RESEARCHES REGARDING THE FERTIGATION THROUGH DRIP IRRIGATION OF SOLARIUM BELL PEPPER CROP

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Summary. *The paper presents some aspects concerning the effect of fertilization factors and drip irrigation over the production level of the bell pepper crop placed in a protected environment. The experiments took place in a solarium from "V. Adamachi"Didactic Farm. The aim of the research was to asses the influence of the fertilization method, when using classic fertilizers and microorganism based fertilizers, simultaneously with drip irrigation. Significant differences regarding the production levels were noticed when the crop was fertilized using the three methods and drip irrigation. The highest production level compared with the control variant (43.885 kg / ha) was obtained for the drip irrigation fertilization method.*

Keywords: *fertigation, bell pepper, harvest, solarium.*

INTRODUCTION

Fertigation achieves fertilization in the same time with irrigation by injecting exact quantities of fertilizers into water; through this method the plants receive the appropriate quantities of fertilizer, depending on the growing stage. A fertigation system contains the aspersion or drip irrigation installation and the devices for injecting the liquid fertilizer into water, including tanks for the concentrated liquid fertilizer, dosing pumps or automatic programmers and an ejector or Venturi type homogenizing device (Ţenu, 2004*)*.

In order for the vegetable plants to absorb the necessary soil minerals, they consume an amount of water about 10,000 times greater than the amount of these substances (Grumeza and Drăgănescu, 1983).

Drip irrigation is characterized by the slow, drop wise distribution of water through a network of valves, pipes, tubes and emitters, in the root area of plants, thus wetting only a part of the soil surface and of the root system (Ţenu 2004; Hoble, 2010). Drip irrigation was used in ancient times by the burial in soil of clay pots filled with water, allowing its gradual infiltration into the soil.

Modern drip irrigation has its early development in the 1860s Germany, when researchers began experimenting using clay pipes in order to create

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combined irrigation and drainage systems (Reinders, 2007).

Bell pepper (Capsicum annuum L.) is a nutritious plant, mainly due to the high content of vitamin C (150-300 mg/100g) and carotenoids (1.8 to 4.5 mg/ 100g) (Hoble, 2010).

Pepper has high demands for water during the growing season due to a poorly developed root system and to the abundant biomass, strongly exposed to perspiration (Tanaskovik, 2013). In the case of bell pepper the amount of fertilizer has a distinct significant influence over the differences in the total yield (Stan et al.).

Another key factor for a successful fertigation is the choice of the cultivar, which has to be suitable for the salt stress conditions (Stoleru et al., 2012; Ciobanu et al., 2009).

MATERIAL AND METHOD

The researches were conducted in a semicircular type solarium farm with an area of 270 m^2, located within the "V. Adamachi" Didactic Farm of USAMV. Two experiments were organized within the solarium area, for two different vegetable species, respectively tomatoes and pepper, alternatively positioned in the same number of variants (fig. 1).

The studied plants belong to the *Brillant F1* bell pepper cultivar, grouped into four experimental variants (Table 1), on 80 cm spaced bands, with a distance of 60 cm between the rows per band and a distance of 45 cm between the plants in a row, resulting in a density of 31,740 plants/ ha. The same hybrid, but unfertilized, was used for the protective band of the experiment.

Table 1

Experimental variants (2015)

Experimental variant	Fertilization method
v_1	Drip fertigation with soluble fertilizers
v_2.	Classic fertilization, through soil spreading
v_3.	Microorganism fertilizer spread on the soil surface
v_4.	Unfertilized (M)

A dripping line was used for plant irrigation; the watering bands had a diameter of 16 mm and a distance of 10 cm between the individual drippers. An equivalent quantity of water of 5200m^3/ha was administered during the entire vegetation period; the irrigation was performed every two days, 2 hours/day, between 8 am and 10 am or between 7 am and 9 am, depending on the temperature.

The fertigation system consists of a constant level water tank (20 tons), a tank for the concentrated fertilizer solution, an automatic programming system and watering lines (fig. 1).

