

RESEARCH ON THE FERTILIZATION OF TOMATOES UNDER PROTECTED CROP

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Abstract. *This article presents the influence of the fertilization methods on the production obtained from a culture of tomatoes located in a protected space. The experiments were organized in a solar belonging to the Vegetable discipline, located in the "V. Adamachi" Didactic Farm, in Iasi County. The aim of the research is to determine the influence of fertilization by irrigation, compared to the classical fertilization and the microorganism one. In this regard, after subjecting the plants to the three types of fertilizer, there were observed differences in the amount of tomatoes per hectare. The highest production, compared to the control one, was obtained by the Minaret cultivar, fertilized dropwise, which is of 111,421 kg / ha.*

Keywords: *fertigation, tomatoes, yield, tunnel.*

INTRODUCTION

Drip irrigation consists of distributing the water slowly, dropwise, to the roots of the plants and it is constant and continuous. This method of irrigation has a number of advantages, such as: enables the accurate dosing of the quantities of water and fertilizer for the plants, allows the automation of the process, reduces water consumption, increases production up to 100% and higher, reduces the occurrence of fungal diseases in the cultures by maintaining them at low atmospheric humidity rates, reduces the amount of weeds, thus the number of works in culture, allows performing works in the culture even during irrigation etc (Țenu, 2004, Ceașescu et al., 1984).

In order for the vegetable plants to absorb the necessary soil minerals, they consume an amount of water about 10,000 times greater than these substances (Grumeza and Drăgănescu, 1983). Fertigation refers to the injection of the fertilizer in the watering system. Through this method of

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fertilization, plants can receive the appropriate and recommended dosages, depending on the vegetative stage they are in, thus increasing or decreasing the amount of the fertilizer used (Snyder, 2000).

The aim of fertigation is to improve the availability of the nutrients in the wet ground, creating a reserve of nutrients proportional to the degree of culture assimilation. By fertigation, we can determine: the applied amount, the duration of the applications, the proportion of the fertilizer, the start and the end moment of the application. A fertigation system comprises the Venturi injector head control, the metering pumps, the fertilizer tank and the automatic timers.

Another factor for a successful dropwise fertilization is choosing the cultivar, that has to be suitable for the salt stress conditions. (Stoleru et al., 2012; Ciobanu et al., 2009)

MATERIAL AND METHOD

The research was conducted in a semicircular solar located in the Didactic Farm of "V. Adamachi " within USAMV Iasi, with an area of 270 m².

The studied plants belong to the Minaret F1 tomato cultivar, being grouped into four work versions (Table 1), in strips, the distance between the plants in a row being 80 cm and between the rows 60 cm, resulting in a density of 31,740 plants/ha. The protection experience strip was founded with tomatoes from the 1600 Buzău variety.

Table 1

Work versions (2015)

Current no.	Experimental version	Distance between strips (cm)	Distance between rows (cm)	Distance between plants in a row (cm)
1.	<i>Minaret tomatoes</i> x dropwise fertigation	80	60	45
2.	<i>Minaret tomatoes</i> x classic fertilization	80	60	45
3.	<i>Minaret tomatoes</i> x microorganism fertilization	80	60	45
4.	<i>Minaret tomatoes</i> x not fertilized (M)	80	60	45

In order to irrigate the plants, a dripping line, having the diameter of the strips of 16 mm and the distance between the droppings of 10 cm, was created.

To perform the experiments, a fertigation system was projected (Figure 1) within the disciplines of Agricultural Mechanization, composed of a fertilizer tank, an automatic watering scheduling system and a watering line.

The plants from the 1st version were fertilized dropwise, weekly, every 4 days, the fertigation being carried out in the morning. The fertilizer used was Nutrispore® - NPK (MgO) 10.30.10 (2), Boron (B), Iron (Fe), Manganese (Mn), Zinc (Zn), (PGPR) - 300 kg / ha, Nutrispore® NPK (MgO) 30.10.15 (2), Boron (B), Iron (Fe), Manganese (Mn), Zinc (Zn), (PGPR) - 425 kg / ha and NPK Nutrispore® 12-48 -8 (2) with Boron (B), Iron (Fe), Manganese (Mn), Zinc (Zn), (PGPR) - 400 kg / ha.

In order to obtain a better fertigation, plant nutrition was conducted in three stages.

1. In the first stage, the irrigation was carried out without fertilizers, which were introduced when the soil was moistened through the fertilizer tank.

2. In the second stage, the fertilizers were introduced into the fertilizer tank, along with 20 L of water. After mixing, the diluted solution has been introduced in the dripping water through the bus, thus showing proper fertigation.

