University of Novi Sad

Faculty of Agriculture

Field test of commercial products ekolive biostimulants

1. Basic info

Requestor and producer:	Test executor:
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Objective of the trial was to determine the effect of two biostimulants on strawberry production in field condition. **Ekofertile®** plant and **Microfertile®** plant were applied separately or combined in concentration of 5 and 10%.

2. Methodology

2.1. Experimental site (meteorological parameters and agrochemical analysis)

The trial was conducted in Gospođinci, province of Vojvodina, Serbia, at 80 m above the sea level, 45°403957” N latitude and 19°969406” longitude in 2024. Total size of experimental plot was around 800m^2 (80m x 10m). All variants were evaluated at the same location, therefore weather and soil conditions were the same. Meteorological parameters such as temperature and rainfall during the 2023/2024 year were obtained from Republic Hydrometeorological Service of Serbia and presented in figure 1. Maximum rainfall was measured in November (83.8 mm).

Soil had slightly alkaline pH reaction (7.22-8.23), with medium content of total carbonates (4.27%) and rich in humus (4.01%). Total nitrogen (N) content was 0.20%, phosphorus (P_2O_5) content was 21.58 mg/100g and potassium (K_2O) 41.76 mg/100g.

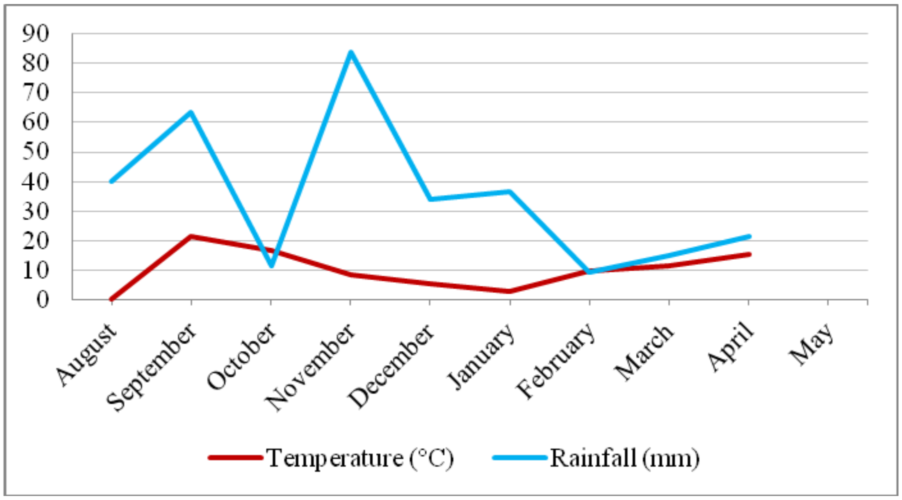

Figure 1. Meteorological data 2023/2024

2.2. Experimental design

The experiment was set up as a randomized block design with 60m plot per variant (20m replicated three times). The study included 10 treatments: two biostimulants (ekofertile® and microfertile®) in concentration 5 and 10% applied separately or combined with full dose of NPK or with 50% reduction of NPK fertilizers. Control variant included only application of mineral NPK (Table 1).

The foliar application was performed with a "Womax" (16l) sprayer. Biostimulants were applied five times altogether, two weeks apart. First spraying started in early spring to promote flowering initiation.

Table 1. Description of the variants

Variants	Description	Abbreviation
1	NPK + microfertile 5% sprayed 5 times	M5
2	NPK + microfertile 10% sprayed 5 times	M10
3	NPK + ekofertile 5% irrigated to roots 5 times	E5
4	NPK + ekofertile 10% irrigated to roots 5 times	E10
5	NPK + mix ekofertile 5% and microfertile 5% sprayed on the leaves 5 times	EM5
6	NPK + mix ekofertile 10% and microfertile 10% sprayed on the leaves 5 times	EM10
7	50% reduction of NPK with ekofertile 5% and microfertile 5% irrigated 5 times and sprayed 5 times	EM5, 50%
8	50% reduction of NPK with ekofertile 10% and microfertile 10% irrigated 5 times and sprayed 5 times	EM10, 50%
9	50% reduction of NPK with ekofertile 5% irrigated 5 times	E5, 50%
10	Control	C

2.3. Strawberry cultivation management

The strawberry variety used in the field trial was Clery. This variety is tolerant to diseases, especially mildew that affect the foliage and root system. It has strong semi-spreading bushes,

forms many whiskers during growth. Stems and peduncles are tall. The leaves are large and dark green in color. Flowers are rich in pollen, quite resistant to frost. Fruits are bright red in color, with well-balanced flavor, large and homogeneous in size, conical in shape.
The agronomic treatments such as planting, application of fertilizers, times of harvest were identical, except for the variants with 50% reduced fertilizers. Applied fertilizers (Table 2) were standard for integrated management in strawberry production. Plants were regularly irrigated based on soil humidity and meteorological conditions.

