COMPARATIVE STUDY REGARDING THE EFFECT OF TWO GROWTH STIMULATORS ON PRODUCTION AND SOME BIOCHEMICAL PARAMETERS AT TOMATO FRUITS

STUDIU COMPARATIV PRIVIND EFECTUL UNOR BIOSTIMULATORI ASUPRA PRODUCȚIEI SI VALORILOR UNOR PARAMETRI BIOCHIMICI LA FRUCTELE DE TOMATE

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Abstract. *The paperwork presents comparative aspects of the obtained production values, as average data of two consecutive years, at Buzău 1600 tomato breed. The applied treatments included two growth stimulators from the synthetic auxins' class, subclass phenoxy-alkyl-carboxylic acids, from group IV of toxicity applied in two dilutions, selected after preliminary tests. There was also observed the aspect of fruit quality, by determining some parameters for the treated variants compared to the control. The obtained results show a significant production increase for all the treated variants compared to the control, even if one of the observation years had severe climate conditions during the vegetation period. There were observed clear positive differences in the fruits' aspect and structure, without significant differences of the biochemical parameters' values for the treated fruits in detriment of quality.*

Rezumat. *Lucrarea prezinta aspecte comparative asupra valorilor producției obținute , ca medie a doi ani consecutivi, la tomate din soiul Buzău 1600. Tratamentele efectuate au inclus doi biostimulatori din clasa auxinelor sintetice, subclasa acizilor fenoxialchil carboxilici, din grupa a IV-a de toxicitate, aplicați în două diluții selectate în urma unor teste preliminare. S-a urmărit deasemeni şi aspectul calității fructelor obținute, prin determinarea unor parametri biochimici la variantele tratate față de martor. Rezultatele obținute arată creşterea semnificativă a producției la toate variantele tratate față de martor, chiar daca unul din anii de observații a avut condiții climatice deosebite în perioada de vegetație. S-au observat diferențe pozitive clare în aspectul şi structura fructelor, fără ca parametrii biochimici măsurați să difere la fructele tratate în detrimentul calității.*

The experimental data presented here are part of a more extended study on the effects of two growth stimulators (2-chloro, 4-amido-sulphonic phenoxy acetic acid, sodium salt – substance A - and 4-chloro, 2-amido-sulphonic phenoxy acetic acid, sodium salt – substance B) on tomato plants, from the rooting process to fruit production. Even if the positive effects were observed in all stages of development, the most evident results consist in the productivity and fruit quality parameters.

MATERIAL AND METHOD

The tomato breed used in this study was Buzău 1600, created in 1972 at Buzău Center for Vegetables Research. The fruits obtained from this breed are spherical, light red when reaching maturity and of 190 – 260 g. The maturation is gradual, uniform distributed in the interval August-September and there can be obtained 70 – 90 t fruits /ha in multi-belt culture, for a density of 40,000 plants per ha.

The fruits are fleshly, with a pleasant, well-balanced taste and a dry matter content of 5.6 – 6.1%. This breed can be cultivated in all favorable and very favorable zones for tomato cultures.

The treatment variants were chosen after a preliminary dilution test which determined the first two growth stimulator's concentrations for each of the two substances. These four dilutions were compared to a control variant. For both substances (2-chloro, 4-amido-sulphonic phenoxy acetic acid, sodium salt and 4-chloro, 2-amido-sulphonic phenoxy acetic acid, sodium salt) there were chosen the dilutions of 20 and 25 ppm in leaf application and for the control, distillated water was used. The treatment was applied twice, the first time before the flowers blossomed and second time before fruit apparition. Sodium salts were used for both acids in order to increase solubility and absorption rate.

Besides measuring the fruit production as average value for two consecutive years, in t fruits/ha, there were also determined some biochemical parameters for the tomato fruits: humidity and dry matter content, ash content, reductive and total sugar content and ascorbic acid content. The methods used for determining these parameters are briefly listed below.

1**. Humidity and dry matter content.** Measuring the water quantity contained by tomatoes is indispensable for any further analysis; the usual expression of the chemical composition is always based on dry matter or on the substance with a precise humidity. We measure the weight loss when heating the sample up to 105°C.

The weight loss is expressed in percentages and it is considered as the sample's humidity:

$$\%\,U = \frac{G - G_1}{G} \times 100$$ where:

U - humidity (%);
G – sample weight (g);
G_1 - dry sample weight (g).

The difference (100 – U) represents dry matter at 105^0C, expressed in percentages, compared to the wet sample ( ).

2. Ash content. By heating in air at over 400^0C, dry vegetal matter is oxidized and transformed in mineral volatile substances (CO_2, H_2O, N_2) and in mineral fix substances – vegetal ash. The vegetal matter is incinerated until the constant weight of the obtained ash. The ash content is expressed in percentages compared to air dried matter or compared to matter dried at 105^0C.

The relation for calculating the ash content is:

$$\%\,A = \frac{m_1}{m} \times 100$$ where:

A – ash content (%);
m – ash weight (g)
m_1- dry sample weight (g).

