higher dose of water (‘Siriana’ – 64%, ‘Minaret’ – 79%, ‘HTP’ – 70% and ‘Inimă de bou’ – 43%), while increases in organically fertilized and small doses of water were lower (‘Siriana’ – 50%, ‘Minaret’ – 30%, ‘HTP’ – 36% and ‘Inimă de bou’ – 39%) (Fig. 1). Same results on the influence of the organic fertilizer and the irrigation regime were obtained by Gonzales and May, 1994; Stoleru *et al.*, 2007.

Conclusion

The research carried out in 2017 revealed that, within the range of tomatoes used, there are significant variations in morphological characters and production.

Cultivars react differently to technological factors on nutrition and irrigation regime.

The height of tomato plants is primarily determined by genetic factors, but within the

cultivar varies depending also on the fertilizer and the irrigation regime.

The highest number of fruits was achieved in 'HTP' F₁ cultivar under organic fertilization and 7800 m³/ha of water regime.

The highest yield was obtained in 'Minaret' F₁ and 'HTP' F₁ imported cultivars, under chicken manure fertilizer and high dose of water.

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