The effect of *Fusarium culmorum* and *Pseudomonas fluorescens* 2137 on the content of abscisic acid in the roots and shoots of barley seedlings

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Key message. Inoculation of barley with a *F. culmorum* not accompanied by an increase in the number of abscisic acid in plants, but under *P. fluorescens* 2137 inoculation, the accumulation of abscisic acid in the roots occurred.

Keywords: *Fusarium culmorum*, *Pseudomonas fluorescens*, abscisic acid

Abscisic acid (ABA) plays an important role in the development of plant pathogenesis, often counteracting the implementation of an effective protective reaction. It was shown that ABA is able to directly inhibit the development of induced systemic resistance, acting as an antagonist of salicylic and jasmonic acids, as well as ethylene, leading to increased susceptibility of plants to various bacterial and fungal pathogens. On the other hand, ABA can contribute to the development of resistance in some interactions between plants and pathogenic microorganisms. The aim of the study was to assess the effect of the phytopathogenic fungus *Fusarium culmorum* and biocontrol rhizobacteria *Pseudomonas fluorescens* 2137 on abscisic acid metabolism in barley seedlings of *Hordeum vulgare* L. cv. Belogorsky. The content of ABA in roots and shoots was determined by ultra-efficient liquid chromatography using the Waters ACQUITY UPLC H-class system (Waters, USA). As the experiments showed, ABA was absent in the daily barley seedlings. In three-day and eight-day shoots of barley ABA was found, the highest amount of ABA being detected in the shoots of control plants (8.63 and 7.08 ng/g), and its amount in plants infected with *F. culmorum* was lower (6.47 and 4.33 ng/g). In the roots, on the third day, the highest amount of ABA was found in the presence of *P. fluorescens* 2137 (0.14 ng/g), and on the eighth day, in the control variant (0.91 ng/g) and in the presence of *P. fluorescens* 2137 (0.11 ng/g). The analysis did not show the presence of ABA in the roots of uninoculated plants in three-day-old plants, and in the inoculated *F. culmorum* on the eighth day.

Thus, inoculation of barley with a *F. culmorum* caused the development of root rot, but this process was not accompanied by an increase in the number of ABA in plants, however, in response to colonization of the roots with *P. fluorescens* 2137, the accumulation of ABA in the roots occurred. A high level of ABA in the roots of an eight-day control plants may be associated with the development of fusarium rot caused by seed infection: immunofluorescence microscopy showed that barley was, although very slightly, infected with a fungus of the genus *Fusarium*, which by 8 days led to the appearance of root rot symptoms. Apparently, the presence of the fungus with reduced aggressiveness, when its amount on the roots increased, caused a strong response in barley that was not observed in response to the infection of barley with the highly aggressive *F. culmorum* strain used in our studies.

It is widely believed that the hormone ABA inhibits defense reactions in plants. However, in our experiment, we did not observe the inhibitory effect of ABA on the expression of the *PAL* gene in roots on the third day of the experiment. The highest level of expression of this protective gene on the third day was observed in the roots of barley plants inoculated with *P. fluorescens* 2137, and in this case amount of ABA increased too. The obtained results correspond to the currently accepted conception of the cross-suppression of various plant defense systems (ABA signaling and others) as a complex process, the result of which depends on the plant genotype, as well as the infectious strategy, which applies to both phytopathogens and biocontrol microorganisms.

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