3. Reductive and total sugars content. A) Reductive sugars. In order to determine the reductive sugars content the following operations are required: - sugars extraction; - the separation of the proteins, vegetal pigments, organic acids etc. from the sugar solution; - the actual determination. Schoorl method was used for all these steps. The reductive sugars reduce, at temperature, Cu $(OH)_2$ to Cu_2O. The excess of copper (II) oxidizes KI to I_2, which reactions with $Na_2S_2O_3$. The quantity of $Na_2S_2O_3$ for each sample is in fact a difference between the quantity of $Na_2S_2O_3$ consumed by a control sample and the quantity of $Na_2S_2O_3$ consumed by the analyzed sample.

In accordance with the consumed quantity of $Na_2S_2O_3$ we determine the quantity of reduced copper and after that, from the tables, the quantity of reductive sugar, expressed in glucose, fructose etc.

B) Total sugars. To determine the total sugar content we have to hydrolyze the non-reductive sugars from the sample extract, for example by treating it with hydrochloric acid. After that, the actual sugar determination can be made by gravimetrical, volumetrical, refract-metrical or polar-metrical methods.

The relation for calculating the reductive and total sugars content is:

$$\text{Glucose\%} = 100 \cdot B/M \quad , \quad \text{where}$$

B – the quantity (in mg) of sugar corresponding with the reduced copper (in mg), from the tables:

M – the quantity of solid vegetal material corresponding to analyzed sample volume.

The percentage of the non-reductive sugars is represented by the difference between the total sugars content and the reductive sugars one.

4. Ascorbic acid content. The chemical quantitative methods for determining the ascorbic acid content are based on its reductive action. In the method used for these analyses, the ascorbic acid has the property to reduce 2,6-dichlorophenol-indophenol (Tillmans reactive) to its hydrogenated derivative.

The extract obtained from the fresh vegetal material is treated with Tillmans reactive and the results are compared to a control sample. The ascorbic acid content, expressed in mg per 100 g vegetal material is calculated with the following expression:

$$\text{Vit.C} = \frac{V_0 - (V_1 + V_2) \times V_3 \times C}{V_4 \times m_0} \times 100 \quad \text{(mg/100g), where:}$$

m_0 = the quantity of the solid analyzed sample (g);

C = the mg of ascorbic acid corresponding to 1 ml solution of Tillmans reactive;

V_0 = the volume of Tillmans reactive solution used for sample treatment (ml);

V_1 = the volume of Tillmans reactive solution used for control sample treatment (ml);

V_2 = the volume of Tillmans reactive solution used for reductive substances treatment (ml);

V_3 = total volume of the sample extract (ml);

V_4 = the volume of the sample's acid extract (ml).

RESULTS AND DISCUSSIONS

In what regards the average values of the production for two consecutive years of experiments, expressed in tones/ha, the obtained results in the comparative calculus show differences of 13.7 – 47.3 t/ha for the treated variants compared to the control.

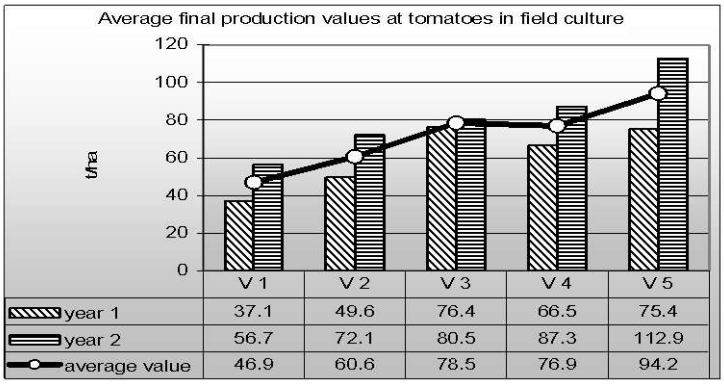

Fig.1 - Average final production values related to the treatment variant

Table 1.

The influence of the applied treatment on the final average production value

Variant	Average production	% compared to the control	Differences	Significance
5	94.2	200.85	47.3	xx
3	78.5	167.38	31.6	x
4	76.9	163.97	30.0	x
2	60.9	129.85	14.0	
1	46.9	100.00	0.0	Control
DL 5% : 23.3 t/ha DL 1% : 38.6 t/ha DL 0.1 % : 72.2 t/ha				

Analyzing the data regarding the production for tomatoes in field culture in the first experimental year, for 40,000 plants/ha, there were observed significant production increases compared to the control and to the breed's productive potential. The variant V_5 treated with substance B (20 ppm) had a constant better evolution and over passed the breed's potential with 24,44 %.

In the second experimental year, there were obtained better results for the treatment with substance A (20 ppm) – 76,4 t/ha (V_3). Although the production did not over passed the breed's potential, still, considering the unfavorable climate conditions of that year, there was observed that at this variant a double production was obtained, compared to the control (37,1 t/ha).

As average value for both experimental years regarding production for a surface cultivated with 40,000 plants/ha, the final production varied between 46,8 t/ha for the control and 94,2 t/ha for the variant treated with substance B (20 ppm) that gave the best results.

