Scientific Papers. Series B, Horticulture. Vol. LXVIII, No. 1, 2024
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

A RESEARCH ON THE USE OF ORGANIC FERTILIZERS APPLIED TO TOMATO PRODUCTION

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Abstract

Studies have been conducted with regard to the way in which the elements of tomato field crop yield are influenced by the application of supplementary fertilization with organic fertilizers obtained only from natural ingredients. The organic material used was TAMARIS F1, an early tomato hybrid, recommended for greenhouse, solarium and field palisade cultivation. Based on the analysis of the experimental variants, it was found that the variant additionally fertilized with Plantella Bio had an average fruit weight ranging between 170-180 g, with a yield of 40 t/ha as compared to the control variant where the average fruit weight was between 130-140 g and the yield was 28 t/ha,. Consequently, there was a 30% higher yield in the variant fertilized with Plantella Bio than in the reference variant.

Key words*: Plantella, Agrecol, Tamaris, hybrid.*

INTRODUCTION

The research focused on the application of plant beneficial microorganisms to partially replace the use of chemical fertilizers is on the rise due to the requirement of sustainable agricultural development (Lin Ye et al., 2020) and studies have found that inoculation with selected native rhizobacteria has increased the quality of tomato seedlings; they can be used as bio-inoculant to achieve integrated nutrient management (María Micaela Pérez-Rodriguez et al., 2020). Application of organic fertilizers to the cherry tomato crop has increased the microbial biomass and improved nutrient movement, such as nitrogen movement activity and phosphorus movement activity (Takamitsu Kai et al., 2020). Application of compost-based fertilizer (derived from corn, cassava hulls and poultry manure) increased fruit yield by 145% compared to the control variants (Lateef Bamidele Taiwo et al., 2007). Organo-mineral fertilizers are a combined source of nutrients that can be effectively used to increase the long-term productivity of the tomato plant. (Adama Traore et al., 2022)

When compared to other vegetables such as cabbage and potatoes, tomatoes contain significant amounts of protein and carbohydrates and small amounts of fibre. In the US, tomatoes are a very important vegetable, whereas in Germany tomato consumption is no higher than cabbage consumption (Nillson T., 2005). The high value of tomatoes also lies in the fact that this vegetable is consumed very much in its raw state, so that the vitamins and mineral salts it contains are almost entirely used by the body. In terms of dietary value, the main points of interest are the sugar content (around 3-4%), vitamin C (20-60 mg per 100 g) and vitamin A (2-6 mg), and less so the energy value, which is quite low (176 calories) compared to other foods. We should not overlook the favourable proportion of amino acids and organic acids found in tomato fruit, as well as the magnesium, sodium, potassium and iron salts which are also found in an appropriate percentage for the proper functioning of the human body.

Nowadays, there is a great demand for environmentally friendly agriculture, for the production of quality and healthy food to feed the continuously growing population. (Pradeepa Jayasinghe, 2016) and in this context research has shown that the application of poultry manure has greatly increased the production and quality of fruit and chemical nitrogen fertilizers could be largely replaced with poultry manure (Yang Tao et al., 2022).

Research shows that the combined application of chemical fertilizers with organic fertilizers, specifically manure, stimulates plant growth, increases tomato yield and improves soil fertility in clay-textured soil. (Muhammad Hasnain et al., 2020). Studies have also shown that following organic fertilization, the quality of tomato fruit is superior, with increased lycopene content (Dimitrios Bilalis et al., 2018).

In the current context of environmentally friendly agriculture where it is recommended to reduce the use of chemical fertilizers and pesticides, we aimed, by this paper, at finding environmentally friendly alternatives to fertilize tomato crops. The hypothesis that we started from is to demonstrate that organic fertilizers depending on their chemical composition can influence differently the growth and fruiting of tomato plants and the novelty of the research is related to the use of an organic fertilizer Bio Plantella with seaweed extract as main component.

MATERIALS AND METHODS

The biological material used was the hybrid TAMARIS F1, produced by Clause Vegetable Seeds, an early tomato hybrid, recommended for greenhouse and solarium cultivation as well as for field, palisade cultivation. It has a high resistance to diseases and pests and a good tolerance to adverse conditions.

Three organic fertilizers have been used: Plantella Bio Organik produced by Unichem Slovenia, which is a long-lasting universal organic fertilizer made from poultry compost and comes in pellets. It improves soil fertility and increases soil yield and contains : N - 5%; P - 3%; K - 2%; CaO - 9%; MgO - 1% and microelements: B, Cu, Fe, Mn, Mo, Z. The second fertilizer was Bio Plantella produced by Unichem Slovenia, in liquid form, with the main component being seaweed extract (*Ascophyllum nodosum*), added vitamins, natural hormones and a mix of nutrients, amino acids, carbohydrates. The third fertilizer used was Agrecol organic vegetable fertilizer produced by the Polish company Agrecol Sp. z.o.o. high quality granular fertilizer with chemical composition nitrogen (N) - 6%, phosphorus (P2O5) - 5%, potassium (K2O) - 10% and magnesium (MgO) - 4%, ideal for soil preparation before sowing and planting.

