

EFFECT OF THE BROWN ALGA *ASCOPHYLLUM NODOSUM* AS BIOFERTILIZER ON VEGETATIVE GROWTH IN GRAPEVINE (*VITIS VINIFERA* L.)

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Abstract

Environmental growing farm technology involves utilization of agricultural inputs which are friendly with the production and ecosystem. Seaweed extracts are used as biofertilizers in horticulture in special to increase plant growth and productivity. In this study, we investigated the effect of seaweed extracts made from *Ascophyllum nodosum*, on vegetative growth of *Vitis vinifera* cv. *Feteasca Alba*. We used three different concentrations of seaweed extracts to asset the effect on fertility coefficients, shoot length, shoot diameter and leaf area. All treatments with seaweed extract showed a stimulatory effect for studied parameters. The plants treated with the higher levels of seaweed concentrate produced the highest absolute fertility coefficient and relative fertility coefficient relative to the plants treated with lower concentration of or untreated control plants. Foliar spray application at different concentration of seaweed extract of *Ascophyllum nodosum* influenced the vegetative growth expressed by leaf area of vine stock. The results indicate that the 170 ml⁻¹hl concentration of seaweed extract showed the higher enhanced of growth parameters in grapevine.

Keywords: *Ascophyllum nodosum*, grapevine, leaf area, *vitis*.

1. INTRODUCTION

The grapevine is one of the most cultivated fruits with a total global surface area of 7.6 million hectares under vines, where most of it is processed to wine, leading to a global production of 265 million hectoliters (OIV, 2013; Rienth et al., 2014). *Vitis vinifera* L. is an economically important crop worldwide and one of the most important fruits in Romania, producing highly valued fruit, juice, liquor, cosmetic products and wine products. Grapevine is one of the most important fruit crops in Romania, grown on an area about 180.000 ha, with an annual wine production of 5,1 hectoliters (INS, 2013).

In the present one of the main task of scientists is to find natural ways of improving plant productivity that lead to environmentally friendly agriculture (Nagy and Pintér, 2014).

Most of the products based on marine algae are extracted from Brown algae *Ascophyllum nodosum*. The use of extracts of seaweed in agriculture is beneficial because the amount of chemical fertilizers and obtaining organic yield (Popescu, 2013).

Seaweed biomass is already used for a wide range of other products in food, nutrient supplements, including application in agriculture and horticulture (Holdt and Kraan, 2011). Seaweed extract

stimuli in plant science and agriculture is described in recent publications such as Fan et al. (2011) and the comprehensive review by Craigie (2011) or by Bulgari et al. (2014).

Seaweed extracts have been used in agriculture as soil conditioners or as plant stimulators. They are applied as foliar spray and enhance plant growth, freezing, drought and salt tolerance, photosynthetic activity and resistance to fungi, bacteria and virus, improving the yield and productivity of many crops (Eris et al., 1995; Norrie and Keathley 2006; Gajc-Wolska et al., 2013; Sharma et al., 2014).

Aziz et al. (2003) found that brown alga *Laminaria digitata* is able to induce a defence response in plants and can be used to protect plants against pathogens such as *Botrytis cinerea* and *Plasmopora viticola* in grapevine.

Fan et al. (2011) studied the effects of root treatment of spinach with commercial extracts of the brown macro alga, *Ascophyllum nodosum* on antioxidant level of spinach were studied. *Ascophyllum nodosum* (L.) is a perennial brown marine alga and it is a widely-researched seaweed species traditionally used as a fertilizer, a soil conditioning agent, animal feed supplement and also as a human nutritional supplement (Fan et al. 2011).

The purpose of this study was to evaluate the effect of liquid seaweed extract made from *Ascophyllum nodosum*, commercially named Alga Special, on some coefficients and growth parameters in grapevine.

2. MATERIALS AND METHODS

The study was carried out in private vine plantation from Stefanesti vineyard. Part of observations and analyses were performed at the laboratories of the University of Pitesti. The plant material tested and evaluated in this research was represented by Feteasca Alba grapevine variety. Feteasca Alba is a commercially Romanian wine white grape. Feteasca Alba is a Romanian traditional grape variety grown in most vineyards and occupying large areas in Romanian viticulture. The selected vines having single trunk with two cans, uniform vigor and health, were selected for the experimental purpose. The selected plants for the experiment received during the growing season the same cultural practices including pruning, crop load, green operations, insecticide and pesticide applications.

