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Effects of foliar biostimulators on the physiological processes in *Vitis vinifera* L. - *Italian Riesling* variety from the Oltenia region

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Abstract The research regarding the effects of foliar biostimulators on the physiological processes were performed in the grapevine - *Italian Riesling* variety grown in the climatic conditions in Oltenia region.

The physiological analyzes were performed in July 22th 2016 on the leaves of plants treated with the *Cropmax* foliar biostimulator, compared to leaves of plants without treatments (Control).

In leaves of grapevine *Italian Riesling* variety has been noticed that the photosynthesis and transpiration intensity varies during the day according to the climatic conditions presenting low values in the morning, high values in the afternoon and low values towards the evening, but the recorded values are higher for the leaves of plants treated with the *Cropmax* foliar biostimulator, compared to leaves of plants without treatments (Control).

At the analyzed grapevine, according to the climatic conditions, good positive correlations were established between the physiological processes' intensity and photosynthetic active radiation, leaf temperature and stomatal conductance.

In the leaves of plants treated with the foliar biostimulator was registered a higher content in water and clorophyllian pigments, between the clorophyll content and the photosynthesis intensity being a positive correlation.

Key words

foliar biostimulators, grapevine, leaves, physiological processes

Vitis vinifera (grapevine) is a species originating from the Mediterranean region, central Europe and southwestern Asia. It is a plant with the alternate leaves, palmately lobed. The flowers are small, the fruit look like berries and can be green, red, or purple [7].

Foliar biostimulators have an effect on plant growth, removal of mineral deficiencies as well as increasing plant resistance to diseases and pests.

Biostimulators are natural growth regulators or chemicals, most of them contain plant hormones as auxin, gibberellic acid, cytokinins and aminoacids. Effects of these components increase physiological activities in plants, first of all protein synthesis. Biostimulators help plants surviving stresses. These are used for protect fruit plants from spring frost damage [8].

The high point in the photosynthesis for the grapevine is achieved at its base leaves in the period preceding the ripening phase and during this phase, around 1 o'clock p.m. During the ripeness phase, the photosynthesis intensity came before 1 o'clock p.m. and the greatest photosynthesis intensity was established at the apical leaves [5].

The photosynthesis intensity depends on the degree in leaves light exposure [2].

The external leaves which directly absorb sunlight have a higher photosynthesis intensity, while the inner leaves which absorb up to 85% active photosynthesis radiations, have a lower intensity of this process [6].

It has been ascertained that 70 % of the photosynthesis activity of palisate grapevines is accomplished by the leaves with direct light exposure, although they represent only 1/5 of the total leaves [3].

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The photosynthesis intensity process varies between 13.8 μmol CO_2 / m^2 / s in August and 7.5 μmol CO_2 / m^2 / s in September [9].

The efficiency of the photosynthetic apparatus depends on the chlorophyll contents [4].

The transpiration intensity, within adequate ground humidity conditions, has a dynamic characteristic with a high point in the afternoon and two low points in the morning and evening [1].

The young leaves have the highest intensity of the transpiration process and as they get older, the

transpiration intensity decreases, the lower values being recorded at senescent leaves [2].

Material and Method

The research regarding the effects of foliar biostimulators on the physiological processes were performed in the grapevine - *Italian Riesling* variety grown in the climatic conditions in Oltenia region.

The *Italian Riesling* variety is probably originating from Middle Europe. Regarding the origin, some ampelography scientists claim it comes from Germany, others say it comes from Austria or Italy, as the name itself shows. It has a middle to long vegetation, middle growth strength, the twig wood grows strong and it distinguishes the buds at its base string. The leaves are elongate with three or five lobes and they have crenate edges. The grapes are cylindrical in shape, with dense, greenish, spherical fruit and they sometimes get a lighter shade when exposed to sunlight. The seeds are medium sized, cylindrical and a little bent at the top. It responds well to frost, bad to drought and it has a medium resistance to mildew and blight.

It is grown in many vineyards in Romania as a high-quality wine variety.

The physiological processes (photosynthesis intensity and transpiration intensity) were established with the ultra compact system LCi, system which enables automatic recording and other parameters (photosynthetic active radiations, leaf temperature, stomatal conductance etc.). The results obtained were graphically represented and statistically interpreted.

The water contents and that of dry substance were determined by the gravimetric method.

