# INFLUENCE OF SCD ProBio Oryginal<sup>TM</sup> PREPARATION ON THE CONTENT AND RATE OF MICRONUTRIENTS UPTAKE BY LETTUCE

### Agnieszka Dobrowolska, Władysław Michałek

Department of Plant Physiology, University of Life Sciences in Lublin Akademicka str. 15, 20-950 Lublin, wladyslaw.michalek@up.lublin.pl

Summary. The research was aimed at elucidating the influence of varied concentrations of SCD ProBio Oryginal<sup>TM</sup> on the content and rate of macronutrients uptake by lettuce plants. Experiments were carried out in a phytotron at the Department of Plant Physiology, University of Life Sciences in Lublin. Ice lettuce cv. 'Beata' was the test plant species. The directions of the bio-preparation concentration effects on macronutrients accumulation in lettuce were analysed. Results achieved from the experiments revealed that the investigated preparation applied in 2.5% concentration positively affected the macronutrients content in aboveground parts and roots of 2 and 4-week-old seedlings of lettuce. It was found that content of the main macronutrients was at optimum level in aboveground parts and roots of 2-week-old plants. Under such conditions, macronutrients quantities were reduced after 4 weeks of vegetation. A positive influence of 2.5% studied solution on nitrogen, phosphorus, and magnesium uptake by roots of 2-week-old lettuce seedlings was observed. The Rr indicator reached its maximum level. Only potassium and calcium uptake rate appeared to be lower than for control under those conditions. In the case of nitrogen, phosphorus and potassium, the value of Rr indicator for 4-week-old seedlings was higher than for the control plants. The lowest macronutrients contents were recorded for plants treated with 10% solution after 4 weeks of vegetation, when Rr indicator reached its lowest level in the case of three main macronutrients: nitrogen, phosphorus, and potassium.

Key words: effective microorganism (EM), lattuce, activity of microorganisms, content and rate of macronutrients uptake

## INTRODUCTION

SCD ProBio Oryginal<sup>TM</sup> (formerly EM-Farming) contains fungi, actinomycetes, yeasts, and many bacterial strains, e.g. photosynthesising bacteria and lactic acid bacteria [Mau 2007]. A combined action of aerobic and anaerobic microorganism strains is far better than if they were to be applied separately. Schneider *et al.* [2003] reported that the efficient action of the preparation results – among others – from the fact that microorganisms form complexes surrounded by double-layer capsules. Janas and Grzesik [2005] found that SCD ProBio Oryginal<sup>TM</sup> applied for pre-sowing seed treatment exerted some significant effects on the quality and healthiness of the crops obtained. Therefore, it can be an alternative for chemical dressings used currently. Moreover, results from recent investigations revealed that substances contained within the preparation may enhance the availability of macronutrients, hence positively influencing plants growth and health status. However, the complicated character of physiological transformations being the grounds for macronutrients uptake by plants has not been fully recognized yet.

Therefore, taking into account above premises, it seemed to be reasonable to undertake studies upon evaluating the optimum concentration of SCD ProBio Oryginal<sup>TM</sup> solution, at which macronutrient contents and their uptake rate by lettuce plants would be at the best level, which greatly determines the biological quality of a plant biomass.

### MATERIAL AND METHODS

The study was carried out in a phytotron at the Department of Plant Physiology, University of Life Sciences in Lublin. Ice lettuce cv. 'Beata' was the test plant species. Twenty-five seeds were placed on Petri dishes covered with filter paper. Afterwards, aliquots of 5 ml of SCD ProBio Oryginal<sup>TM</sup> solution at 2.5% and 10% concentrations were poured onto each dish. The control series of seeds was treated with distilled water instead of the studied preparation. Another part of the experiment focused on plant vegetation: it was set by means of pot cultures and seedlings grown on Petri dishes were transferred to pots filled with versatile subsoil applied for vegetable cultivation. Plants were harvested after 2 and 4 weeks of vegetation, then dry matter of above ground parts and roots was evaluated. Harvested material was subjected to determinations of nitrogen content - by means of Kjeldahl method; phosphorus and magnesium - colorimetrically (magnesium – with titanium vellow, phosphorus – vanadomolybdate); potassium and calcium - photometrically (Tab. 1). Based on achieved results, the rate of minerals uptake by lettuce roots was calculated using the following formula applied in a publication by Tuner and Lahaw [1985]:

$$Rr = [(InWr_2 - InWr_1)/(t_2 - t_1)] \times [(M_2 - M_1)/(Wr_2 - Wr_1)]$$

where:

 $Wr_1$  and  $Wr_2$  – dry matter of roots,

 $M_1$  and  $M_2$  – weight of analysed mineral components at plants after  $t_1$  and  $t_2$  periods, respectively.