The seaweed concentrate Alga Special (AS) (L. Gobbi s.r.l., Campo Ligure, Italia), made completely from natural high concentrated liquid extract of *Ascophyllum nodosum*, was applied as a foliar spray in the following concentration:

- AS 150: Alga Special at a concentration of 0.15% (150 ml hl⁻¹);
- AS 135: Alga Special at a concentration of 0.135 % (135 ml hl⁻¹);
- AS 170: Alga Special at a concentration of 0.17 % (170 ml hl⁻¹).

The achieved results were reported at control vine without seaweed extract foliar application. We determined the effect of liquid seaweed extracts treatments on absolute fertility coefficient and relative fertility coefficient, shoot length, shoot diameter and leaf area.

Aim of this study was to evaluate the effectiveness of biofertilization with seaweed extracts on vegetative growth in grapevine cv. Feteasca Alba in the climatic conditions of the Stefanesti vineyard in order to determine the optimal dosage and timing of application.

A statistical analysis was performed using the ANOVA in the SPSS 16.0 software (IBM Corporation, Armonk, New York, USA) and means were compared using Duncan's multiple range tests at 5% level. The results of this study are expressed as mean.

3. RESULTS AND DISCUSSIONS

Effect of seaweed extracts treatments on absolute fertility coefficient and relative fertility coefficient of grapevine cv. Feteasca Alba is showed in the figure 1. The plants treated with the higher levels of seaweed concentrate produced the highest absolute fertility coefficient and relative fertility coefficient relative to the plants treated with lower concentration of or untreated control plants. The 0,135% seaweed extract of Alga Special rate produced the lower results of absolute fertility coefficient.

Regarding the influence of seaweed extract on fertility coefficients, there were no significant differences between applying AS 150, AS 135 and control vines, but we found significant differences AS 170 concentration and all other foliar application rate ($P < 0.05$).