The chlorophyll content was estimates by Minolta SPAD 502 chlorophyll meter.

In grapevine - *Italian Riesling* variety the treatment with the foliar biostimulators *Cropmax* 0,2% was applied on the leaves in two stages, immediately after the bloom and at the beginning of the intensive growth period of the grapes. The physiological analyzes were performed in July 22^{th} 2016 at the leaves of plants treated with the *Cropmax* foliar biostimulator, compared to plants without treatments (Control).

The foliar biostimulators were applied in the morning, when plants have a corresponding photosynthetic activity, insisting on the lower part of the leaves where the absorption is more intense.

Results

Treatments with foliar biostimulators are important for grapevine plants, especially during development of the reproductive organs, between blooming and fructification, when more nutrients are consumed, and plants can not be grown satisfactorily in the soil (Fig. 1 and Fig. 2).

Treatments with *Cropmax* biostimulators lower the metabolic deficits by injecting microelements and act on photosynthesis resulting in the increased carbohydrate content in the plant.

The physiological analyzes were performed on leaves of plants treated with the foliar biostimulator, compared to leaves of plants without treatments (Control).

Fig. 1. *Vitis vinifera* L. - *Italian Riesling* variety - leaves of the plant (Original).

Fig. 2. *Vitis vinifera* L. - *Italian Riesling* variety - unripe grapes (Original).

The photosynthesis intensity increases in the morning due to the increase of light intensity, temperature and the stomata opening level, it maintains itself constant at noon, then gradually decreases towards the evening due to the decrease of light intensity, the gradual decrease of temperature, as well as the reduction of the opening degree of stomata.

The intensity of photosynthesis throughout the day in the leaves of plant treated with the *Cropmax* foliar biostimulator is similar to that in plant without foliar biostimulator (Control), but the recorded values are higher in comparison with these as a result of increased chlorophyll synthesis, fact manifested by the increase in carbohydrate content (Fig. 3).

The transpiration intensity increases from the morning when the opening of stomata takes place, presents a maximum value during the afternoon when the temperature is higher and the air relative humidity is lower, and towards evening the decrease of the transpiration intensity takes place.

The transpiration intensity throughout the day in the leaves of plant treated with the foliar biostimulator is similar to that in plant without foliar biostimulator (Control), but the recorded values are higher in comparison with these, fact manifested by the increase of the radicular water absorption in response to the increase of the water requirement of the leaves automatically bringing more minerals into the plants (Fig. 4).

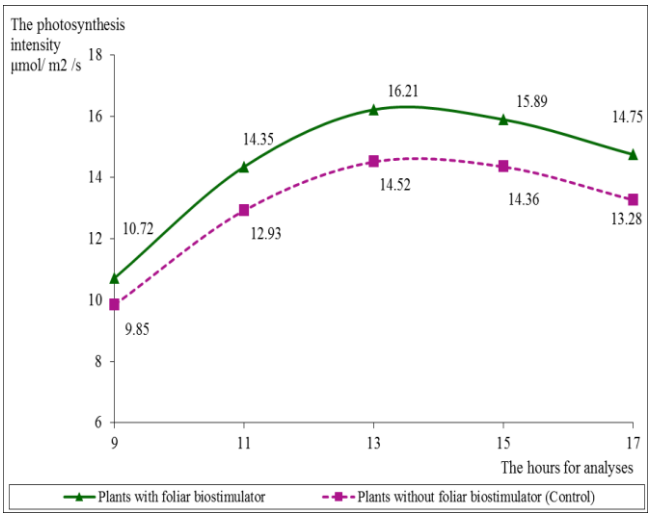

Fig. 3. The diurnal photosynthesis intensity at the grapevine - *Italian Riesling* variety.

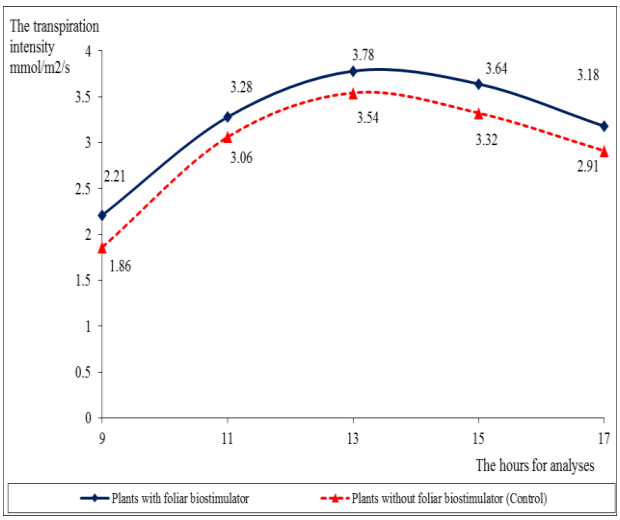

Fig. 4. The diurnal transpiration intensity at the grapevine - *Italian Riesling* variety.

