Enterobacter cloacae Bacterium as a Growth Regulator in Greenhouse Cucumbers (*Cucumis sativus* L.)

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Introduction: There is a great diversity of microorganisms inhabiting the plant rhizosphere and exerting an influence on their development. Some of them - the fungi *Trichoderma sp*. and *Gliocladium sp.,* the bacteria *Streptomyces griseoviridis* and *Pseudomonas putida* are used for disease control in vegetable crops (3, 5, 8). It is known that the phytopathogene antagonists stimulate plant growth and increase plant yield (1). The bacteria from genus *Enterobacteriaceae* play an important role in the biocenose links in cereals by promoting nitrogen-fixation (6*). Enterobacter cloacae* is described as an antagonist of *Pythium sp*., which causes cucumber root rot, and increases soil suppression in soils infected with *Fusarium oxysporum*. It can also be used as a seed treatment (4, 7). Possibilities for the use of *Enterobacter cloacae* for control of powdery mildew and downy mildew in greenhouse cucumbers have been studied (2). In this article we shall discuss the results from the investigation of the *Enterobacter cloacae* properties to stimulate cucumber growth.

Material and Methods: We multiplied the *Enterobacter cloacae* bacterium (isolate 1B) on an agar-meat infusion (AMI) at t +32^{o}C within 72 hours. The bacterial suspension with a titre of 1.10^{10} cells/ml was used for the pre-sowing soaking of seeds for 8 hours and for watering the soil after sowing by 5 l/m^2. The germinated plant percentage, plant height two weeks after germination, stem height, leaf number and the phenophase one month after planting were recorded. In order to be determine the germination percentage, we used 100 seeds. We planted 20 plants on constant place for each treatment. In the control treatments we sowed seeds without preliminary soaking in the bacterial suspension and water for 8 hours. An analysis of variance of the data at P = 5% was made.

Results and Discussion: The results from the experiments showed that the soaking of cucumber seeds in the bacterial liquid for 8 hours before sowing stimulates germination (Table 1). It was established that in the control treatment without preliminary seed soaking there were 73.0-80.0% germinated plants twenty days after the sowing. With soaking in water, there were 80.0-90.0% germinated plants, and in the treatment with soaking in bacterial suspension there were 86.0-95.0% germinated plants. Watering of the sown seeds with the bacterial suspension stimulated the germination as in the treatment with soaking of seeds in water. The effect of this treatment is manifested two weeks after germination (Figure 1). The analysis of the seedlings conditions two weeks after germination showed that in the treatment where the soil is watered with bacterial suspension, 55% of the plants had a stem height of 10-15 cm, 39% had a stem height over 15 cm, and only 6% had a stem height below 10 cm. Seedlings from the group with treated seeds also are near to these values. For comparison, in the control treatment 37% of the plants were below 10 cm in height, 13% were over 15 cm in height, and 50% were between 10 and 15 cm. Therefore the seedlings were bigger when the soil and seeds were treated with bacterial suspension. The measuring of some biometric plant indices one month after their planting in a constant place showed that in the treatments with processing of the seeds and soil, the plants are more vigorous and had larger vegetative mass (Table 2). The fruit formation in these treatments started earlier and the yield per plant was considerable higher compared to the treatments where the bacterial suspension had not been applied. The stimulation effect of the bacterium *Enterobacter cloacae* on growth and yield in greenhouse cucumbers probably is due to the ability of bacteria from this genus to produce extracellular polysaccharides, serving as growth regulators.

The results from these investigations expand the possibilities for the use of *Enterobacter cloacae* in greenhouse cucumbers. Preliminary soaking of cucumber seeds in bacterial suspension from *Enterobacter cloacae* (10^{10} c/ml) stimulates seed germination with 13 – 15% compared to the control. The bacterial suspension from *Enterobacter cloacae*

Table 1. Effect of bacterial suspension on cucumber seed emergence.

№	Treatment	Percentage of emerged plants (%)	
		1 year	2 year
1	Seed soaking in bacterial suspension	86.0	95.0
2	Soil watering with bacterial suspension	80.0	90.0
3	Seed soaking in water	80.0	90.0
4	Seeds without preliminary soaking	73.0	80.0

Table 2. Effect of bacterial suspension on some biometric traits, phenophase and yield in cucumbers

№	Treatment	Stem height	Leaf number	Phenophase	Yield kg/plant
1	Seed treatment	70.5	12	Sets	6.20
2	Soil treatment	78.0	15	Sets	5.30
3	Free of treatment	55.8	8	Full anthesis	4.05
4	Soaking in water	60.0	10	Full anthesis	4.95

$F_{table.} = 2.68$ $F_{empiric} = 30.0$ $P = 5\%$

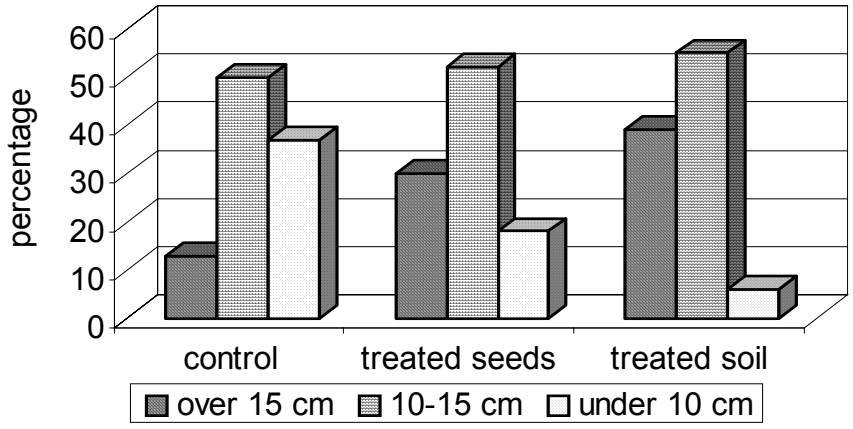

Figure 1. Percentage according to stem height two weeks after emergence.

(10^{10} c/ml) used for preliminary soaking of the seeds for 8 hours or soil watering with 5 l/m^2 after sowing exert an influence on cucumber seedlings size. The treatment of seeds and soil with bacterial suspension from *Enterobacter cloacae* accelerates the elapse of phenophases and increases the yield from cucumbers.

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