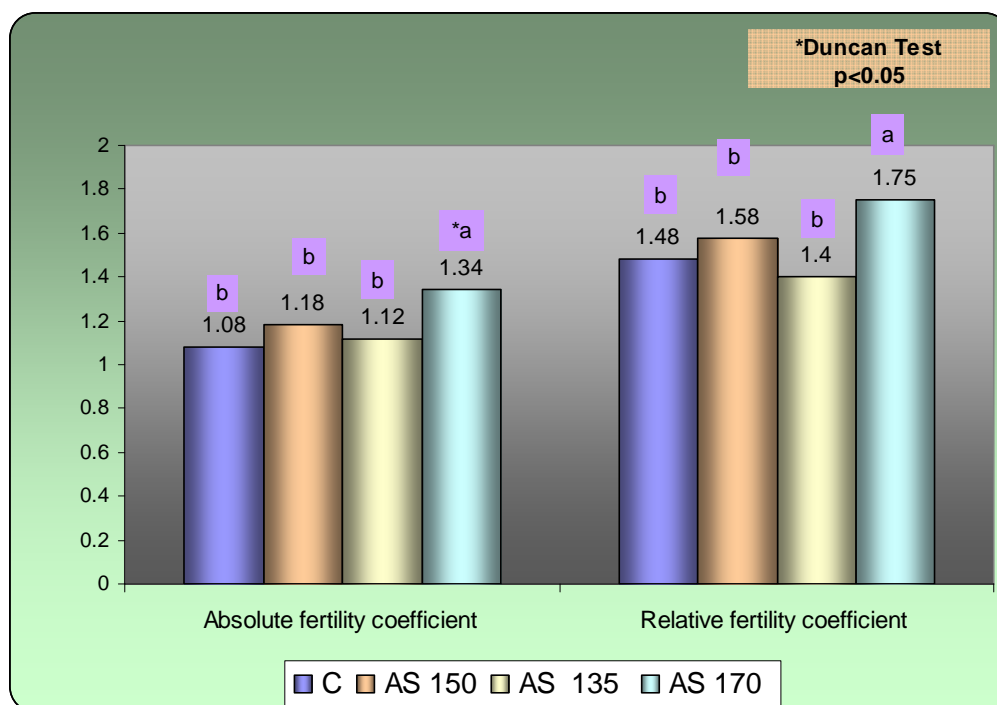


Figure 1. Effect of liquid seaweed extracts (Alga Special) treatments on absolute fertility coefficient and relative fertility coefficient of grapevine cv. Feteasca Alba.

C: control; AS 150: Alga Special at a concentration of 0,15% ; AS 135: Alga Special at a concentration of 0,135 %; AS 170: Alga Special at a concentration of 0,17 %. Data presented as mean. Mean values followed by the same letter are not significantly different according to Duncan's multiple range test ($P < 0.05$).

The achieved results of shoot length varied between 132 cm and 148 cm. Length of treated vine plants was increased by all the seaweed concentrate treatments (fig.2). Plant treated with Alga Special at a higher concentration (0,17 %) showed more increased shoot length than all other application rate.

Regarding the influence of seaweed concentrate on shoot length, there were no significant differences between plants without biofertilization and plants treated with Alga Special at a concentration of 0.15% and 0.135% ($P < 0.05$). The effect of the seaweed extracts of *Ascophyllum nodosum* at a concentration of 0.17% gave a significant ($P \leq 0.05$) increase in shoot length.

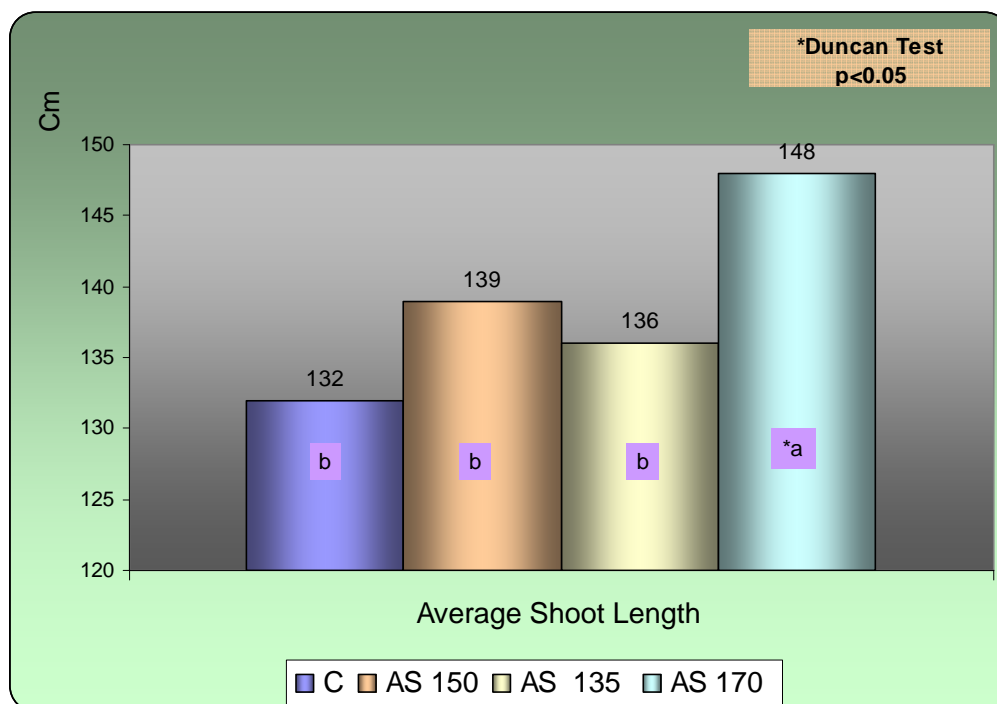


Figure 2. Effect of liquid seaweed extracts (Alga Special) treatments on shoot length in grapevine cv. Feteasca Alba. C: control; AS 150: Alga Special at a concentration of 0,15% ; AS 135: Alga Special at a concentration of 0,135 %; AS 170: Alga Special at a concentration of 0,17 %. Data presented as mean. Mean values followed by the same letter are not significantly different according to Duncan's multiple range test ($P < 0.05$).