The experiment had 4 variants, each variant with 3 repetitions, randomly assigned. In all variants, the basic fertilization was based on manure at a dose of 40 t/ha, the control variant was fertilized only with manure and in the other 3 variants Plantella Bio Organik, Bio Plantella and Agrecol legume were applied, these fertilizers were applied several times during the growing season, at an interval of 2 weeks between applications, making a total of 7 applications.

The research methods used were quantitative methods by means of which we were able to determine to what extent the use of different fertilizers based on natural ingredients influences the process of plant growth and the size of productivity elements.

For this purpose, measurements were made on the development of plant height by means of a tape measure every 10 days. The measurements also focused on the average number of fruits per plant by counting and on the average fruit weight by weighing.

RESULTS AND DISCUSSIONS

The tomato crop was planted on May 12, 2019, on a vermic, phreatic, moist, moderately carbonate chernozem soil overlaying loess, clay loam soil type in Ciocile commune, Chichinetu village, Braila county, using 67 days old seedlings, employing the following planting scheme: 75 cm between rows and 30 cm between plants per row. The purpose of the observations was to determine the influence of fertilization with products obtained from natural ingredients on the elements of productivity in the tomato crop grown in the field.

In terms of climate, during the growing season, rainfall was below the multiannual monthly average, except in June, when rainfall was above the multiannual monthly average. From a temperature point of view, during the entire growing season, the average monthly temperatures were above the multiannual monthly average.

As different growth rates of tomato plants were observed after fertilizer application, determinations were made on the evolution of plant height, the results of which are shown in Figure 1.

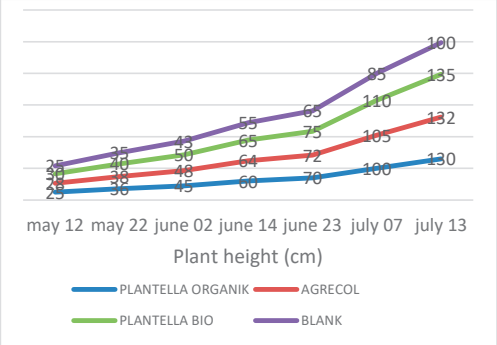

Figure 1. The evolution of plant height in the analyzed variants

From the graphical representation presented in Figure 1, it can be observed that among the organic fertilizers used compared to the variant fertilized only with manure, the most significant increases were recorded in the variant fertilized with Plantella Bio fertilizer. Thus, the plant height was 135 cm compared to only 100 cm for the control variety fertilized only with manure in the basic fertilization.

According to the graphical representation shown in Figure 2, the number of fruits per plant is also higher in the Plantella Bio fertilized variety than in the exclusively manure fertilized variety by 40%. The main component of this fertilizer is seaweed which strengthens the root system of the plants, ensures healthier plant growth and richer flowering.

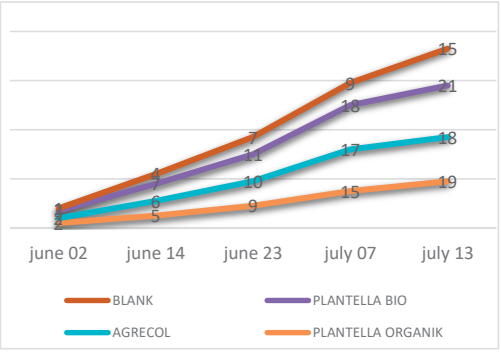

Figure 2. The evolution of the number of fruits per plant in the analyzed variants

Based on the reported results, it can be concluded that when compared to the control variant, which was fertilized only with manure, in the experimental variants analyzed there is a positive correlation between the plant height and the number of fruits per plant, thus, the variant fertilized with Plantella Bio delivered 21 fruits per plant, against only 15 fruits in the control variant, the variant fertilized with Plantella Bio being also the tallest plant, specifically 135 cm, which indicates that the stimulation of growth is also reflected in the stimulation of fruiting.

The productivity elements defined were the average number of fruits per plant, the average fruit weight and the average yield per plant.

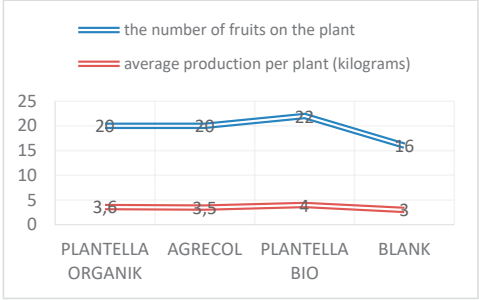

Figure 3. The correlation between the average number of fruits per plot and the weight of fruits per plant (kilograms)

Figure 3 shows that the yield per plant was 1 kg higher in the Plantella Bio fertilized variant than in the control variant, whereas, in the Plantella Organic fertilized variant, the difference compared to the control variant, was 0.6 kg/plant while in the Agrecol vegetable fertilized variant, the difference was 0.5 kg/plant.

