productivity of Ukrainian critical *Allium* crops, supporting economic stability and food security in the country.

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BIODAMAGE OF STEEL BY *DESULFOVIBRIO ORYZAE* UNDER THE INFLUENCE OF SUPERNATANT FROM CULTURES OF *STREPTOMYCES GARDNERI* AND *BACILLUS VELEZENSIS*

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Introduction. Microorganisms take an active part in the processes of microbiologically influenced corrosion [1-3]. For protection against them, bactericides with inhibitory properties are used. Such compounds are often toxic [4-6]. Currently, there are a number of studies of eco-friendly "green" biocides-inhibitors, in particular, based on microbial metabolites, for the prevention of microbial corrosion [6-10]. Previously, we investigated the antibiofilm properties of a supernatant from meat-peptone broth (MPB) cultures of strains *Bacillus velezensis* NUChC C1 and NUChC C2b in relation to the formation of a biofilm on the surface of polyethylene terephthalate by the bacterium *Desulfovibrio oryzae* NUChC SRB1 [11] and the culture liquid of *Streptomyces gardneri* ChNPU F3 and *B. velezensis* NUChC C2b regarding the formation of a biofilm on the glass surface by the bacterium *B. simplex* ChNPU F1 [12]. The aim of this study was to investigate the biodamage of steel by *D. oryzae* under the influence of supernatant from *S. gardneri* and *B. velezensis* cultures.

Materials and methods. The research used bacterial strains *D. oryzae* NUChC SRB2, *S. gardneri* ChNPU 3, previously isolated from the soil ferrosphere [13] and *B. velezensis* NUChC C2b from the collection of the Department of Biology of the T.H. Shevchenko National University "Chernihiv Colehium" [11]. Corrosion activity of *D. oryzae* strain NUChC SRB2 against steel 3 was investigated by biofilm formation ability based on biofilm biomass on the surface of steel samples (crystal violet method) and the effect on corrosion rate (gravimetric method). Sterile medium Postgate "C" (78% of the volume) with the addition of MPB (22% of the volume) was used as a control. A 5-day culture of SRB in the liquid medium of Postgate "C" was dissolved with sterile isotonic sodium chloride solution to optical density of 0.5 McFarland and was used in further studies.

The experiment was carried out during the cultivation of the investigated SRB (2% of the volume) in anaerobic conditions at a temperature of 29 ± 2 °C in the liquid medium of Postgate "C" (76% of the volume) with the addition of 22% of the volume of MPB (option 1), or a supernatant from MPB cultures of strains: *S. gardneri* ChNPU 3 (variant 2), *B. velezensis* NUChC C2b (variant 3), or mixtures of supernatants of the specified strains of *S. gardneri*:*B. velezensis* (2:1). Supernatants were prepared from the appropriate bacterial culture in MPB by centrifuging it for 15 min at 8000 rpm. Samples of steel 3 (20×20×2.5 mm) were introduced into test tubes, which

were pre-treated with sandpaper, weighed, and sterilized with ethyl alcohol. The duration of exposure of the samples in the respective environments was 120 days. The repetition of the experiment was 4. The results were processed statistically.

Results and discussion. It was established that the mass of crystal violet adsorbed on the surface of steel 3 was 60.61 ± 1.78 mg/m^2 in the sterile media of Postgate "C", and the corrosion rate of the samples was 85.7 ± 4.7 × 10^{-4} g×m^2/hour. The biomass of the *D. oryzae* biofilm formed on the surface of the steel samples (option 1) was 231.46 ± 11.5 mg/m^2. Under the influence of a supernatant from MPB cultures of *S. gardneri*, *B. velezensis* and their mixture, there was a significant difference in no biofilm formation of the investigated SRB. Thus, the biomass of the biofilm of SRB under the influence of a supernatant from MPB cultures of heterotrophic bacteria and their mixture was: 216.35 ± 7.35 mg/m^2 (option 2), 210.91 ± 13.26 mg/m^2 (option 3) and 203.56 ± 10.11 mg/m^2 (option 4). The rate of steel corrosion was equal to 65.6 ± 12.2 × 10^{-4} g×m^2/h (option 1), 76.4 ± 4.6 × 10^{-4} g×m^2/h (option 2), 107.6 ± 17.57 × 10^{-4} g×m^2/h (option 3), 49.5 ± 2.9 × 10^{-4} g×m^2/h (option 4). At the same time, a significant difference was noted only between the control option (sterile Postgate medium "C") and option 4 (a mixture of a supernatant from MPB cultures of *S. gardneri* and *B. velezensis*) - a significant reduction in the corrosion rate by 1.7 times.