Treatments of Alga Special had a positive effect on shoot diameter of treated vines and the register values were between 8.44 mm (control) and 10.42 (AS 170). All concentrations exceeded values of plants without seaweed foliar application (fig. 3). There were no significant differences in shoot diameter of treated vines between treatments with Alga Special at a concentration of 150 ml⁻¹hl and 135 ml⁻¹hl.

Foliar spray application at different concentration of seaweed extract of *Ascophyllum nodosum* influenced the vegetative growth expressed by leaf area of vine stock (fig. 4). Treated grapevine with Alga Special at an all concentration increased leaf area than untreated grapevines. Leaf area of studied plants registered values between 4.24 m² and 5.26 m². The statistical analysis using analysis of variance in the SPSS 16.0 software showed significant differences of leaf area among all treatments.

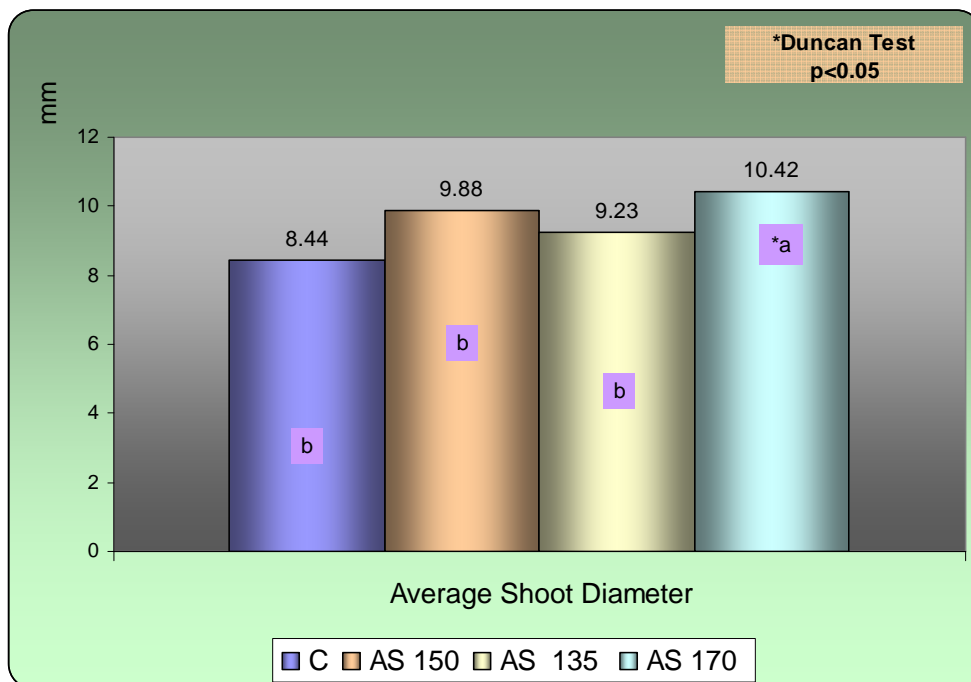


Figure 3. Effect of liquid seaweed extracts (Alga Special) treatments on shoot diameter in grapevine cv. Feteasca Alba.

C: control; AS 150: Alga Special at a concentration of 0,15% ; AS 135: Alga Special at a concentration of 0,135 %; AS 170: Alga Special at a concentration of 0,17 %. Data presented as mean. Mean values followed by the same letter are not significantly different according to Duncan’s multiple range test (P < 0.05).