The plants in variant 1 were fertilized simultaneously with the drip irrigation, twice a week, the fertigation being carried out in the morning. The fertilizer 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; NPK Nutrispore® 12-48 -8 (2) with boron (B), iron (Fe), manganese (Mn), zinc (Zn), (PGPR) - 400 kg / ha.

In order to obtain the best fertigation possible plant nutrition was achieved twice a week, between two consecutive irrigations.

For variant V_2 the chemical fertilizer was spread around each plant as follows: 200 kg/ha Cristaland® NPK 20-20-20 for the base fertilization; 250 kg/ha Cristaland® NP 15-50 + 2MgO in the phase of floral button (first inflorescence); 200 kg/ha Cristaland® NPK 9-18-27+ 2 MgO in the forming of the first fruits of the inflorescence phenophase (Ø 3 cm).

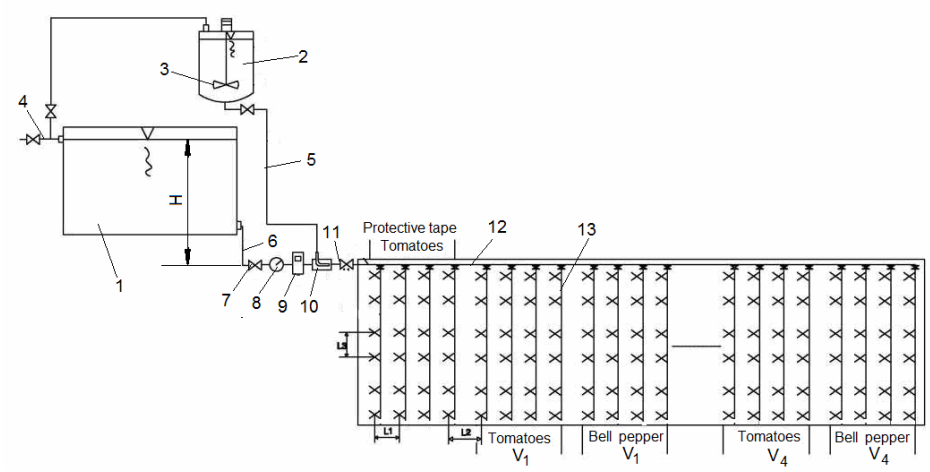

Fig 1. Experimental setup

1- water pool; 2- graduated cylinder; 3- electric motor; 4 - rotating mixing paddle; 5, 7, 10 - valves; 6 - hose with fertilizing solution; 8 - filter; 9 - hose; 11 - water meter; 12 - programmer; 13 - dripping watering band; L1 – distance between rows within the band; (60 cm); L2 – distance between the bands (80 cm); L3 – distance between the plants in a row (45 cm).

The plants in variant 3 were fertilized with the microorganism type fertilizer Micoseed® MB, in quantity of 60 kg/ha applied during tillage, 2-3 days before planting the peppers. According to the literature data Micoseed MB is a fertilizer based on *Glomus sp., Beauveria sp., Metarhizium sp. and Trichoderma sp.* (Stoleru et al., 2014). For this variant two fertilizations with Nutryaction® (5 L/ha) were applied during the growing season, aiming to boost the biological activity).

Drip irrigation was applied to the control variant V_4, in the same conditions as the ones for variants V_1, V_2 and V_3.

Biometric measurements (plant height and the number of flowers/fruits) were performed weekly, aiming to evaluate the plant growth dynamics for each variant.

The pepper plants were cared for in accordance with the literature data (Ciofu et al., 2004; Indra et al., 2003). Experimental data processing was performed using the analysis of variance (ANOVA), in order to calculate the limit differences (Săulescu and Săulescu 1967).

RESULTS AND DISCUSSION

The dynamics of the bell pepper plants height in the year 2015 is presented in Figure 2. Seven biometric measurements were performed during the experiments, every 7 ... 10 days, beginning with the third week after planting. The *F1 Brillant* bell pepper cultivar displayed an indeterminate increase, being used

for two crop cycles. The average height obtained from the measurements was 43.15 cm.

Figure 2 shows that the height of the *F1 Brillant* hybrid increased until the beginning June, after which the plant growth ceased. At the beginning of the growing season (26.05), the highest values for the plant height - 35.6 cm - were obtained for variant V_3 (microorganisms).

