Abstract of PhD thesis entitled: "The role of plant stringent response in *Brassica napus* L. in response to biotic and abiotic factors and during seed development"

The regulatory nucleotides (p)ppGpp (alarmones) were originally identified in *E. coli* and control several aspects of cell metabolism. The alarmone dependent control of cell metabolism is referred to as the stringent response. At the beginning of the 21st century, genes responsible for the synthesis and degradation of alarmones were identified in plants, indicating that the stringent response is a widely evolutionarily conserved regulatory mechanism. The plant RelA/SpoT Homolog (*RSH*) genes have been identified and characterized in various plant species. Moreover, alarmones have been shown to accumulate mainly in chloroplasts. The stringent response in plants homologous to bacterial stringent response plays a very important role in plant growth, development, and adaptation to the environmental changes, and is not just a leftover from the plastid endosymbiotic ancestor. During evolution, the *RSH* ancestor genes were sustained in the host plant cells and further diversified. The evolutionary aspect of the plant mechanism homologous to the bacterial stringent response raises the question about the complexity of the plant RSH families including the number, structure, and functions in different plant species.

A total number of 14 *RSH* genes was identified in the genome of *Brassica napus* L., and further examination of their amino acid sequences revealed that they could be categorized into three subgroups: RSH1, RSH2/3, and CRSH, similar to other plant species. Notably, the promoter regions of these genes were found to harbour diverse regulatory elements, indicating their responsiveness to various environmental cues, including light, phytohormones, and both biotic and abiotic stresses (Publication I). In CRSH proteins EF-hand calcium-binding motif in present which is highly conserved in these plant proteins. During canola seed maturation, an increase in calcium ions and the amount of *BnCRSH* transcripts was observed, suggesting a that calcium-dependent stringent response is involved in seed maturation and condition seed

dormancy (Publication II). The expression of *BnRSH* genes was influenced by biotic and abiotic factors. Plant growth-promoting bacteria (PGPB), belonging to *Serratia* sp., were found to significantly increase the expression of *BnRSH* genes, not only in control condition but also under salinity suggesting the involvement of the stringent response in plant response to biotic and abiotic factors (Publication I). Moreover, the expression of BnRSH was affected in canola seedlings grown in the presence of plant growth-promoting fungi (PGPF) *Trichoderma viride*. Furthermore, the antagonisms of T. viride towards plant pathogens, especially *Fusarium culmorum* was demonstrated. New biodegradable seed coating containing the spores of *T. viride* was developed. It promoted the growth of *B. napus* seedlings, did not negatively affect seeds germination, did not induce plant stress responses, and limit pathogen growth (Publication III).

Overall, this research has brought new knowledge about the potential roles of RSH proteins in *B. napus*, particularly in plant growth and development, adaptation to stress, and interactions plant-microorganisms. In addition, new biocoating has been developed which might be used for increasing crop yield and phytopathogens biocontrol. The insights into the stringent response provided in this study significantly contribute to developing our knowledge of plant adaptation to stress and plant development and offer potential strategies for enhancing crop productivity and biological control of plant pathogens. Understanding the mechanisms by which RSH controlled plant metabolisms in changeable environmental conditions is of utmost importance for the survival of not only a single organism but also the whole species.