Table 2. Fertilizers combined with biostumlants in strawberry field

Treatments	**Date**	**Fertilizers**
1	15. 3. 2024.	FERTICARE™ 15-30-15
2	22. 3. 2024.	FITOFERT™ 20-20-20 + 2.4 MgO + microelements + Yara CALCINIT™
3	31. 3. 2024.	FITOFERT™ 20-20-20
4	15. 4. 2024.	FITOFERT™ 11-7-33 + 4 MgO + microelements
5	26. 4. 2024.	FERTICARE™ 15-30-15

2.4. Determination of plant growth and yield

Vegetative potential (rosette height (cm) and number of leaves in rosette) and generative parameters (number of flowers) were determined by standard morphometric methods and counting (Figure 2).
Harvest started eight months after planting in April (Table 3). Strawberry fruits were taken for physical fruit analysis such as length (cm), width (cm) and weight (g). Average yield was calculated by measuring freshly harvested fruits (g) and average number of flowers per plant. Fruit length and width were determined using sliding scale (Vorel, Poland) while fruit weight was determined using technical scale. The harvest season lasted one month.

Table 3. Timeline of the trial

Timing	**Activity**
12. 08. 2023.	Strawberry planting
08. 03. 2024.	Application of herbicides between the rows
15. 03. 2024.	1st biostimulant application
22. 03. 2024.	2nd biostimulant application
31. 03. 2024.	3rd biostimulant application and measurement number of flowers
15. 04. 2024.	4th biostimulant application
26. 04. 2024.	5th biostimulant application
30. 04. 2024.	Plant growth measurements (number of leaves and plant height)
20. 04. – 20. 05. 2024.	Strawberry harvest and fruits measurements

Figure 2. Strawberry trial (Gospođinci, Serbia)

Each treatment had three biological replicates. Results were expressed as mean±standard deviation of three replicates. Fisher test was used to test significant differences between means of treatments and its influence on yield per strawberry plants.

3. Results

Effect of the two biostimulants on strawberry production was investigated in field conditions. Results show that the application of biostimulants, in average, lead to increase of all investigated parameters of vegetative and generative plant growth. The highest increase in plant height, in relation to the control variant was achieved with Ekofertile 10% (20% increases). Also, we calculated increase in leaves number which varied from 19.36% to max. 56.69% as well as flowers number (max. 31.05%). Strawberry fruits were slightly increased in height, width and weight compared to control, resulting in nicely formed, uniform and regularly shaped berries (Figure 4).

Table 4. Effect of biostimulants on vegetative and generative growth of strawberry

Treatments	Plant height (cm)	N° leaves	N° of flowers
Microfertile 5%	27.20±1.92	25.67±5.69	44.90±11.38
Microfertile 10%	28.33±3.67	28.00±5.71	38.03±10.55
Ekofertile 5%	21.29±2.62	22.00±3.25	26.37±7.47
Ekofertile 10%	29.56±2.71	27.93±4.77	43.43±11.89
Microfertile and ekofertile 5%	26.48±2.23	22.53±6.56	33.46±7.59
Microfertile and ekofertile 10%	26.36±2.70	24.20±5.72	36.43±8.74
50% Microfertile and ekofertile 5%	23.56±1.91	21.33±8.20	30.80±9.32
50% Microfertile and ekofertile 10%	24.66±2.73	24.53±5.49	29.50±9.19
50% Ekofertile 5%	22.83±2.86	24.73±6.51	28.30±10.29
Control	24.63±3.21	17.87±5.62	34.26±9.95

Data are means±standard deviation at *n*=3.

Table 5. Effect of biostimulants on physical properties

Treatments	Fruit height (cm)	Fruit width (cm)	Fruit weight (g)
Microfertile 5%	4.11±0.84	3.02±0.59	18.27±2.81
Microfertile 10%	3.94±0.41	3.06±0.38	15.67±1.33
Ekofertile 5%	3.76±0.77	3.12±0.41	16.93±1.10
Ekofertile 10%	4.05±0.60	3.28±0.38	19.80±2.60
Microfertile and ekofertile 5%	4.14±0.66	3.11±0.38	18.50±3.58
Microfertile and ekofertile 10%	4.05±0.70	3.16±0.50	19.66±4.64
50% Microfertile and ekofertile 5%	4.04±0.77	3.09±0.41	18.76±1.10
50% Microfertile and ekofertile 10%	3.77±0.83	2.95±0.55	15.46±1.30
50% Ekofertile 5%	3.76±0.74	2.99±0.43	16.20±2.42
Control	3.83±0.95	2.88±0.63	15.68±0.95

Data are means±standard deviation at *n*=3.

