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EFFECT OF *LACTOBACILLUS PLANTARUM* AND *BACILLUS ATROPHAEUS* ON GROWTH OF WHEAT SEEDLINGS

Abstract

The effect of bacteria of the strains *Lactobacillus plantarum* ONU 12, ONU 311 and *Bacillus atrophaeus* ONU 528 on growth characteristics of wheat seedlings have been studied. Inoculation of surface sterilized seeds with the diluted cultures was conducted. The inoculated seeds were brought into wet-chambers, and after germination the measurements of seedling growth characteristics were done. The treatment by *L. plantarum* ONU 311 resulted in increase of the length of seedlings roots in 31% as compared with the control and stimulation effect on the height of seedlings was 48%. The mixture of the strains *L. plantarum* ONU 12 and ONU 311 increased the length of roots and height of seedlings in 41,1% and 52,4% accordingly. The treatment of wheat seeds by bacteria *B. atrophaeus* ONU 528 resulted in increase of mean length of roots in 39,7% and height of seedlings in 45% as compared with the control. Bacteria *L. plantarum*, *B. atrophaeus* and their mixtures had the stimulation effect both on roots and height of wheat seedlings.

Key words: *Lactobacillus plantarum*, *Bacillus atrophaeus*, stimulation activity, wheat.

Introduction

Efficiency of the use of various microorganisms including rhizosphere bacteria in the agriculture is well known. Nitrogen-fixing and phosphate-mobilizing bacteria can stimulate plant growth and development. From this point of view, a diverse group of lactic acid bacteria (LAB) that also inhabit plant rhizosphere is less studied [3].

It is known that plant growth stimulation can be achieved indirectly by increasing the absorption of minerals and nutrients or directly by regulation of plant hormones such as indole-3-acetic acid (IAA), cytokinins and ethylene [4].



The aim was to study the effect of *Lactobacillus plantarum* and *Bacillus atrophaeus* on seed germination and growth characteristics of wheat seedlings.

Materials and methods

Strains of *Lactobacillus plantarum* ONU 12, ONU 311 (isolated from plant material) and *Bacillus atrophaeus* ONU 528 (isolated from soil) were used in experiments. The LAB were cultivated in MRS liquid medium at 37 °C [1], *B. atrophaeus* – in NB liquid medium at 28 °C [2].

Several variants of seed treatment were used in experiments: bacterial culture of *L. plantarum* ONU 12, *L. plantarum* ONU 311, *B. atrophaeus* ONU 528, mix of bacteria cultures *L. plantarum* ONU 12 + *L. plantarum* ONU 311, *L. plantarum* ONU 12 + *B. atrophaeus* ONU 528. MRS 1% and tap water were used as controls.

Wheat seeds were surface sterilized in 25% H₂O₂ for 1 minute. Seeds were washed three times in sterile tap water from the residual H₂O₂. Seeds were soaked in prepared bacterial suspensions for one hour and then were brought into sterile Petri dishes with filter paper disks. The bottom of the chambers was moistened with 15 ml of tap water. Seeds germinated in a greenhouse at 25 °C, wet-chambers were moistened as far as drying. The measurement of seedling growth characteristics was done after 5 days of germination. Statistical analysis was performed using Microsoft Office Excel.

Results and discussion

L. plantarum ONU 12 ($1,78 \times 10^7$ CFU/mL) showed no significant effect on plant growth. The treatment by *L. plantarum* ONU 311 ($1,47 \times 10^7$ CFU/mL) resulted in increase of the mean length of seedlings roots ($5,7 \pm 0,4$ cm) in 31% as compared with the control ($4,4 \pm 0,4$ cm) and stimulation effect on the height of seedlings was 48% (mean height - $7,3 \pm 0,3$ cm / control – $5,0 \pm 0,4$ cm) (fig. 1, 2).

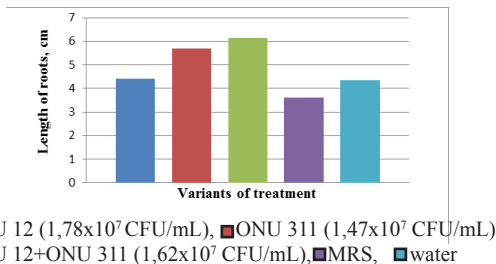


Fig. 1. Effect of bacteria of *L. plantarum* strains on growth of wheat roots

Note: * – significant different from the control (water) ($p \leq 0,05$)

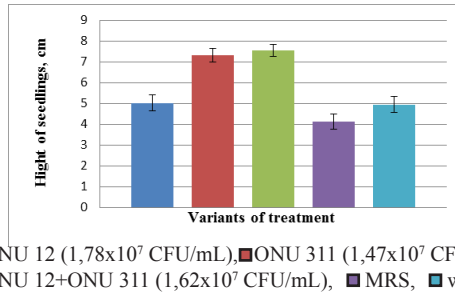


Fig. 2. Effect of bacteria of *L. plantarum* strains on wheat height

Note: * – significant different from the control (water) ($p \leq 0,05$)

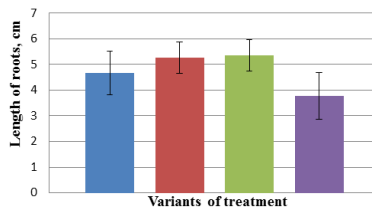


Fig. 3. Effect of the treatment with bacteria of *B. atrophaeus* ONU528 and *L. plantarum* ONU12 on mean length of wheat roots

Note: * – significant different from the control (water) ($p \leq 0,05$)

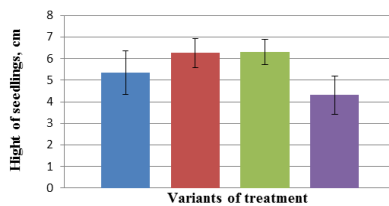


Fig. 4. Effect of the treatment with bacteria of *B. atrophaeus* ONU528 and *L. plantarum* ONU12 on mean height of wheat seedlings

Note: * – significant different from the control (water) ($p \leq 0,05$)



The mixture of the strains *L. plantarum* ONU 12 and ONU 311 ($1,62 \times 10^7$ CFU/mL) increased the length of roots ($6,2 \pm 0,4$ cm) and height of seedlings ($7,5 \pm 0,3$ cm) in 41,1% and 52,4% accordingly (fig. 1, 2).

The treatment of wheat seeds by bacteria *B. atrophaeus* ONU 528 ($6,14 \times 10^5$ CFU/mL) resulted in increase of mean length of roots ($5,3 \pm 0,6$ cm) in 39,7% and height of seedlings ($6,3 \pm 0,7$ cm) in 45% as compared with the control ($3,8 \pm 0,9$ cm and $4,3 \pm 0,9$ cm, accordingly) (fig. 3, 4).

L. plantarum ONU 12 ($1,75 \times 10^7$ CFU/mL) showed no significant effect on plant growth. The treatment of wheat seeds by mixture of the strains *L. plantarum* ONU 12 та *B. atrophaeus* ONU 528 resulted in increase of mean length of roots ($5,4 \pm 0,6$ cm) in 42,3% and height of seedlings ($6,3 \pm 0,6$ cm) in 46,4%.

Conclusions

Bacteria *L. plantarum*, *B. atrophaeus* and their mixtures had the stimulation effect both on roots and height of wheat seedlings. The different LAB strains in similar concentrations of bacterial cells had a different effect on the growth of wheat seedlings. These data suggest that the stimulating properties of bacteria are strain-specific.

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