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PRELIMINARY RESULTS ON THE ACTION OF SOME BIOLOGICAL SUBSTANCES ON VEGETATIVE GROWTH ON PEACHES CULTIVATED ON SANDY SOILS

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Abstract: Plant protection bioproducts are biological means based on natural compounds (plant extracts) with complex mode of action on crop plants, some biopreparations have also proved to be stimulators of vegetative growth. Biopreparations application is done through treatments, which are either treatments in vegetation (sprays with different volumes of liquid) or seeds treatments. The treatments with plant protection bioproducts on the peach species have led to better assimilation of nitrogen, phosphorus and potassium in leaves compared to the untreated control. Due to the action of substances from bioproducts in overcoming the plant stress caused by diseases and pests, the metabolism of plants is more intense and the absorption of nutrients is better.

Key words: *peach, sandy soil, biological substances*

INTRODUCTION

In the context of global climate change, Romania is also seeing changes related mainly to the annual average temperature increase of about 1.6°C (Burzo, 2014). The increased summer temperatures (July and August) led to changes in the biology of diseases and pests. The control of diseases and pests in agricultural crops is done through several methods: physico-mechanical (thermal disinfecting of seeds), chemical (using pesticides), agro-technical (through soil works, including weed hoarding) but also biological (natural products and antagonistic organisms).

Bioproducts are biological means made on the basis of natural compounds (plant extracts) with a complex action on crop plants, biopreparations that have been shown to be stimulants of vegetative growth (Sharma et al., 2014).

MATERIALS AND METHODS

At CCDCPN Dăbuleni it was tested the action of some biological substances. Treatments have been made on the peach species, the Springold variety, with volatile oils, a combination of *Ocimum basilicum* L., *Abies alba* Mill., *Rosmarinus officinalis* L., *Mentha piperita*, and *Origanum vulgare* L. essential oils, together with water, agar, diatomaceous earth and gelatin.

In addition to this combination of oils, were chosen three experimental variants, concretized by treating the peach in vegetation with biological products such as: Metab, Sublic, Metab + Sublic, along with the untreated variant (control).

The following observations and determinations were made:
- state of supply of soil in nutrients;
- total nitrogen - the Kjeldahl method;

- extractable phosphorus (P-AL) - Egner-Riem Domingo method, where the phosphates are extracted from the soil sample with an acetate-ammonium lactate solution at pH 5.75 and the extracted phosphate anion is colorimetrically determined as - blue molybdenum;
- exchangeable potassium (K-AL) - the Egner-Riem Domingo method. Potassium dosing in the solution was done by flame photometric emission.
- organic carbon - wet oxidation method and titrimetric dosage method;
- PH-soil, potentiometric method.
- the supply of leaves with N, P, K;
- total nitrogen (%) - Kjeldahl method;
- total phosphorus (%) - colorimetric method;
- total potassium (%) - flame photometry method;

In order to highlight the quality of essential oils as stimulators of vegetative growth during the Springold variety vegetation period, determinations of the foliar surface were made. Also, physiology determinations were made regarding the diurnal variation of some physiological indices such as:
- forms of leaf water - gravimetric method;
- cell juice concentration - refractometric method;
- rate of photosynthesis - LC-pro device;
- rate of foliar sweating - LC-pro device.

RESULTS AND DISCUSSIONS

The location of the Springold cultivated variety is on a psamosol with reduced natural fertility (Table1), characterized by a nitrogen content ranging between 0.05% and 0.07%, values indicating a reduced soil supply status, according to literature data (Davidescu & Davidescu, 1981). Extractive phosphorus exhibited values ranging from 28 ppm to 40 ppm, values that characterize the soil as reduced to well supply with phosphorus. The exchangeable potassium content ranged from 32 ppm to 58 ppm. The obtained values characterize the soil as being in a low state supply. Due to the soil content in organic carbon which had values in the range of 0.22-0.48%, the state of soil supply in organic matter was reduced, which is characteristic of sandy soils. The pH of the experiments soil oscillated between 5.30 and 5.70, values that show a moderately-strong acid to moderately-acid reaction. Generally, soil pH is seasonally variable, being lower in dry and higher temperatures and with higher values in cooler and high humidity periods.