In what concerns the influence of the applied treatment on the studied biochemical parameters, there were no significant differences between the samples. The dry matter content had the biggest value for the variant V_4, treated with substance B (25 ppm) and the smallest value was obtained at variant V_3, treated with substance A (20 ppm), smaller even that the **control's.**

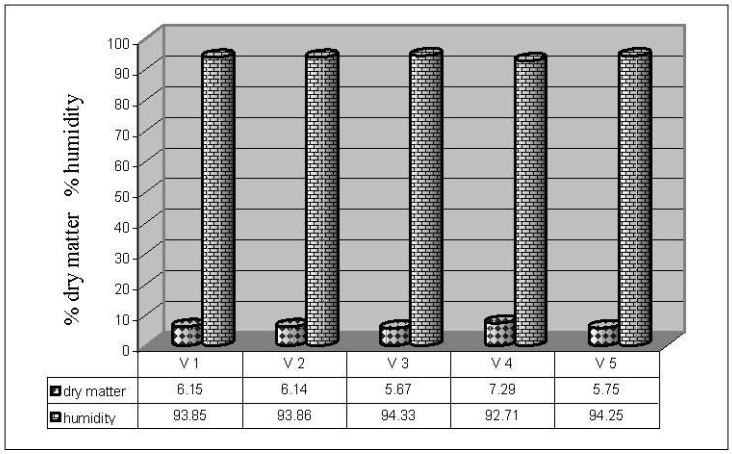

Fig. 2 - Dry matter and humidity values for tomatoes related to applied treatment

The reductive and total sugars' content was tested with standard Schoorl method. The obtained results showed slightly increases for the variants V_3 (substance A – 20 ppm) and V_5 (substance B – 20 ppm) compared to the control. The biggest value was registered at both categories for variant V_2 (substance A – 25 ppm) – 7.92 g glucose/100 g for reductive sugars and respectively 10.56 g glucose/100 g for total sugars. Even if no significant increases were noticed, yet the values were no smaller than the control's. Only one variant had the same values for both sugar types determined in the analysis.

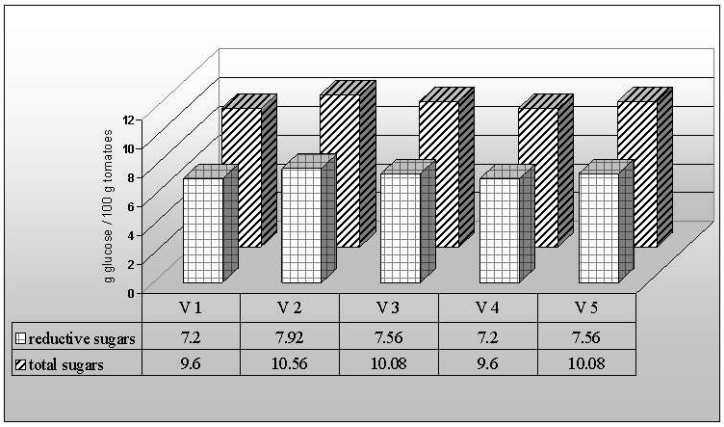

Fig. 3 - Reductive and total sugars' values for tomatoes related to applied treatment

For the ascorbic acid's content, all variants had smaller values than the control, but still no significant decreases were registered. From all four variants, V_4 (substance B – 25 ppm) had the biggest value and variant V_2 (substance A – 25 ppm) had the smallest one.

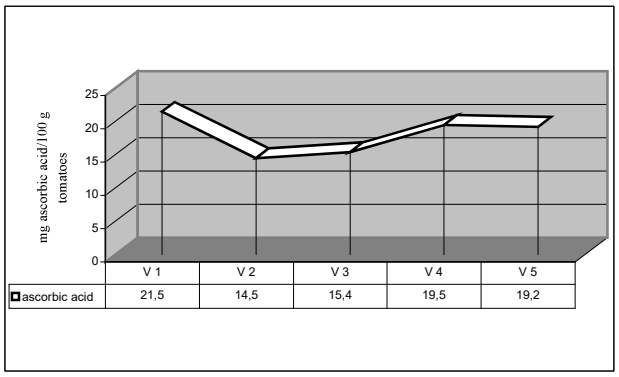

Fig. 4 - Ascorbic acid contents for tomatoes related to applied treatment

CONCLUSIONS

1. There are significant differences between untreated tomato plants and the ones treated with the two growth stimulating substances. Both in optimal or critical climate conditions, the treatments with these two substances in dilutions of 20 and 25 ppm lead to remarkable increases of the production at tomatoes in field culture, with differences of 13,7 – 47,3 t/ha compared to the control variant.

2. From direct observations on tomato fruits harvested from the treated variants, these are bigger, in larger numbers on each plant and have a wrinkled aspect in the attach point area. Also, there was noticed an increase of the pulp ratio, very important for the industrial conditioning of these fruits.

3. From the analyzed biochemical parameters' study, a slightly increase of the reductive and total sugars content is noticed for the tomatoes harvested from the treated variants compared to the control, as well as a small decrease for the ascorbic acid content with 2 – 7 mg/100 g tomatoes.

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