Table 6. Effect of biostimulants on strawberry yield/plant (% of increase)

Treatments	Fruit weight	Fruit yield
Microfertile 5%	**116.47%**	**152.61%**
Microfertile 10%	99.89%	**110.87%**
Ekofertile 5%	**107.97%**	83.08%
Ekofertile 10%	**126.25%**	**160.02%**
Microfertile and ekofertile 5%	**117.96%**	**115.20%**
Microfertile and ekofertile 10%	**125.40%**	**133.33%**
50% Microfertile and ekofertile 5%	**119.66%**	**107.55%**
50% Microfertile and ekofertile 10%	98.62%	84.90%
50% Ekofertile 5%	**103.29%**	85.31%
Control	100%	100%

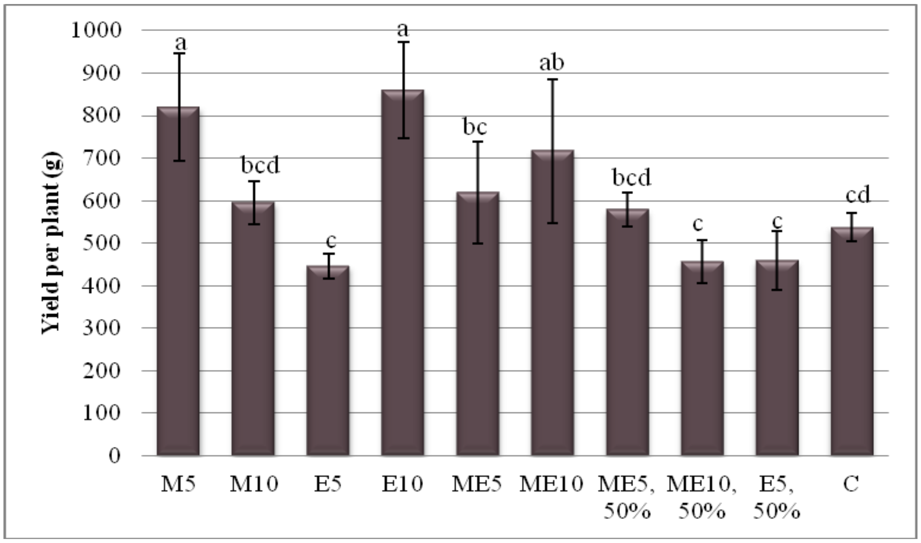

Figure 3. Effect of biostimulants on yield per plant (g)

Data are means ± standard deviation at *n*=3. Different letters indicate statistically significant difference at $p<0.05$ level between treatments (Fishers test)

Figure 4. Strawberry fruit ready for market

4. Discussion

The increase of leaves number in all treatments could be associated with primary and secondary metabolites produced by microorganisms in biostimulants. Significantly higher plants and number of leaves improved bioavailability of essential nutrients and water uptake and resulted in increased vigor of strawberry plants (Schmitzer et al., 2023). According to Žunić et al. (2024), microalgae-based biostimulants produce phytohormones (auxin, cytokinins and gibberellins) responsible for increased fruit weight of strawberries. Increased plant height, number of leaves and flowers as well as fruit weight could be attributed to composition of the applied products.

5. Conclusion

Results of the large scale field trial highlighted the positive effect of applied biostimulants on vegetative and generative growth parameters as well as on strawberry yield.

Microfertile® in concentration 5% (M5), Ekofertile® in concentration 10% (E10) and the combination of Microfertile and Ekofertile 10% (ME10) increased strawberry yield more than 30% in relation to the control. Plants in all variants showed faster growth, improved plant vigor and immunity compared to the control variant. These data strongly suggest that the mentioned increases and the overall improvements in strawberry production can be attributed to the tested biostimulants.

However, it is strongly advisable that in order to get more reliable and accurate information of biostimulants efficiency in strawberry production, the same trail (or similar) should be performed on more soil types of different fertility and/or in arid conditions during longer period of time. This trial lasted one vegetation season, was set on fertile soil, which was rich in humus, with high amount of total N and available P and K. The weather conditions were favorable too. It is usually expected that microbe-based formulations perform better on less-productive soils and more-challenging surroundings.

Furthermore, soil microbiological analysis after the trial may demonstrate the influence of biostimulants on the number and distribution of microorganisms in soil, their activity and interactions with the indigenous microbial populations.

Cited literature:

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