Achieved numerical data were subjected to statistical analysis. When differences appeared to be significant, the Tukey confidence intervals were calculated and marked as LSD in whole research (Tab. 2).

### **RESULTS AND DISCUSSION**

Experimental plants were treated with various concentrations of tested preparation. It was observed if and to what degree it would affect the macronutrient accumulation in lettuce. When the studied preparation was applied at concentration of 2.5%, its positive effects on macronutrients contents in aboveground parts of plants and roots were recorded for lettuce seedlings 2 and 4--week-old (Tab. 1). The aboveground parts of 2-week-old plants contained the highest recorded levels of the main nutrients - nitrogen and phosphorus, while the roots – nitrogen, potassium and magnesium. For 4-week-old lettuce seedlings, potassium and magnesium appeared to be accumulated at the most favourable levels in aboveground parts, whereas phosphorus – in roots. The rate of nitrogen, phosphorus and magnesium uptake by roots of 2-week-old lettuce seedlings was the most beneficial, which was confirmed by Rr index value. Parameters related to potassium and calcium uptake were lower as compared to the control under these conditions (Tab. 2). For the 4-week-old plants, only nitrogen, phosphorus and potassium uptake was at favourable levels, while those of calcium and magnesium uptake were lower.

Two-week-old lettuce seedlings treated with 10% solution of the studied preparation were characterised by lower contents of macronutrients as compared to control plants (Tab. 1). The rate of minerals uptake by roots was also the lowest under such conditions. The value of Rr index reached the least favourable level, which particularly referred to calcium and magnesium uptake (Tab. 2). The preparation ProBio Oryginal<sup>TM</sup> applied at 10% concentration for 4-week-old lettuce plants caused that nitrogen, phosphorus and potassium uptake rate was the lowest (Tab. 2). The opposite reaction was observed in the case of calcium and magnesium, which may be illustrated by Rr index value (Tab. 2).

Concentrations of SCD ProBio Oryginal <sup>TM</sup> , %	Percentage of minerals contents									
	aboveground parts					roots				
	Ν	Р	Κ	Ca	Mg	Ν	Р	Κ	Ca	Mg
0-control 2.5 10	after 2 weeks									
	3.14	0.62	4.95	1.10	0.50	2.11	0.40	3.17	0.44	0.34
	3.22	0.65	5.05	1.22	0.50	2.33	0.45	3.30	0.50	0.41
	2.94	0.54	4.42	0.95	0.43	1.85	0.34	3.02	0.52	0.30
0-control 2.5 10	after 4 weeks									
	2.93	0.51	5.11	0.87	0.55	1.93	0.44	3.00	0.40	0.30
	3.12	0.60	5.25	1.05	0.55	2.04	0.50	3.10	0.45	0.36
	2.60	0.45	4.30	1.42	0.42	1.70	0.32	2.31	0.46	0.28

Table 1. Influence of SCD ProBio Oryginal<sup>TM</sup> preparation on macronutrients contents in lettuce cv. 'Beata' harvested after 2 and 4 weeks of vegetation (mean values for 2008–2009)

Concentrations of SCD ProBio Oryginal <sup>TM</sup> , %	Ra Rr	LCD -+ D					
0-control 2.5 10	Ν	Р	K	Ca	Mg	LSD at $P_{0,05}$	
	34.20	5.10	30.50	4.10	3.80	0.36	
	36.60	6.00	28.60	3.90	4.30	0.25	
	29.50	4.60	26.00	2.70	1.85	0.20	
0-control 2.5 10							
	28.00	4.00	28.60	3.60	3.30	0.45	
	30.30	5.20	33.30	3.20	3.00	0.30	
	26.00	3.40	26.00	3.70	3.50	0.25	

Table 2. Influence of SCD ProBio Oryginal<sup>TM</sup> on the rate of minerals uptake by roots (Rr) of 2 and 4--week-old lettuce seedlings cv. 'Beata' (mean values for 2008–2009)

The above results are somehow a confirmation of findings by Denisiuk and Szembowski (2008), who reported that application of the preparation for potato cultivation caused an increase of the contents of some chemicals, which contributed to more intensive gains of tuber biomass. Also experiments by Piskier [2007], performed using spring barley, can prove a prominent yield increase and its structure elements, due to which a clear increase of biological yield of test plants was recorded.