At the grapevine leaves can be noticed an intensification of the photosynthetic active radiations starting with the morning (9 a.m.) when values of 1345 µmol / m^2 / s in the leaves of plant treated with the foliar biostimulator could be recorded and of 1320 µmol / m^2 / s in the plants without foliar biostimulator (Control), their growth up until afternoon (1 p.m.) when were record values of 1695 µmol / m^2 / s) in the plants with the foliar biostimulator and 1638 µmol / m^2 / s after treatments in the plants without foliar biostimulator and towards evening (5 p.m.) one can notice a gradual decrease recording values of 1625 µmol / m^2 / s after treatments with the foliar biostimulator and of 1572 µmol / m^2 / s in the plants without foliar biostimulator.

Linear regression made between the photosynthesis intensity and photosynthetic active radiations shows a good positive correlation, the coefficient of determination (R^2) was 0.98 for the leaves of plant treated with the foliar biostimulator and 0.95 for the plants without foliar biostimulator (Control), and linear regression made between the transpiration intensity and photosynthetic active radiations shows a good positive correlation - R^2 was 0.94 for the plants treated with the foliar biostimulator and 0.90 for the plants without foliar biostimulator (Fig. 5 and Fig. 6).

In the grapevine leaves an increase of the leaf temperature starting with the early hours of the morning (9 a.m) can be noticed, when values of 29.5 ^oC were recorded in the leaves of plant treated with the foliar biostimulator and of 28.4 ^oC in the plants without foliar biostimulator (Control), their growth up until afternoon (1 p.m.) when were record values of 36.2 ^oC in the plants treated with the foliar biostimulator and 35.3 ^oC in the plants without foliar biostimulator and towards evening (5 p.m.) a gradual decrease could be noticed, recording values of 35.1 ^oC in the plants treated with the foliar biostimulator and of 34.3 ^oC in the plants without the foliar biostimulator.

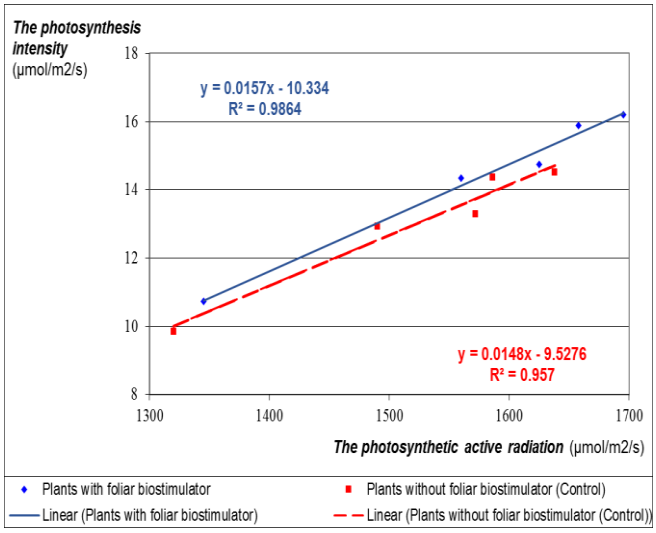

Fig. 5. The correlation between the intensity of photosynthesis and the photosynthetic active radiation at the grapevine - *Italian Riesling* variety.