Table 1. Soil chemical composition

Average sample on soil profile (0-100cm)	**Total nitrogen (%)**	**Extractable phosphorus (ppm)**	**Exchangeable potassium (ppm)**	**Organic carbon (%)**	**pH in water**
Sample 1	0.06	30	58	0.41	5.30
Sample 2	0.05	32	32	0.35	5.40
Sample 3	0.05	40	38	0.48	5.70
Sample 4	0.07	28	49	0.22	5.65
Mean	0.0580	32.60	44.20	0.3660	5.512
Std. Deviation	0.008367	4.561	10.01	0.09555	0.1672

After sampling the leaves from the field, they were conditioned in the laboratory (dry and crushed) and the following analyses were performed: total nitrogen, total phosphorus and total potassium. The obtained results (Table 2) indicate a state of supply of trees with nitrogen ranging from 2.86 - 3.30%, the optimum nitrogen supply range being from 3 to 3.3%. The best results were obtained in the variants Metab + Sublic and volatile oils. Due to the fact that the trees did not have fruit, so the mineral substances were not consumed for the production, the nitrogen content in the leaves should have been much higher. This has not happened due to the climatic conditions of the vegetation period (very high temperatures since June, which exceeded 40 °C in July and August and rainfall was non-existent during this period). Even if water needs were supplied by irrigation, the evapotranspiration was intense and the intensity of metabolic processes affected.

Table 2. NPK content of peach leaves depending on applied treatments

Variant	Nt (%)	Pt (%)	Kt (%)
Untreated	2.86	0.21	2.43
Metab	2.90	0.24	2.67
Sublic	2.88	0.29	2.80
Metab + Sublic	3.30	0.32	2.65
Volatile oils	3.10	0.33	2.97
The optimum supply range (Răuță & Chiriac, 1980)	3.0 – 3.3	0.16 – 0.26	2.1 – 3.0

Leaf phosphorus content ranged from 0.21 to 0.33%, values that characterize trees with a good supply of phosphorus, the optimal range being between 0.16 and 0.26%. In all variants where the treatments with biological products were applied, the phosphorus content in the leaves showed higher values compared to the untreated control.

Phosphorus participates in the plant in the formation of nucleic acids, carbohydrates, fats (lecithin) and proteins. Phosphorus is present in all enzymes involved in protein formation. It influences favourably the fructification processes as well as the transport and deposition of sugars in fruits and roots (Molea, 1982).

The potassium content of peaches was between 2.43-2.97%. The optimal supply of peach trees in potassium is between 2.1 and 3.0%. Potassium content in the leaves showed higher values in all treated variants as compared to the untreated control, the best results were obtained in the variant treated with volatile oils (2.97%).

Potassium is involved in the synthesis, transport and deposition of carbonated carbohydrates and influences osmotic cell pressure and turgidity. The presence of potassium facilitates the penetration of water into the cells and increases the capacity of protoplasm for water retaining. Potassium has a lower influence than nitrogen and phosphorus on plant growth and production.

In order to highlight the quality of essential oils as vegetative growth stimulators, during the Springold vegetation period, determinations of the foliar surface were made (Table 3). Also, physiology determinations were made regarding the diurnal variation of some physiological indices such as: forms of water in the leaves, the concentration of cellular sap, rate of photosynthesis and foliar transpiration rate.

Thus, in the Springold variety, the variant treated with Sublic shows a mean number of leaves higher than the untreated control variant, and the variant treated with Metab + Sublic records a reduced foliar surface and a relatively low number of leaves.

Table 3. Determination of foliar surface on peach (Springold variety)

Variant	Leaf surface (cm^2)	Leaf width (mm)	Leaf length (mm)	Number of leaves/tree	Total foliar surface/tree (m^2)
Untreated (Control)	36.62	34.26	158.06	3276	12.00
Treatment with Metab	38.08	60.26	149.53	3095	11.79
Treatment with Sublic	36.42	37.0	150.4	4134	15.06
Treatment with Metab+Sublic	27.90	30.5	137.63	2744	7.66
Treatment with volatile oils	33.90	39.53	130.53	4148	14.06

Early August determinations have shown that water and cellular sap concentrations (Table 4) have been influenced by climatic factors of the area. Drought in July - August due to lack of rainfall, increased air temperature to 40°C and air humidity below 30%, has reduced the amount of water at the foliar level, which oscillated between 60.72% in the variant treated with Metab + Sublic and 65.52% for the variant treated with volatile oils. The dry substance oscillated between 34.48-39.28% and the concentration of cellular sap between 13.6-18.3%. The maximum recorded cellular sap concentration at Metab + Sublic treated trees shows the adaptation of the trees to the atmospheric and pedological drought in the area.

Table 4. Variation of some physiological indicators on peach

Variety	Applied treatments	Total water (%)	Free water (%)	Bound water (%)	Dry matter (%)	Concentration of cellular sap (%)
Springold	Untreated	63.89	59.72	4.17	36.11	13.6
	Metab	62.86	58.57	4.29	37.14	14.5
	Sublic	63.83	59.57	4.26	36.17	16.0
	Metab + Sublic	60.72	57.14	3.58	39.28	18.3
	Volatile oils	65.52	62.06	3.46	34.48	15.2

Climatic factors in the area and applied treatments have influenced the plant metabolism.