Conclusions. Thus, in terms of biofilm-forming ability, the studied strain of SRB is moderately adherent to steel 3. The decrease in biofilm-forming properties of *D. oryzae* under the influence of the supernatants from MPB cultures of *S. gardneri*, *B. velezensis* and their mixture, the protective properties of the studied supernatants in relation to microbiologically influenced corrosion of steel was not detected.

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INVESTIGATION OF LENTIL DISEASES CAUSED BY PHYTOPLASMAS

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Lentils are a valuable legume crop which is distinguished by their high protein content, excellent taste and nutritional value. Like all legumes, lentils (*Lens culinaris*) are an active nitrogen fixer and can absorb up to 40–90 kg/ha of environmentally safe nitrogen in symbiosis with nodule bacteria, making them a good predecessor in crop rotations and their seeds an environmentally friendly food product.

However, like other pulses, lentils are affected by various phytopathogenic microorganisms, which can be detrimental to their yields.

The most harmful pathogens for this crop are those that cause fungal diseases (ascochitosis, downy mildew, powdery mildew, peronosporosis, lentil rust). Bacterial diseases (bacterial lentil wilt) cause much less damage to lentils. One of the most harmful phytopathogens that can affect, among other things, legumes are phytoplasmas that cause phytoplasmosis in plants affected by these pathogens [1–7].

Until recently, however, there were no reports of phytoplasma infections in lentils in the literature. Therefore, **the aim of the work** was to study the symptoms of phytoplasma disease on lentil plants artificially infected with phytoplasmas of different origin in the greenhouse and in the field.

Materials and Methods. Lentils was grown in the field at the experimental site of the D.K. Zabolotny Institute of Microbiology and Virology of the NAS of Ukraine and in the greenhouse. All used in study mycoplasma strains (class *Mollicutes*) were obtained from the Ukrainian Collection of Microorganisms (UCM). Collectible phytoplasma strains, which were used for inoculation of lentil plants, were isolated from different sources: *A. laidlawii* 85 – from wheat; *A. laidlawii* var. *granulum* 118 – the causative agent of pale green dwarfism of wheat (UCM BM-34) (PGD); *A. laidlawii* 102 (UCM BM-45) – the causative agent of tomato stem blight; *A. laidlawii* 192 – the causative agent of grape phytoplasmosis (blackening of grape wood) (UCM BM-7); *A. laidlawii* 275 – the causative agent of mulberry dwarfism (UCM BM-42). Artificial infection of lentil plants [8] was performed by the Klement method.

Results. In all experimental lentil plants, inoculated with cells of phytoplasma strains from different sources, symptoms characteristic of plant damage by phytoplasmosis were recorded. Thus, on lentil plants artificially infected with inocula of *A. laidlawii* var. *granulum* 118 and *A. laidlawii* 85 isolated from wheat and *A. laidlawii* 102 isolated from tomatoes, very elongated, curved stems were observed.

It should be noted that lentil plants, inoculated with *A. laidlawii* var. *granulum* 118, were significantly more affected by this phytoplasma and, accordingly, a wider range of symptoms characteristic of phytoplasmosis in plants was recorded – in addition to the presence of elongated and bent stems, the formation of numerous additional shoots and small leaves was additionally recorded in such plants.