THE EFFECT OF *CLAMYDOMONAS* AND *ASTEROCOCCUS* GREEN ALGAE SPECIES ON SOIL STATUS CONSERVATION IN SWEET PEPPER GROWING

[1]Ferenc Lantos, [1]Tímea Horváth, [2]Attila Rózsás

[1]University of Szeged Faculty of Agriculture Hódmezővásárhely, Hungary
[2]Szentesi Mag Ltd. Szentes, Hungary
lantos@mgk.u-szeged.hu

ABSTRACT
In Hungary the most important vegetables is the sweet pepper (*Capsicum annuum* L.). In today's agriculture the preservation of soil fertility is a very important factor. In plant cultivation we can use organic nutrients or fertilizers to supplement soil nutrients. In the summer period of 2012 in a sweet pepper (*Capsicum annuum* L.) growing experiment we used a complex Biofluid vermicompost and an organic nutrient composed of *Clamydomonas* and *Asterococcus* (Chlorophyta) green algae species. As control, we applied Poly-feed N:16; P_2O_5:9; K_2O:26 chemical fertilizer containing micronutrients for sweet peppers. At the end of the growing period we analysed the soil samples for humus status and other nitrogen-containing compounds of soil. The natural soil conditions can only be restored by eco-friendly materials, which increase the productivity of the soil, but do not threat the environment. They restore the original ecosystem, which has been steadily destroyed by industrial production.

Keywords: green algae species, *Capsicum annuum* L., organic nutrient, sweet pepper growing,

INTRODUCTION

In Hungary, the maintenance of soil fertility is regulated by strict laws. The law allows farmers to use both natural and chemical fertilizers. In order to supply natural nutrient sources more and more biologically active substances are used.

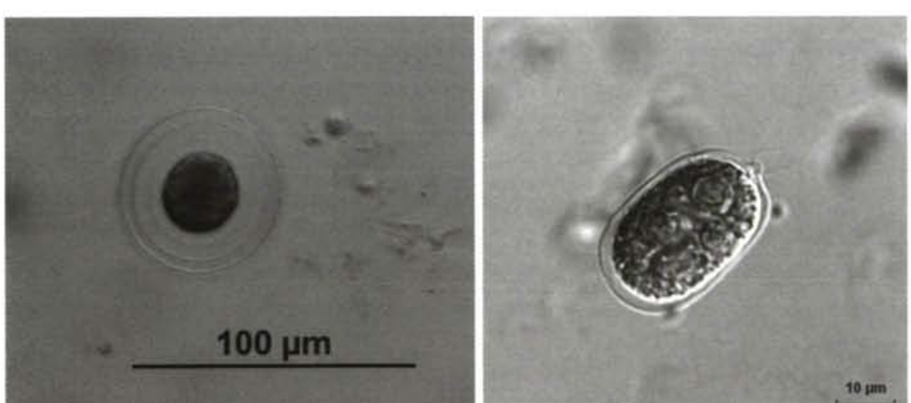

Figure 1. The cell structure of *Asterococcus* (left) and *Clamydomonas* (right) green algae species
(Melichar, 2011).

The micro-algae and cyanobacteria are beneficial organisms existing in soils. The algae are eukaryotic microorganisms capable of photosynthesis and they are able to have a positive impact on binding atmospheric nitrogen (Murray, 2004). They increase soil organic matter content, with their oxygen production reduce the damage of sulfides in soils likely to reduce sulfates. Their structure is made up of extracellular polysaccharides therefore greatly improve the soil structure (Gudin & Chaumont, 1983; Nakazawa et al., 2004). The term soil algae is a generic term, which includes obligate, facultative algae living in the soil and cryophyte algae living on the surface of snow and ice (ETTL & GÄRTNER, 1995). Based on the results of several years of research (FEHÉR, 1936; TRAINOR & MCLEAN, 1964; HUBER, 1985; DAVEY & ROTHERY, 1992) it is found that the activities of soil algae are mostly influenced by the light, moisture, temperature, soil pH, and the soil nutrients (LEPOSSA, 2003).

MATERIAL AND METHOD

Our research was carried out at the Institute of Szentesi Mag Ltd. in Szentes, situated on the South Plain in the growing period (from May - to August) of 2012. The Antal F_1 Hungarian sweet pepper hybrid was grown in a 25 m long, 9 m wide plastic covered greenhouse. In the growing period we provided 80-90% relative humidity and a temperature of 26-30 °C in daytime and 18 °C at night. The plastic-cover greenhouse was divided into two equal sections. In the first section, following the phenological stages of plants, micro-algae composition comprising elements was used for the nutrient supply of sweet peppers in 4 different periods (*Table 1*). Biofluid vermicompost microbial plant conditioner concentrate was used in appropriate dilution as macronutrient supplement at the same time when the algae was given. In the second section Poly-feed 16-9-26 microelement containing complex fertilizer was delivered to the plants. The nutrient supply of sweet peppers was periodically repeated from planting to the end of the growing season. Our research was based on the analysis of the starting soil status and on soil samples taken at the end of the growing with special regard to the preservation of the original humus content and other nitrogen-containing compounds (*Table 2*).