The photosynthetically active radiation (Table 5) oscillated between 1078-1279 μmol/m^2/s at 9 o'clock, between 1021-1872 μmol/m^2/s at 12 o'clock and between 926-1697 μmol/m^2/s at 15 o'clock.

The photosynthesis rate recorded the following values:

- At 9 o'clock photosynthesis rates fluctuated between 8.94 μmol CO_2/m^2/s (untreated) and 20.84 CO_2/m^2/s (Metab + Sublic treated variant);
- at 12 o'clock values ranged between 10.72 CO_2/m^2/s (Metab treated variant) and 16.41 CO_2 /m^2/s (variant treated with volatile oils);
- at 15 o'clock the values fluctuated between 4.09 CO_2/m^2/s (treated variant with volatile oils) and 13.99 CO_2/m^2/s (Metab treated variant).

Daily average values ranged between 9.62 CO_2/m^2/s (untreated) and 14.82 CO_2/m^2/s (Metab + Sublic treated variant).

The maximum daily was recorded in trees treated with Metab + Sublic at 9 o'clock. The daily average value shows that treatment with Metab + Sublic has positively influenced the rate of photosynthesis in the treated trees.

Table 5. Diurnal variation of peach photosynthesis

Variety	Applied treatments	RAF µmol/ m^2/s	Photosynthesis µmol CO_2/m^2/s	RAF µmol/ m^2/s	Photosynthesis µmol CO_2/m^2/s	RAF µmol/ m^2/s	Photosynthesis µmol CO_2/m^2/s	The daily average of photosynthesis
		9 o'clock		12 o'clock		15 o'clock		
Springold	Untreated	1132	8.94	1364	12.41	926	7.51	9.62
	Metab	1175	9.62	1748	10.72	1516	13.99	11.44
	Sublic	1145	11.32	1862	15.68	1444	9.00	12.00
	Metab + Sublic	1279	20.84	1255	10.78	1697	12.84	14.82
	Volatile oils	1078	11.97	1021	16.41	1565	4.09	10.82

Stress factors on sandy soils as: air temperature over 35^0C, relative air humidity below 30% and the absence of rainfall, influences as dehydrating forces on the foliar appliance, increasing the evaporation of water by the leaf transpiration. The foliar transpiration rate (Table 6) recorded the following values:

- at 9 o'clock leaf transpiration rate values varied between 1.17 mmol H_2O/m^2/s (variant treated with Metab + Sublic) and 2.89 mmol H_2O/m^2/s (variant treated with Sublic);
- at 12 o'clock leaf transpiration rate values varied between 1.53 mmol H_2O/m^2/s (Metab treated variant) and 3.04 mmol H_2O/m^2/s (Sublic treated variant);
- at 15 o'clock leaf transpiration rate varied between 1.93 mmol H_2O/m^2/s (untreated) and 3.60 mmol H_2O/m^2/s (Metab treated variant).

Table 6. Diurnal variation of peach transpiration

Variety	Applied treatments	T°C	Leaf transpiration mmol H_2O/m^2/s	T°C	Leaf transpiration mmol H_2O/m^2/s	T°C	Leaf transpiration mmol H_2O/m^2/s	Daily average of transpiration
		9 o'clock		12 o'clock		15 o'clock		
Springold	Untreated	30.8	2.14	26.6	1.88	34.8	1.93	1.98
	Metab	30.9	2.38	27.7	1.53	35.1	3.60	2.50
	Sublic	31.0	2.89	28.6	3.04	35.4	3.14	3.02
	Metab + Sublic	31.0	1.17	29.9	2.22	36.1	3.48	2.29
	Volatile oils	31.6	2.56	30.8	2.72	36.7	1.97	2.41

Daily average values ranged from 1.98 mmol H_2O/m^2/s (untreated) and 3.02 mmol H_2O/m^2/s (Sublic treated variant). Maximum diurnal was recorded in Metab treated trees at 15 o'clock. The average daily maximum recorded in trees treated with Sublic. Treatments with Sublic influenced the loss of water on the foliage. Treatment with Metab + Sublic maintained a balance between photosynthesis and foliar sweating.

CONCLUSIONS

Treatment with Metab + Sublic maintained a balance between photosynthesis and foliar transpiration. Biological treatments on peach led to a better supply of nitrogen, phosphorus and potassium in the leaves compared to the untreated control. Because of the role these substances play in overcoming the stress of the plant caused by diseases and pests, the metabolism of plants is more intense and the absorption of nutrients is better.

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