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Response of wheat seedlings interacting with glycosylated flagellins of the plant endophyte bacterium Azospirillum irakense KBC1.

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Plants grow and develop in an environment formed and densely populated by bacteria. However, plants exhibit homeostasis, restraining bacterial colonization of their inner tissues. Flagellin, a structural protein that forms the flagellar filament of motile microorganisms, is a bacterial molecule triggering a cascade of biochemical-defense reactions in plants. The interaction of bacterial flagellins with specific plant receptors leads to a considerable increase in the intracellular concentration of hydrogen peroxide and decreases the level of metabolism and the growth rate (Chinchilla et al. 2007). One factor of bacterial evolution necessary for the successful colonization of macroorganisms is the method of overcoming the immune system of plants. An example of such a mechanism is flagellin glycosylation, which reduces the probability that flagellin will be recognized by receptors.

We investigated the effect of flagellin from the growth-promoting rhizobacteria *Azospirillum irakense*, strain KBC1, on seedlings of soft spring wheat cultivar Saratovskaya 29. This endophyte bacterium was isolated from rice (*Orysa sativa* L.) roots (Khammas et al. 1989). Earlier, we showed that the polar flagellum flagellin of *Az. irakense* KBC1 is a glycoprotein and the residues of rhamnose, mannose, and galactose are present in the carbohydrate fragments of its flagellin at a 3:1:2 ratio, which is the same ratio as that found to exist between these sugars in the KBC1 O-specific polysaccharide (Fedonenko et al. 2004).

When 3-day-old wheat seedlings were treated with a bacterial flagellin solution (10.0 µg/mL), root length and root dry weight were inhibited considerably, –65% and –55%, respectively, and the mitotic index of the root meristem cells decreased twofold. When the seedlings were treated with different flagellin concentrations (0.01, 0.1, and 1.0 µg/mL), no statistically significant differences in the mitotic index compared with the control plants were observed. The morphometric parameters changed slightly; the root dry weight decreased by 9% and 15% for the 0.1 and 1.0 µg/mL solutions, respectively. For the glycosylated flagellin of the *Az. irakense* KBC1 polar flagellum, 10.0 µg/mL (~10^{-7} M) was found to inhibit plant growth, which is a concentration two orders of magnitude higher than the concentrations of nonglycosylated flagellins inhibitory to the growth of *Arabidopsis* (Chinchilla et al. 2007). One can speculate that the glycosylation of *Azospirillum* flagellins is one of the most important traits necessary for the successful colonization by *Azospirillum* of plants, including their inner tissues.

In summary, this study is the first to detect responses in the innate immune system of wheat to treatment with a bacterial flagellin, indicating the presence of receptors that recognize microbe-associated molecular patterns. The present results may be useful in understanding the molecular mechanisms of plant-microbe interactions and also in choosing plant microsymbionts and in developing bacteria-based fertilizers in agrobiotechnology.

References.

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