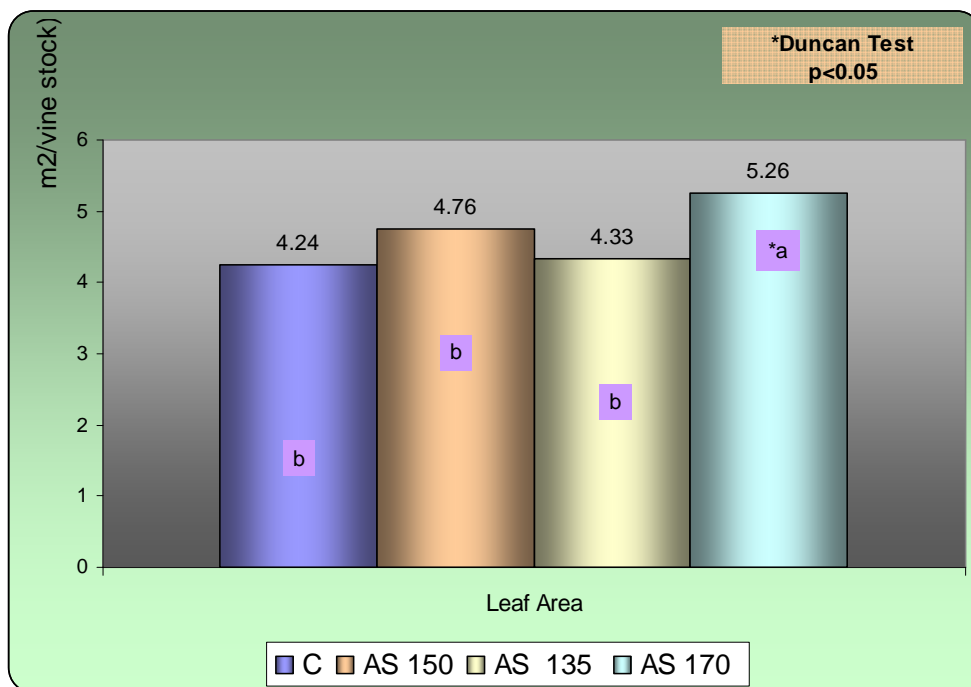


Figure 4. Effect of liquid seaweed extracts (Alga Special) treatments on leaf area of grapevine cv. Feteasca Alba.

C: control; AS 150: Alga Special at a concentration of 0,15% ; AS 135: Alga Special at a concentration of 0,135 %; AS 170: Alga Special at a concentration of 0,17 %. Data presented as mean. Mean values followed by the same letter are not significantly different according to Duncan’s multiple range test (P < 0.05).

Popescu (2013) studied the influence of seaweed *Ascophyllum nodosum* on the species *Phaseolus vulgaris* and *Sinapis alba* and the author found that the soil and foliar fertilization caused had a significant stimulation of plant growth of beans and mustard.

Seaweed and yeast extracts increase protein content in plants as has been shown in *Vicia faba*. However, the increased protein content can be also associated with an increase of carbohydrate concentration in leaves (Abbas, 2013).

Haider et al. (2012) reported the effect of foliar application of seaweed extract Primo as an organic biostimulant on potato (*Solanum tuberosum* cv. Sante) and they found a significant improvement of plant growth, yield and tuber quality. Moreover, it also improved nitrogen, total soluble solids and protein contents of the tubers.

At the concentration of 1.0 g/L of *Ascophyllum nodosum*, treatment significantly increased the total phenolics and flavonoids content, total antioxidant activity in spinach leaves (Fan et al., 2011).

Kelpak product, derived from the seaweed species *Ecklonia maxima* (Kelp), is a natural source of auxins and cytokinins that was evaluated in different concentration on the growth and yield of three varieties of greenhouse cultivated peppers. Application of 0.4% Kelpak as a foliar spray during the growth of the plants significantly increased the number and size of the marketable peppers fruit (Arthur et al., 2003).

4. CONCLUSIONS

Rational use of natural product extracts as an alternative of some chemical inputs for increasing the efficiency of vineyard ecosystem is an important goal to ensure sustainable development of environment and rural activities.

The seaweed extract of *Ascophyllum nodosum* used in this study influenced vegetative growth expressed by length and diameter of shoot and leaf area of vine stock. In this research we found a stimulatory effect of Alga Special foliar application at different rate. Feteasca Alba variety grown the climatic conditions of the vineyard Stefanesti had the best response to the foliar application of *Ascophyllum nodosum* at 0.17% concentration.

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