3. In the third stage, the injection was stopped before the watering cycle was completed. The irrigation water allowed the fertilizer to be removed from the system.

The plants from the 2nd version were chemically fertilized with Cristaland® NPK 20-20-20, applied to the basic fertilization of 200 kg/ha, Cristaland® NP 15-50 + 2MgO in an amount of 250 kg/ha, applied in the stage of floral button (first inflorescence) and Cristaland® NPK 9-18-27 + 2 MgO, applied in the first blossom fruit phenophase (3cm), in an amount of 200 kg/ha.

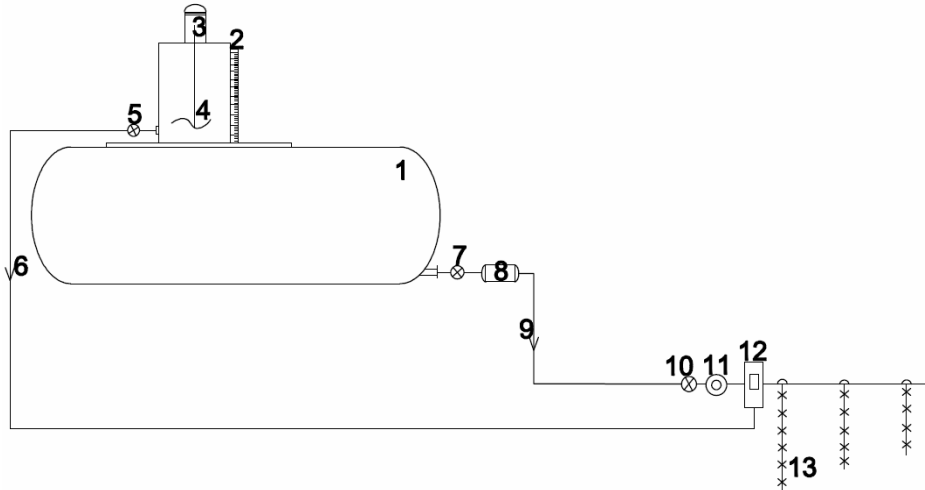


Fig 1. Fertigation system scheme

1 - water pool; 2- graduated beaker; 3- electric motor; 4 - rotating mixing paddle; 5 - way valve; 6 - water hose with fertilizing solution; 7 - pass valve; 8 - filter; 9 - water hose; 10 - pass valve; 11 - water meter; 12 - developer; 13 - dripper watering band.

The plants from the 3rd version were fertilized with fertilizers based on Micoseed® MB microorganisms, in an amount of 60 kg/ha, applied in order to prepare the ground, 2-3 days before planting the tomatoes. According to the specialty literature, Micoseed MB is a fertilizer based on *Glomus* sp., *Beauveria* sp., *Metarhizium* sp. and *Trichoderma* sp. (Stoleru and al., 2014).

During the growing season, these plants have been fertilized twice with Nutryaction® at 5 L / ha.

The plants from the 4th version (the control version) were irrigated by dripping, at the same time with the plants from the 1st version, using the same water, in the same amount.

Weekly biometric measurements were performed, which determined the dynamics of the plant growth, depending on the version, aiming the plant's height, the number of inflorescences and the related flowers/ fruits.

The tomato plants were cared for according to the data of the specialty literature (Ciofu et al., 2004; Indra and al., 2003). Experimental data processing was performed using the analysis of the version (ANOVA), by calculating the limit differences (Săulescu and Săulescu 1967).

RESULTS AND DISCUSSION

The dynamics of the tomato plant height in 2015 is shown in Table 2. During the experiments, there were conducted seven biometric measurements every 7 ... 10 days, beginning with the third week after planting. The F1 Minaret tomato cultivar shows a semi-determinate increase, being used for two crop cycles. It presents an average height of 81.2 cm.

Table 2

The dynamics of the tomato plant height (cm)

Date vers. Exp	13.05. 2015	26.05. 2015	3.06. 2015	10.06. 2015	18.06. 2015	25.06. 2015	2.07. 2015	Average hight
V1 (fertig.)	46,6	68,0	76,2	84,6	91,4	101,0	108,2	82,3
V2 (cl. fert.)	46,0	58,2	69,2	79,6	87,2	94,0	95,8	75,7
V3 (m.o.o.)	44,8	59,6	73,4	80,2	87,0	95,6	95,6	76,6
V4 (control)	71,8	79,8	86,4	92,4	96,8	100,2	104,8	90,3
Mean	52,3	66,4	76,3	84,2	90,6	97,7	101,1	81,2

From Figure 2 we can see that the Minaret hybrid shows an upward increase of the plant height until early July, after which the growth of the plants ceases. At the beginning of the growing season (13.05. and 26. 05.), the highest values of plant height were obtained in the V4 version (the control version).