As regards the determination of the average weight of tomato fruits and production, the results obtained show that the average weight of the fruits in the Plantella organic fertilized variety was 180 grams and the production was 40.33 tons per hectare compared to only 130 grams and 28.10 tons per hectare in the variety fertilized only with manure.

In order to see if the differences recorded between the variants analysed are statistically assured, we used the statistical analysis program JASP, the analysis of the variants was carried out using the ANOVA test, the results of which are shown in Table 1.

Given that $p<0.001$ is below the 0.05 significance threshold, the difference is highly significant (99.9% significance threshold), the coefficient of variation values are reported in Table 2.

Table 1. ANOVA - Production

Cases	Sum of Squares	df	Mean Square	F	p
Variant	249.389	3	83.130	1017.915	<0.001
Residuals	0.653	8	0.082		

Note. Type III Sum of Squares TyIIISum

Table 2. Descriptives - Production

Variant	N	Mean	SD	SE	Coefficient of Variation
AGRECOL	3	32.000	0.200	0.115	0.006
BLANK	3	28.100	0.200	0.115	0.007
PLANTELLA BIO	3	40.333	0.473	0.273	0.012
PLANTELLA ORG	3	36.067	0.153	0.088	0.004

Figure 4 shows the yields of each repetition (tons) in the experimental variants analysed.

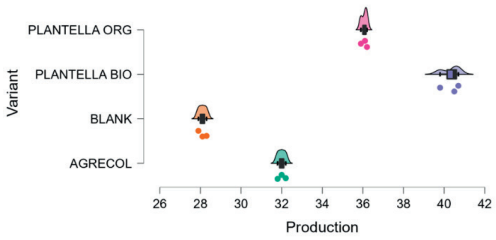

Figure 4 Yield per repetition of the variants analysed (tons/hectare)

In order to check the homogeneity of the dispersion, Levene's test was performed, and Figure 5 is a graphical representation of the homogeneity of the dispersion showing that there is no systematic deviation from the straight line.

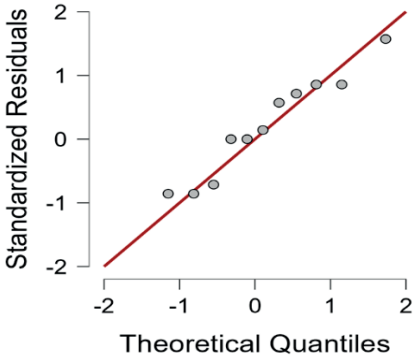

Figure 5 Homogeneity of dispersion

In order to determine the extent of the differences among the variants, Post Hoc tests have been carried out and the results are shown in Table 3.

Table 3 Post Hoc Comparisons - Variant

			95% CI for Mean Difference					
		Mean Difference	Lower	Upper	SE	t	p_{tukey}	p_{bonf}
AGRECOL	BLANK	3.900	3.153	4.647	0.233	16.714	< .001	< .001
	PLANTELLA BIO	-8.333	-9.081	-7.586	0.233	-35.714	< .001	< .001
	PLANTELLA ORG	-4.067	-4.814	-3.319	0.233	-17.429	< .001	< .001
BLANK	PLANTELLA BIO	-12.233	-12.981	-11.486	0.233	-52.429	< .001	< .001
	PLANTELLA ORG	-7.967	-8.714	-7.219	0.233	-34.143	< .001	< .001
PLANTELLA BIO	PLANTELLA ORG	4.267	3.519	5.014	0.233	18.286	< .001	< .001

Note. P-value and confidence intervals adjusted for comparing a family of 4 estimates (confidence intervals corrected using the tukey method).

The results of the Post Hoc tests presented in Table 3 indicate that the greatest differences in yield are between the variant fertilized only with manure and the variant in which, in addition to the basic fertilization with manure on vegetation, the Plantella bio fertilizer was also applied.

CONCLUSIONS

As a result of the determinations carried out, it may be said that all the fertilizers used had positive effects on the tomato production obtained, but the Plantella organic fertilizer in liquid form was particularly remarkable, having as its main component seaweed extract which, according to recent studies, contains a lot of nutrients such as nitrogen, phosphorus, potassium, plant growth hormones and oligoelements.

Based on the results obtained, we recommend the use of fertilizers based on natural ingredients in the fertilization of tomato crops. These results are to be followed by an analysis of the influence of fertilizers based on natural ingredients on the quality of tomato fruit.

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