The aim of the project is a broadening knowledge about the genetic background of benzoxazinoid (BX) biosynthesis. BX are secondary metabolites present mainly in species belonging to *Poaceae* family. It is considered that these metabolites are involved in plant defense reactions, primarily against biotic stresses such as attack by pests, pathogen infection and in allelopathy. Despite decades of research, many aspects related to the BX genetics has not been explained and the results and opinion of various scientists are not fully consistent. There is not obvious what is the role of two genes: *Bx1* i *Igl* controlling the formation of indole in native and induced conditions. There has been not fully documented how various factors affect the induction of genes that control biosynthesis BX. It is also unclear how the level and the specificity of expression of these genes is related to the content and composition of BX in aerial parts and roots of plants. In particular, data concerning the genetic and biochemical aspects of rye BX is fragmentary. All these gaps and questions provoked us to undertake research in this project. We intend to perform a complex analysis of an expression of rye orthologs of *Bx* genes induced by the following factors: infection by the pathogenic fungus causes serious disease for rye - brown rust, a presence of exudates secreted by clover plants growing in the neighborhood of rye, vernalization and *in vitro* culture conditions, in different plant parts and tissues, accompanied by the biochemical analysis of BX content and composition. We also plan, using several experimental approaches, clarify the role of *ScBx1* i *ScIgl* genes which, as shown by preliminary tests, may act alternatively depending on external circumstances. We expect that the obtained results will contribute to a better understanding of the mechanisms that control the biosynthesis of BX. The gained knowledge can be used in practice, e.g. for more effective protection against pests and pathogens by breeding varieties with the enhanced ability for BX synthesis. Such varieties could also be a valuable source of functional food due to the fact that BX are human health promoting metabolites. Another benefit can be related to stimulation of BX biosynthesis by weed secretions. If the synthesis BX will found to be stimulated by weeds, it may open new perspectives for rye as crop for no tillage agriculture or as a cover crop (in mixtures with, e.g., clover). Finally, recognizing the capability of rye tissues to produce BX *in vitro* could be utilized to elaborating the technology of synthesizing these compounds in plant bioreactors which open quite new possibilities for the biotechnological usage of this species.