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

Problem and research issues

Developed in Japan, Effective Microorganisms, "EM", constitute a mixture of different types of microorganisms, which are found in nature and are bred in a special manner. Practitioners and scientists have reported significant positive effects of the mixture when used in agriculture. The objective of the 2-year research project was to investigate the extent to which, in combination with stone powder, EM would influence the growth, yield and susceptibility to disease of tomato plants in pots in a plastic tunnel greenhouse. (Figure 6).

Table 1: Plant treatments using EM variants 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

Materials & Methods

Over two years, the tomato varieties "Cassiopeia" (2006) and "Mercedes" (2007) were tested in a plastic tunnel at the Vienna University of Life Sciences research centre in Jedlersdorf. Two batches were compared, one with EM in combination with stone powder and the second as a control, whereby each year, ten repeats were made using eight plants in pots (30x30x30cm) arranged in a Complete Randomized Block Design (RCBD). The 80 plants of the combined EM-stone powder batch were continually watered with 0.120l of EMa® weekly and at intervals of approx. 3 weeks were sprayed with a mixture of EMa®, EM5, EMFPE and stone powder (Table 1), initially by hand and then by means of a backpack. In addition to this variation, in 2006, Bokashi (= spelt bran fermented with EMa®) was added to the plant substrate. In order to increase the comparability of the two variations, in the second year (2007), the appropriate amount of spelt bran was added to the substrate of the control batch (without EMa® fermentation). The untreated control plants were sprayed with water (without EMa®) on the same days as the EM batch was watered. Among other parameters, growth, yield, the nutrient content in the leaves and substrate, the biophotons in the fruit and leaves and the allergen content in the fruit were all measured. The chlorophyll measurements were made using the acetone method, while inorganic nitrogen in the substrate (Nin) was measured with the ÖNORM L 1091 method and microbial biomass nitrogen (Nmic) with the fumigation-extraction method. Diverse nutrient analysis methods were utilised such as the LECO CNS-2000 analysis system CNS-2000, an atom absorption spectrophotometer and ÖNORM L methods. For biophotons, a single photon counting method was employed and SDS-PAGE and WESTERN BLOT analyses were used for allergen analysis. A statistical data analysis was made with SPSS-15.0 (ANOVA, t-Test, $P < 0.05$).

Fig. 6: Test arrangement of the pots in the plastic tunnel

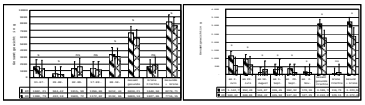

Fig. 7: Total weight of the harvested fruit in grams per plant in 2006 (l.) and in 2007 (r.). Comparison of EM-treated and untreated batches.

Results and discussion

A higher germination rate and earlier plant growth could be observed among the EM treated pots (Fig.1) in 2006 and 2007. As compared to the untreated control batch, the EM stone powder plants demonstrated a significantly higher yield of marketable fruits (Fig. 7) in both years. Moreover, in 2007, the EM batch contained far fewer fruits with blossom end rot than the untreated batch (3%:31%,Fig. 4). In both years, the EM variation also demonstrated a markedly higher chlorophyll "ab" and "a" content. In the EM-treated plants, an increase in the microbial biomass (Cmik and Nmik) within the substrate was determined, which in 2007 was confirmed by higher C- and N-mineralization on both the examination dates. The lower levels of available nutrients had no negative effects on the yield and quality of the EM-treated batch. On the contrary, the very high N_{min} content in the control batch could possible have been responsible for poor plant health (Fig.4 and 5). The nsLTP-allergen was found in tomatoes from the control batch, but not in the EM-stone powder treated plants (Fig.2). The number of biophotons was higher in the control batch than in the EM-treated tomatoes, which points to a high stress load in the control plants.

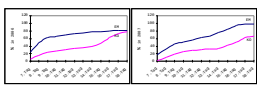

Fig. 1: Germinating rate after sowing (up to 18.4.2006 and 15.4.2007). Comparison of 125 EM-treated and control seeds

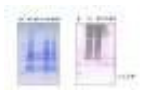

Fig. 2: Proof of LTP allergens in the control batch

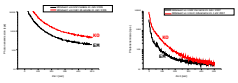

Fig. 3: Biophoton emissions from the fruit (original analyses, scale: Log10) in 2006 and 2007

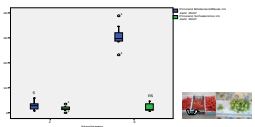

Fig. 4: Blossom end rot and bowl tear in % of all fruits; (ANOVA for $P < 5\%$); comparison of EM-treated (EM) and control plants (KO)

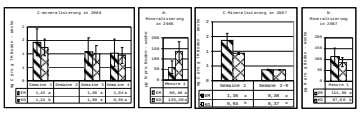

Fig. 5: C-mineralizing and N-mineralizing of the substrate in the EM-treated (EM) and control batches (KO)

Fig. 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

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