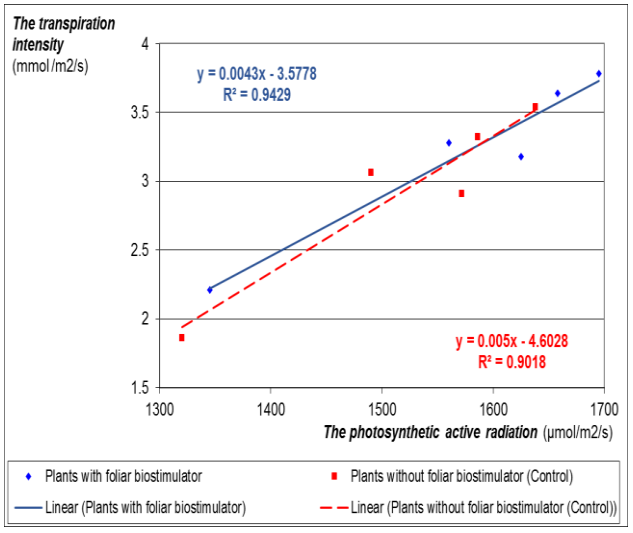

Fig. 6. The correlation between the intensity of transpiration and the photosynthetic active radiation at the grapevine - *Italian Riesling* variety.

Linear regression made between the photosynthesis intensity and leaf temperature show a good positive correlation, the coefficient of determination (R^2) being of 0.98 for the leaves of plant treated with the foliar biostimulator and 0.97 for the plants without foliar biostimulator, and linear regression made between the transpiration intensity and leaf temperature shows a positive correlation - R^2 was of 0.93 for the plants treated with the foliar biostimulator and 0.91 for the plants without foliar biostimulator (Fig. 7 and Fig. 8).

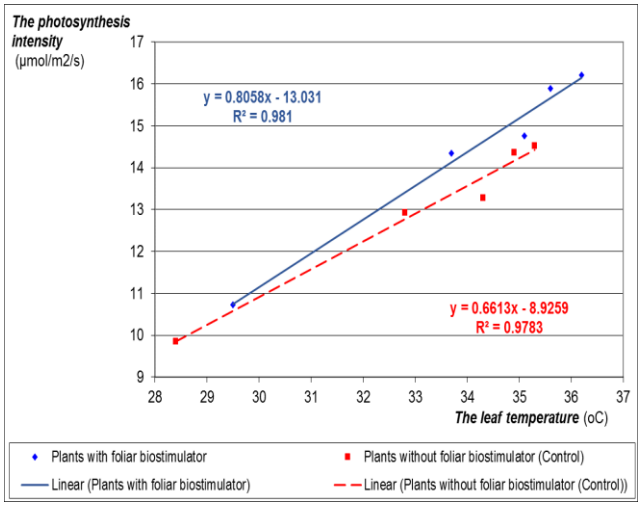

Fig. 7. The correlation between the intensity of photosynthesis and the leaf temperature at the grapevine - *Italian Riesling* variety.

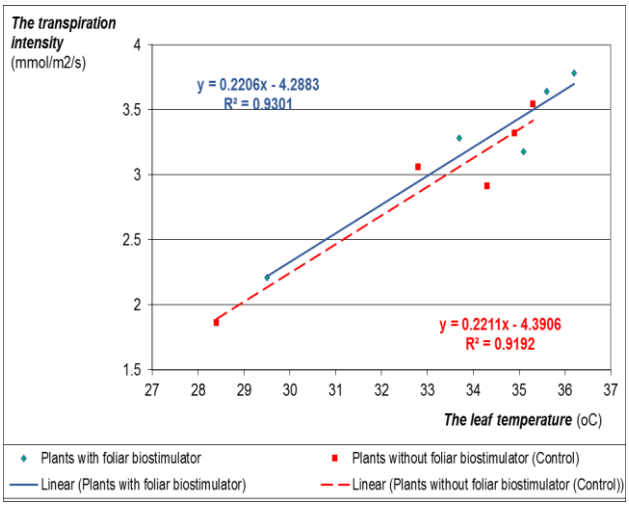

Fig. 8. The correlation between the intensity of transpiration and the leaf temperature at the grapevine - *Italian Riesling* variety.

At the leaves of the grapevine plants was noticed an intensification of the stomatal conductance starting in the morning (9 a.m.), when where recorded values of 0.12 mol / m^2 / s in the leaves of plant treated with the *Cropmax* foliar biostimulator and 0.10 mol / m^2 / s in the plants without foliar biostimulator (Control), their growth up until afternoon (1 p.m.) when values of 0.24 mol / m^2 / s in the plants treated with the foliar biostimulator were recorded and 0.20 mol / m^2 / s in the plants without foliar biostimulator and towards evening (5 p.m.) a gradual decrease could be noticed, recording values of 0.18 mol / m^2 / s in the

plants treated with the foliar biostimulator and 0.14 mol / m^2 / s in the plants without foliar biostimulator.