From the data we find in Table 2 we can say that, in the case of the fertilized versions, the plant height was lower at the beginning of the growing season, as the fertilizers used increased the salt nutrient content in the soil, thus the plants had a lower growth dynamics. In the second half of the growing season, we can see that V1 recorded the highest increase in the height of the tomato plants (108.2 cm).

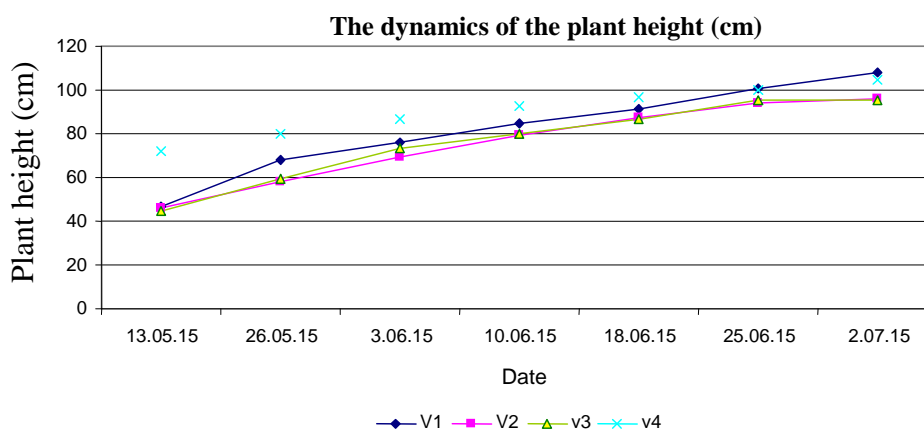


Fig. 2. The plant height dynamics diagram

The results concerning the dynamics of the tomato plants are shown in Table 3. The average number of inflorescences varied between 3.45 (V4) and

4.00 (V1), which shows that the fertigation version ensures the best distribution of the mineral elements in time and space.

The average number of fruits per plant ranged from 11.20, in the classic fertilized version V2, up to 15.34, in the fertigation version, V1. Average values that were close to version 2 have been completed in the control version, V4 (11.78) also.

Table 3

The results concerning the development dynamics of the tomato plants

Experimental version	Number of inflorescences	Number of fruits	Average weight (g)
V1	4,00	15,34	228,80
V2	3,68	11,20	228,20
V3	3,91	12,54	248,00
V4	3,45	11,78	209,00

Regarding the average weight of the Minaret tomato fruits, we can say that it ranged from 209 g in V4, up to 248 g in V3.

In the classic fertilized version, the average fruit weight was about 228 g, which indicates that the chemical fertilization favors the earliness of the fruits.

The results concerning the tomato production in 2015 are shown in Table 4. The production of tomatoes in the experiment ranged very widely, from 78,173 kg/ha in the control version, up to 111,422 kg/ha in the fertigation version.

The difference of 33,249 kg/ha, compared to the control version, is considered to be very significant. A significant difference was also achieved in the microorganism fertilized version, the difference being of 20,558 kg/ha.

Table 4

The results concerning the tomato production (2015)

Experimental version	Total production, kg/ha	Relative production, %	Difference to the control version	Differential significance
V1	111422	142,5	33249	xxx
V2	81120	103,7	2947	-
V3	98731	126,2	20558	xx
V4	78173	100	0	-

DL 5 % = 9.136 t/ha; DL 1 % = 14.398 t/ha; DL 0,1 % = 21.438 t/ha

The classic fertilized version, V2, has made a difference to the control version of 2947 kg/ha, which is considered to be insignificant.

CONCLUSIONS

1. At the beginning of the growing season, the highest values of plant height were obtained from version V4 (the control version), 79.8 cm, while in the second half of the growing season the highest increases of the height of tomato plants, of

108.2 cm, were recorded in V1.

2. The average number of fruits per plant varied from 11.20 in the classical fertilized version V2, up to 15.34, in the fertigation version, V1.

3. The average weight of the Minaret tomato fruits ranged from 209 g in V4 (the control version) to 248 g in V3 (microorganism fertilization).

4. The tomato production in the experiment ranged from 78,173 kg/ha in the control version, up to 111422 kg/ha in the fertigation version, which means that the fertigation version provides the best distribution of chemical fertilizers in time and space.

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