

Brown rust, triggered by fungus *Puccinia recondita f.sp. secalis*, is the disease of rye is a disease of rye causing severe yield losses of up to 40%. The majority of the contemporary rye varieties cultivated in Poland are tolerant to brown rust in a medium degree. Despite many years of research, the knowledge on the genetic background of the resistance to brown rust is still incomplete. **Up to date, the genes conferring a resistance to this disease have not been cloned, and only they were identified and located in the genome using the methods of Mendelian genetics. The aim of this project is deepening the current knowledge on this subject by isolating and characterizing genes associated with resistance to the pathogen that causes the disease at various stages of rye development as well as, additionally, identifying metabolites synthesized by infected plant and sequencing pathogen genome.** The comprehensive approach including effective molecular and biochemical: (1) transcriptome sequencing, (2) identifying genes being targets for plant and pathogen small RNA particles mobilized during infection, (3) analysis of candidate gene expression in real time, (4) *in silico* analysis performed in order to find sequences containing the structure characteristic for resistance genes in rye genome, (5) genetic mapping of genes and quantitative trait loci associated with the resistance to brown rust, (6) high-performance liquid chromatography enabling a precise monitoring of metabolism of infected plants, as well as (i) promising results of preliminary research, (ii) possession of well characterized fungal isolates and (iii) the access to the full sequence of rye should let us to achieve quickly the assumed goal. An isolation of brown rust resistance genes will allow better understanding mechanisms related to the pathogenesis process and plant response. The recognition of their sequence can also become the basis for the development of molecular markers that may effectively support the rye resistance breeding, and this in turn, in the longer term, can bring economic effects in the form of breeding and registration of new varieties resistant to brown rust.