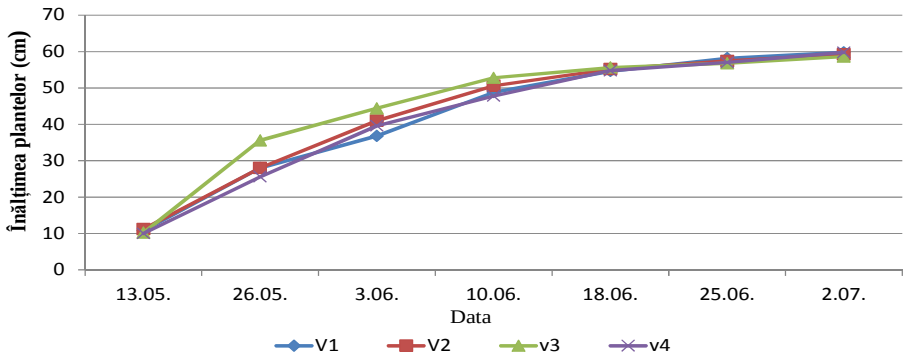

Fig. 2. Plant height dynamics

The data presented in Figure 2 show that the control variant V_4 recorded lower heights of the plants at the beginning of the growing season compared with the fertilized variants. In the second half of the growing season the highest increases in the height of the pepper plants (59.8 cm) were recorded for V_1 (fertigation) and V_4 (unfertilized).

The results concerning the dynamics of the pepper plants are shown in Table 2. The average number of fruits per plant ranged from 10.06 in the control variant (V_4) to 13.31 in the fertigation variant (V_1). Average values close to the one recorded for V_1 (12.60) were achieved by the microorganism variant, V_3

Table 2

Results regarding the dynamics of the sweet pepper plants

Experimental variant	Average number of fruits per plant	Average fruit weight (g)
V_1	13,31	104,30
V_2	11,77	95,05
V_3	12,60	118,85
V_4	10,06	105,55

The average weight of the *Brillant F1* bell pepper fruits ranged from 95.05 g (for V_2, classic fertilization) to 118.85 g (V_3, fertilized with microorganisms).

The results concerning the pepper production in 2015 are shown in Table 3. The production of pepper in the experiment varied within wide limits, from

29.048 kg/ha in the control variant (V_4), to 43.885 kg/ha in the fertigation variant (V_1).

Table 3

Results regarding the production of sweet peppers (2015)

Experimental variant	Total production, kg/ha	Relative production, %	Difference from the control variant (kg/ha)	Differential significance
V1	43,885	151,07	14,837	***
V2	32,785	112,86	3,737	*
V3	29,164	102,39	116	ns
V4 (M)	29,048	100	0	ns

DL 5 % = 3719 t/ha; DL 1 % = 5831 t/ha; DL 0.1 % = 9321t/ha

The difference of 14.837 kg/ha between variant V1 and the control variant was considered to be very significant. A significant positive difference (3737 kg/ha) was also achieved in the classically fertilized variant. The difference for the microorganism fertilized variant V_3 (116 kg / ha) was considered to be insignificant.

CONCLUSIONS

1. At the beginning of the growing season, the highest values of the plant height were obtained for the V_3 version (microorganisms), respectively of 35.6 cm; in the second half of the growing season, the greatest increases of the height of the pepper plants (59.8 cm) were recorded variants V_1 (fertigation) and V_4 (unfertilized).

2. The average number of fruits per plant ranged from 10.06 in the control variant, V_4, to 13.31 in the fertigation variant, V_1. Average values close to the ones for variant 1 were achieved by the microorganism fertilized variant, V_3 (12.60).

3. The average mass of the *Brillant F1* pepper fruits ranged from 95.05 g in variant V_2 (classically fertilized) to 118.85 g in variant V_3 (fertilized with microorganisms).

4. The pepper production was ranged between 29.048 kg/ha (control variant, V_4) and 43.885 kg/ha (fertigation variant, V_1); this indicates that the variant using fertigation achieved a better distribution, in time and space, of the fertilizer towards the root system and that the fertilizer was uniformly distributed during the growing season.

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