Linear regression made between the photosynthesis intensity and stomatal conductance show a positive correlation, the coefficient of determination (R^2) being of 0.89 for the leaves of plants treated with the foliar biostimulator and 0.85 for the plants without foliar biostimulator, and linear regression made between the transpiration intensity and stomatal conductance show a positive correlation - R^2 was 0.92 for the plants treated with the foliar biostimulator and 0.91 for the plants without the foliar biostimulator (Fig. 9 and Fig. 10).

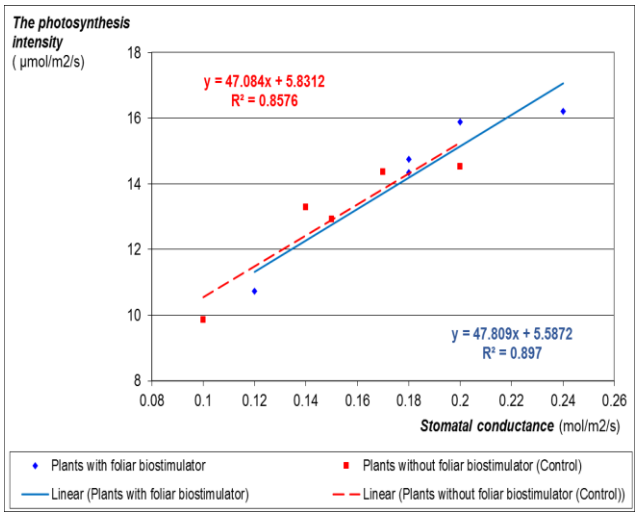

Fig. 9. The correlation between the intensity of photosynthesis and the stomatal conductance at the grapevine - *Italian Riesling* variety.

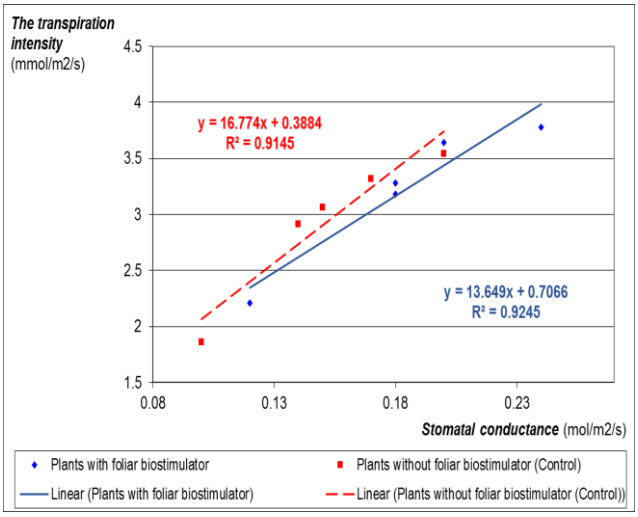

Fig. 10. The correlation between the intensity of transpiration and the stomatal conductance at the grapevine - *Italian Riesling* variety.

The grapevine plants treated with the *Cropmax* foliar biostimulator present an higher water content and a lower dry substance content, compared with the plants without foliar biostimulators (Fig. 11).

In the plants treated with the foliar biostimulator it registers an higher chlorophyll content, fact also noticed by the dark green color of the leaves, in comparison with the leaves plants without this treatment (Fig. 12).

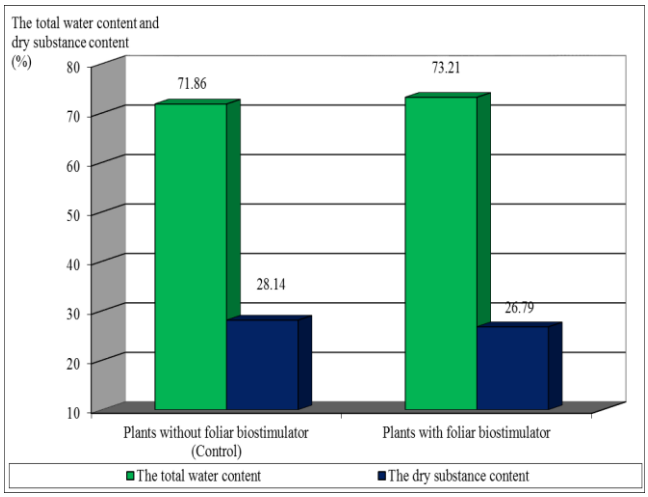

Fig. 11. The water content and the dry substance content at the grapevine - *Italian Riesling* variety.

