

Antagonistic effect of some isolates against *Pseudoperonospora cubensis* on cucumber plants under protected cultivations

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ABSTRACT

Cucumber (*Cucumis sativus* L.) is one of the important economic vegetable crops, which belongs to family cucurbitaceae. Several fungal diseases attack cucumber plants in all growing stages such as downy mildew caused by *Pseudoperonospora cubensis* (Berk. and Curt.) Rostow, which causes loss in the yield reaching about 30-80 % under suitable condition of low temperature and high relative humidity. To control such disease, the synthetic chemical fungicides are traditionally used. Nowadays, environmental and health disorders caused by synthetic chemicals are considerable. This work aimed to search for safe means to control this disease using microbial biocontrol agents which considered as healthy and environmentally safe method alternative to chemical methods (fungicides). The obtained results in the following. Among the tested bioagents, the highest percentage of downy mildew in inhibition cucumber plants using antagonistic microorganisms as curative treatments were obtained by *Bacillus pumilus* (49.55%), *Bacillus chitinosporus* (48.75%) and *Bacillus subtilis* (48.2%). The mixture of these bacterial agents came at the fourth order having (47.8%) disease inhibition, meanwhile, the fungal antagonists *Epicoccum* sp. achieved 45% disease inhibition. On the other hand, the fungicide (Equation Pro) achieved the highest disease inhibition percentage (52.0%). Screening for prophylactic inhibition effect indicated the percentage of disease inhibition obtained by *B. pumilus*, *B. subtilis*, *B. chitinosporus*, mixture of bacteria and *Epicoccum* sp. were (72.9, 69.2, 67.3, 63.7 and 59.2 %), respectively. To determine the number of foliar application, *B. chitinosporus* achieved the highest disease inhibition (55.75%) when applied every week followed by *B. subtilis*, mixture of bacterial, *B. pumilus* and *Epicoccum* sp. that recorded 54.6, 54.35, 52.19 and 50.91 % of disease inhibition, respectively. Applications of the tested bioagents every two or three weeks resulted in significant lower inhibition effects. To determine the suitable initial time for application, the obtained results revealed that applications at three weeks age of plants were significantly more efficient to inhibit the downy mildew disease than the later times of applications (4, 5 and 6 weeks of plant age). The highest inhibition was obtained by *B. subtilis* (70.2 %) and *B. pumilus* (72.65 %), respectively, and the botanical measurements (plant height, total chlorophyll, fresh and dry weight) and yield parameters (average number of fruits/plant and average weight fruits/plant) showed no adversely effects even under the dense applications (weekly applications) or the early applications (started at 3 weeks of plant age). However, *B. pumilus* and *B. subtilis* gave the highest botanical and yield measurements in all cases comparing with the other treatments. The microscopic examination (light and scanning electron microscopy) of the downy mildew lesions treated by liquid culture of *B. pumilus* and *B. subtilis* showed direct effects that appeared as loss in turgor and osmolysis of sporangia of hyphae of *Pseudoperonospora cubensis*. The surface activity of *B. pumilus* culture filtrates was proven by treating the red blood cells. The treated red blood cells showed membrane lysis. The cucumber plants, prophylactically treated with the tested bioagents showed other indirect effects appeared as rising of (peroxidase and polyphenoloxidase) activities as indicator of induced resistance. The spectrum of Gas Chromatography of the metabolites excreted by *B. subtilis* and *B. pumilus* included various bands which mostly represent different antagonistic compounds (fatty acids) having surface activities.

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