Table 1. The application of green algae and Biofluid fertilizers in sweet pepper growing

Time of treatments	Dilutions (%)	Methods of treatment
soil preparation	3-5	drop irrigation
planting	3	drop irrigation
before blooming	5	drop irrigation and leaf spray
fruit ripening	5	drop irrigation and leaf spray

The materials of nutrient supply:

- Poly-feed 16-9-26 chemical fertilizer: N: 16%; P_2O_5: 9%; K_2O: 26%. Microelements: MgO: 2,5%; SO_3: 25%; B: 0,01%; Cu: 0.01%; Fe: 0.1%; Mn: 0,1%; Mo: 0,004%; Zn: 0,025%.
- Green algae natural fertilizer: pH 6-7; N: 0.25%; P_2O_5: 0.1%; K_2O: 14%, Ca: 0,5%; MgO: 9000 mg/kg, B: 0,01%; Cu: 0,01%; Fe: 0,1%; Mn: 0,1%; Mo: 0,001%; Zn: 0,01.
- Biofluid vermicompost plant conditioner: pH 6-7; N: 2,5%; P_2O_5: 2%; K_2O: 2%.

RESULTS

Based on the results at the end of the growing season, it was found that after harvesting an average of 7,8 kg/m^2 sweet pepper yield, the humus fraction of the area treated with fertilizer significantly degraded, however the humus concentration value of the ones treated with green algae improved. *Table 2* shows that the level of other nitrogen-containing compounds of the soil showed better results when treated with *Clamydomonas* and *Asterococcus* green algae species than then the one treated with fertilizer. It was the result of the nitrogen-absorbing capability of the soil algae. The pH level of the soil treated with green algae did not change; it was on the value optimal for sweet pepper growing. However, the pH shifted to a 7.6 basic direction, which may inhibit the uptake of anions and risk the nitrogen absorptivity of any soil microorganism (*Table 3*). In both cases, the K_2O concentration of the soil decreased to a value, which can not ensure to successful growing of sweet pepper. Therefore, at the autumn soil preparation an increased potassium incorporation of manure is required.

Table 2. The results of greenhouse soil samples

SZENTES	pH	Salt content (m/m%)	$CaCO_3$ (m/m%)	Humus (m/m%)	P_2O_5 (mg/kg)	K_2O (mg/kg)	NO_3-NO_2-N (mg/kg)
initial soil condition	6,7	<0,02	5,89	5,86	7404	2182	6,27
chemical fertilizer	7,6	<0,02	1,0	2,9	3000	550	10
natural fertilizers	6,8	<0,02	4,9	6,05	5317	382	23,53

(Laboratory of DABIC Kht. Szentes, 2012)

Table 3. pH value of nitrogen absorptivity of soil micro-organisms

Soil microorganism	Optimal soil pH value
Rhizobium sp.	6,0 - 7,0
Azomonas agilis	6,5 - 7,5
Beijerinckia derxii	4,5 - 6,0
Actinomyces cellulosae	6,0 - 7,0

(WWW. TANKONYTAR.HU, 2012)

There was no significant difference between the crop yield of the two treated sections. From both sections 5544 kg pepper bells were harvested, respectively. It was an excellent average of 7,8 kg/m^2 crop yield, out of which 60% was first class, 30% second class and 10% under class quality pepper. Our experiment justified that the effect of *Clamydomonas* and *Asterococcus* green algae supplement and vermicompost microbial plant conditioner was not worse than that of the chemical fertilizers.

CONCLUSIONS

The experimental results of 2012 year have clearly demonstrated that the green algae treatment in the intensive sweet pepper growing for preservation of soil status, the addition of Biofluid use is advisable. However, several years of production experience is required to analyze the effectiveness. Ours major experience: "The natural soil conditions can only be restored by eco-friendly materials, which increase the productivity of the soil, but do not threat the environment. They restore the original ecosystem, which has been steadily destroyed by industrial production (J. NEYER)".

REFERENCES

DAWEY, M.C., ROTHERY, P. (1992): Factors causing the limitation of growth terrestrial algae in maritime Antarctica during late summer. Polar. Biol. 12: 595-601. pp.

ETTL, H., GÄRTNER, G. (1995): Syllabus der Boden- Luft- und Flechtenalgen. Gustav Fischer Verlag. Stuttgart, Jena, New York. 721 pp.

FEHÉR D. (1936): Über die Algenflora des Waldbodens. Silva 24 (13): 101-108 pp.

GUDIN, C., CHAUMONT, D. (1983): Solar biotechnology study and development of tubular solar receptors for controlled production of photosynthetic cellular biomass. Proceedings of the Workshop and EC Contractor's Meeting in Capri. Reidel, Dordrecht, Holanda, pp: 184-193. pp.

HUBER, A.L. (1985): Factors affecting the germination of akinetes of Nodularia spumigena (*Cyanobacteriae*). Appl. Environ. Microbiol. 1985. 73-78. pp.

TRAINOR, F.R., MCLEAN, R.J. (1964): A study of new species of *Spongiocloris* introduced into sterile soil. Amer. J. Bot. 51: 57-60. pp.

LEPOSSA, A. (2003): A talajalgák mennyiségi vizsgálata a Balaton-Felvidéki Nemzeti Parkban, valamint a talajból izolált algatenyészetek növényi növekedést befolyásoló hatásainak kimutatása. PhD Doktori értekezés. Veszprémi Egyetem Növénytermesztési és Kertészeti Tudományok Doktori Iskola.

MELICHAR, A. (2011): Floristická studie vodních sinic a řas v jihovýchodní části kraje Vysočina. Jihočeská univerzita v Českých Budějovicích Přírodovědecká fakulta Diplomová práce.

MURRAY, W. (2004): Introduction to Botany. San Francisco, CA: Pearson Education, Inc. ISBN 0-8053-4416-0.

NAKAZAWA, A., YAMADA, T., NOZAKI, H. (2004): Taxonomic study of *Asterococcus* (Chlorophyceae) based on comparative morphology and *rbc*L gene sequences. Phycologia 43: 711-721. pp.

WWW. TANKONYTAR.HU (2012)