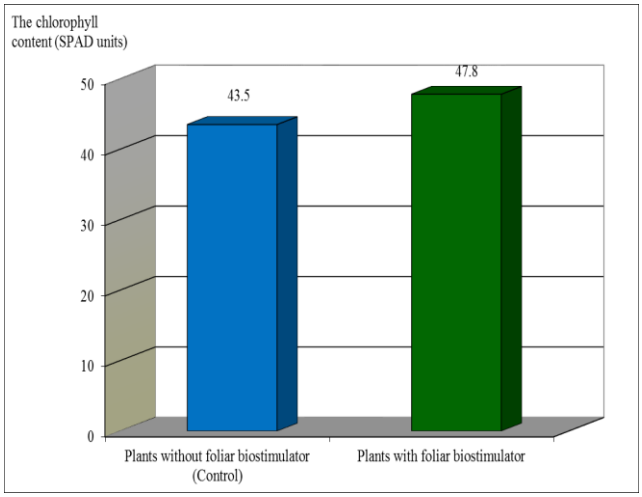

Fig. 12. The chlorophyll content at the grapevine - *Italian Riesling* variety.

Conclusions

In the grapevine - *Italian Riesling* variety was observed that during the day photosynthesis and transpiration intensity presents minimum values in the morning, maximum values afternoon and minimum values toward the evening, but the intensity of these physiological processes presents that values are higher in the plants treated with the *Cropmax* foliar biostimulator, compared with the plants without the foliar biostimulator (Control).

At the analyzed grapevine, according to the climatic conditions, was established a good positive correlations between the physiological process intensity and photosynthetic active radiation, leaf temperature and stomatal conductance.

In the plants treated with the foliar biostimulator, was recorded a higher water content and an lower dry substance content, compared with the plants without the biostimulators.

The chlorophyll content was higher in the plants treated with the foliar biostimulators, compared with the plants without foliar biostimulators, being a positive correlation between the chlorophyll content and the photosynthetis intensity.

References

1. Alleweldt G., Eibach R., Rühl E. 1982. Investigations on gas exchange in grape-vine I. Influence of temperature, leaf age and daytime on net photosynthesis and transpiration. Vitis. 21: 93-100.

2. Burzo I., Toma S., Olteanu I., Dejeu L., Delian Elena, Hoza D. 1999. Fiziologia plantelor de cultură. Întreprinderea Editorial Poligrafică Ştiinţa. Chişinău. 3. pp: 440.

3. Champagnol F. 1994. Facteurs agronomiques de l'acidité des moûts et des vins. Progrès Agricole et Viticole. 111 (21): 469-480.

4. Couvillon G. A. 1988. Rooting responses to different treatments. Acta Horticult. 227: 187-196

5. Hunter J. J., Skrivan R., Ruffner H. P. 1994. Diurnal and seasonal physiological changes in leaves of Vitis vinifera L.: CO2 assimilation rates, sugar levels and sucrolytic enzyme activity. Vitis. 33 (4): 189-195.

6. *Kriedeman* P. E., *Smart*. *R. E.* 1971. Effects of irradiance, temperature and leaf water potential on photosynthesis of vine leaves. *Photosynthetica* 5: 6-15.

7. Nicolae I., Camen D. 2012. Effects of treatment with fungicides on the physiological processes in Vitis vinifera L. attacked by Plasmopara viticola (Berk. & Curt.) Berl. & de Toni. Journal of Horticulture, Forestry and Biotechnology, Timişoara. Romania. 16 (2): 149-154.

8. Szabó Veronika, Hrotkó Károly. 2009. Preliminary Results of Biostimulator Treatments on Crataegus and Prunus Stockplants. Bulletin UASVM Horticulture. 66 (1): 223-228.

9. Williams L. E., Biscay P. J. 1991. Partitioning of dry weight, nitrogen, and potassium in Cabernet Sauvignon grapevines from anthesis until harvest. American Journal of Enology and Viticulture. 42: 113-117