NDONA, R.[1], SPORNBERGER, A.[1], JEZIK, K.[1], RINNOFNER, T.[2], FRIEDEL, K. J.[2], LAIMER, M.[3], MARZBAN, G.[3], KLIMA, H .[4]

Influence of Effective microorganisms as a means of improving the quality of tomatoes in protected cultivation

University of Natural Resources and Applied Life Sciences, Vienna

Problem and research issues

Effective Micro-organisms, "EM“ is a mixture of different types of microorganisms. Practitioners and scientists reported the significant positive effects of the mixture in agriculture. The objective of the 2-year research project was to investigate the influence of EM on tomato plants in pots in a plastic tunnel greenhouse. In addition, comparison of two planting patterns, linear and elliptical, was conducted (Figure 6).

Table 1: Plant treatments in the variant EM in 2006 and 2007

2006	2007	Agent	Concentration	Water
01.06.	29.05.	EMa® + EM5 + EM FPE + stone powder	0,33 % + 0,06 % + 0,06 % + 0,80 %	1,5 l
27.06.	19.06.	EMa® + EM5 + EM FPE + stone powder	1,50 % + 0,03 % + 0,03 % + 0,12%	10 l
18.07.	10.07.	EMa® + EM5 + EM FPE + stone powder	1,50 % + 0,03 % + 0,03 % + 0,12%	10 l
08.08.	31.07.	EMa® + EM5 + EM FPE + stone powder	1,50 % + 0,03 % + 0,03 % + 0,12%	10 l
29.08.	21.08.	EMa® + EM5 + EM FPE + stone powder	1,50 % + 0,03 % + 0,03 % + 0,12%	10 l
19.09.	11.09.	EMa® + EM5 + EM FPE + stone powder	1,50 % + 0,03 % + 0,03 % + 0,12%	10 l
07.10.	01.10.	EMa® + EM5 + EM FPE + stone powder	1,50 % + 0,03 % + 0,03 % + 0,12%	10 l

Figure 6: Tomato plants in pots in plastic tunnel.

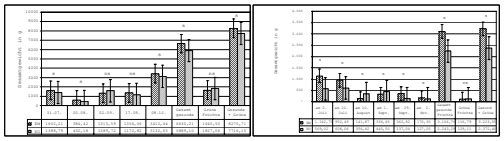

Figure 7: Total weight of the harvested fruits in gram per plant in 2006 (left) and in 2007 (right); Comparison of EM-treatment and control

Materials & Methods

The tomato varieties "Cassiopeia" and "Mercedes" were used in 2006 and 2007 growing seasons, respectively. A Complete Randomized Block Design (RCBD) with 2 treatments (EM and tap water as a control) and 2 planting patterns (line and ellipse shape) was established in 5 replications. The plants with EM treatment received EMa® via irrigation water, while the control plants received a tap water only; furthermore, in the EM variant additional plant spraying treatments were made (table 1), whereas no additional treatments were made in the control. Regarding the substrates, in 2006 EM treated plants were grown in EDAPHOS ® e-Mix (Edaphos 2 + Mest-Best 3) and EM Bokashi while the control plants were grown in EDAPHOS only. In the second year (2007), EDAPHOS and spelt bran (fermented with EMa®= Bokashi) was used as substratum in the EM treatment and EDAPHOS and spelt bran (without EMa®) in the control. Thus, different types of tests and methods were carried on, among others, analysis of chlorophyll, leaves and substrates nutrient analyses, biophotons of fruits and leaves, an allergic analysis of tomato fruits, and potential of fruit yield (productivity). The chlorophyll measurements were made by the acetone method. Inorganic nitrogen in the substrate (N_{in}) was measured with the ÖNORM L 1091 method, microbial biomass nitrogen (N_{mic}) with the fumigation-extraction method. Nutrient analyses were arranged in different methods: analysis system CNS-2000 of LECO, Atom absorptions spectrophotometer and ÖNORM L methods. For the allergic analysis, SDS-PAGE and WESTERN BLOT analyses were used. For biophotons, a single photon counting method was employed. Statistical analysis of data was made with SPSS-15.0 (ANOVA, t-Test, $P < 0.05$).