### CONCLUSIONS

1. When the preparation SCD ProBio Oryginal<sup>TM</sup> was applied at 2.5% concentration, an increase of macronutrients contents in aboveground parts and roots of 2 and 4-week-old lettuce seedlings was observed. A reciprocal tendency was observed for plants treated with 10% solution.

2. The highest concentrations of minerals such as nitrogen, potassium and magnesium in roots were recorded after 2 weeks of lettuce vegetation.

3. The lowest rate of macronutrients uptake occurred in 2 and 4-week-old lettuce plants treated with 10% solution of SCD ProBio Oryginal<sup>TM</sup>, although changes in these contents were not uniform.

## REFERENCES

- Denisiuk W., Szembowski B., 2008. Opportunities to enhance the potential of potato tubers biomass in EM-Farming biotechnology. Conference Proc., 45–49.
- Janas R., Grzesik M., 2006. Biological efficiency of protection methods in cultivation of medicinal and ornamental seed plants. Postępy w Ochronie Roślin, 46, 12–18.

- Mau F.P., 2007. Amazing results of applying the efficient microorganisms at home and garden for better growth of plants and for health. Fundacja Źródła Życia, Mszczonów, 34–36.
- Piskier T., 2006. Reaction of spring wheat to applying the bio-stimulators and soil absorbents. J. Res. App. Agricul. Eng., 53(3), 167–171.
- Schneider Z., Starzycki M., Schurig R., XXXVII Preliminary studies upon organization of efficient microorganisms (EM) and stimulating action of ceramic sinter (EM-ceramics), 38. Intern. Microbiological Symposium 'Efficient microorganisms EM in sustainable farming and environment protection, Rogów k. Łodzi, 86–87.
- Turner D.W., Lahaw E., 1985. Temperature influences nutrient absorption and uptake rates of bananas grown in controlled environments. Sci. Hort. 26, 311–322.

#### WPŁYW PREPARATU SCD ProBio Oryginal<sup>TM</sup> NA ZAWARTOŚĆ I TEMPO POBIERANIA MAKROSKŁADNIKÓW PRZEZ SAŁATĘ

Streszczenie. Podjęte badania miały na celu wyjaśnienie wpływu zróżnicowanych stężeń SCD ProBio Oryginal<sup>TM</sup> na zawartość i tempo pobierania makroskładników przez sałate. Cykl badań przeprowadzono w fitotronie Katedry Fizjologii Roślin UP w Lublinie. Roślina eksperymentalną była sałata krucha odmiana 'Beata'. Przeanalizowano, w jaki sposób stężenie biopreparatu wpłyneło na akumulacje makroskładników w sałacje. Na podstawie wyników uzyskanych z przeprowadzonych badań stwierdzono, że zastosowanie preparatu w stężeniu 2,5% wpłynęło korzystnie na zawartość makroskładników w częściach nadziemnych oraz w korzeniach sałaty u 2- i 4-tygodniowych roślin. Stwierdzono, że zawartość głównych makroskładników była na optymalnym poziomie u roślin 2-tygodniowych w częściach nadziemnych i w korzeniach. W tych warunkach zawartość makroelementów uległa obniżeniu po 4 tygodniach wegetacji. Stwierdzono korzystny wpływ roztworu 2,5% na pobieranie azotu, fosforu i magnezu przez korzenie sałaty roślin 2-tygodniowych. Wskaźnik (Rr) kształtował się na najwyższym poziomie. Jedynie tempo pobierania potasu i wapnia było w tych warunkach niższe w porównaniu do kontroli. U roślin 4-tygodniowych wartość współczynnika Rr jedynie w przypadku azotu, fosforu i potasu kształtowała się na wyższym poziomie niż u roślin kontrolnych. Najmniejszą zawartość makroskładników zaobserwowano u roślin potraktowanych roztworem 10% po 4 tygodniach wegetacji. W tych warunkach współczynnik Rr kształtował się na najniższym poziomie, zwłaszcza w przypadku trzech głównych makroskładników, czyli azotu, fosforu i potasu.

**Słowa kluczowe:** efektywne mikroorganizmy, sałata, aktywność mikroorganizmów, zawartość i tempo pobierania makroskładników