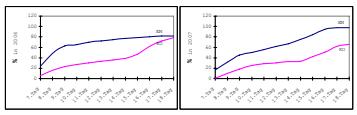

Figure 1: Germinating rate of (in each case 125) seeds of tomato varieties to 21 days after the sowing (to 18.4.2006 and to 15.4.2007); Comparison of EM-treatment and control

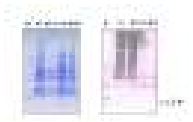

Figure 2: Proof of „LTP “ in the control variant

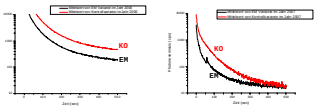

Figure 3: Average value of photon emission of fruits (scale type: Log10) in 2006 and 2007

Results and discussion

In both years, the following results were obtained in the "EM" treated pots in comparison to the untreated control: a significantly higher yield of marketable fruits (Figure 7), less fruits with blossom end rot (3 % in “EM” treated and 31 % in untreated control in 2007, Figure 4), a significantly higher chlorophyll "ab" and "a" content, in both years, a significantly lower N_{min} content in the substrate was measured in the EM-treated plants compared to the untreated control plants (Figure 5) corresponding to a significantly higher microbial biomass nitrogen content in the EM-variant compared to the control (table 2). The LTP-allergen was found in water treated tomatoes, but not in ‘EM’ treated ones. The number of biophotons was higher in the control than in ‘EM’ treated tomatoes, which is related to a high stress load and a quality loss. Brix and dry mass of EM treated fruits found to be significantly higher in both years while the electric resistance was significantly higher only in 2007 (Figure 8). Higher germination rate (Figure 1), in EM-mixture treated plants were observed probably as a result of higher microbial biomass in the treated substrate.

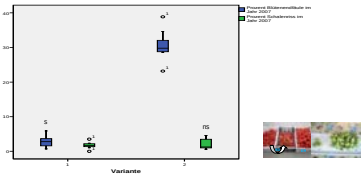

Figure 4: Blossom end rot and bowl tear in % of all fruits; (ANOVA for $P < 5\%$); Comparison of EM-treatment and control

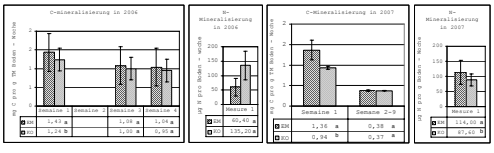

Figure 5: C-mineralizing and N-mineralizing of substrate with EM-Bokashi (EM) and control substrate (KO)

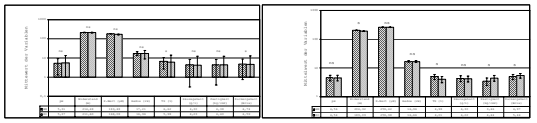

Figure 8: Fruit quality measurement

Table 2: microbial biomass in the substrate

	C_{mik} (µg g^{-1} Boden-TM		N_{mik} (µg g^{-1} Boden-TM	
	2006	2007	2006	2007
EM	2112 a	1746 a	363 a	234 a
KO	1921 b	1414 b	338 a	161 b

[1] Department of Applied Plant Sciences and Plant Biotechnology, Institute of Horticulture, Fruit-Growing and Viticulture, University of Natural Resources and Applied Life Sciences, Vienna; kayamba.ndona@boku.ac.at
[2] Department of Sustainable Agricultural Systems, Division of Organic Farming, University of Natural Resources and Applied Life Sciences, Vienna
[3] Department of Biotechnology, Institute for Applied Microbiology, Unit of plant Biotechnology/Proteomics, University of Natural Resources and Applied Life Sciences, Vienna
[4] Atomic Institute of the Austrian Technical University, Vienna