Current Bachelor´s Thesis Topics for Academic Year 2024/2025

Specialization: Molecular Biology and Genetics

Thesis Title 1

Evaluating guide RNA efficiency for inducing chromosomal rearrangements using CRISPR/Cas in *Cardamine hirsuta*

Annotation: Genome editing in plants using CRISPR/Cas represents a revolutionary tool for genome manipulation, enabling precise DNA modifications and the induction of chromosomal rearrangements. This is crucial for studying gene function and genetically improving crop plants. The aim of this bachelor's thesis is to verify the efficiency of individual guide RNAs (gRNAs) in inducing large chromosomal rearrangements (inversions, translocations) in the model plant species Cardamine hirsuta. From the proposed 16 Cas9 gRNAs or Cas12a gRNAs, the most effective candidates will be selected and tested. The work includes the following steps: selection of transformed plants, performing PCR analyses to detect rearrangements, Sanger sequencing to confirm the accuracy of the modifications, and subsequent verification of the efficiency of individual gRNAs. These steps will enable the identification of the most efficient gRNAs, which will subsequently allow the induction of large chromosomal rearrangements and contribute to a better understanding of gene architecture and function in plant genomes.

Supervisor´s Name: RNDr. Terezie Malík Mandáková, Ph.D. učo 64119
Laboratory of Plant Molecular Genetics, Section of Genetics and Molecular Biology, Department of Experimental Biology, terezie.mandakova@ceitec.muni.cz
Bachelor Thesis Language: Czech or English
Experimental Bachelor Thesis

Thesis Title 2

CRISPR/Cas-based editing of plant genomes with a focus on inducing chromosomal rearrangements

Annotation: Genome editing in plants using CRISPR/Cas represents a modern biotechnology that enables precise and targeted interventions in DNA. This literature review focuses on current knowledge and advances in plant genome editing using the CRISPR/Cas method, with particular emphasis on the induction of large chromosomal rearrangements, such as inversions and translocations. The work includes an overview of the basic principles of CRISPR/Cas technology, a description of various types of chromosomal rearrangements, and their significance for gene function studies and crop breeding. Additionally, it focuses on specific examples and study results that deal with the induction of chromosomal rearrangements in plants, discussing the opportunities and challenges associated with this technology. The aim of the thesis is to provide a comprehensive overview of the current state of research in this area and to identify directions for future studies.

Supervisor´s Name: RNDr. Terezie Malík Mandáková, Ph.D. učo 64119
Laboratory of Plant Molecular Genetics, Section of Genetics and Molecular Biology, Department of Experimental Biology, terezie.mandakova@ceitec.muni.cz
Bachelor Thesis Language: Czech or English
Theoretical Bachelor Thesis

Thesis Title 3

Study of candidate genes for plant vegetative propagation via stolons and rhizomes

Annotation: This bachelor's thesis focuses on studying the genetic mechanisms involved in vegetative (asexual) propagation in plants through the formation of stolons (above-ground runners) and rhizomes (underground stems). The research includes both model and non-model species, with an emphasis on species from the genus *Trifolium*, specifically *T. medium*, which forms underground rhizomes. The main objective of this thesis is to identify candidate genes involved in the formation of these structures using next-generation sequencing. Furthermore, the potential applications of these findings in molecular methods and crop breeding for perennial traits will be explored, with a focus on the CRISPR/Cas methodology for genome editing.

Supervisor´s Name: prof. RNDr. Jana Řepková, CSc. učo 530
Laboratory of Plant Molecular Genetics, Section of Genetics and Molecular Biology, Department of Experimental Biology, repkova@sci.muni.cz
Bachelor Thesis Language: Czech or English
Theoretical Bachelor Thesis

Thesis Title 4

Efficient transformation methods in plant families Brassicaceae and Fabaceae for CRISPR/Cas technology applications

Annotation: This bachelor's thesis provides an overview of plant transformation methods with a focus on the economically important families Fabaceae and Brassicaceae, which are crucial for genome editing applications using CRISPR/Cas technology. The work will offer a theoretical foundation of various transformation techniques, including *Agrobacterium*-mediated transformation and biolistic methods, and explore their adaptation to the specific needs of these plant families. It will address the advantages and disadvantages of different methods, their efficiency, and strategies that enhance the success of integrating CRISPR/Cas systems into plant genomes. Additionally, the thesis will evaluate the application of these methods in the context of genetic modifications and crop improvement, with particular attention to the challenges and prospects associated with CRISPR/Cas technology. This literature review will provide a comprehensive overview of current possibilities and trends in transformation methods, contributing to the development of effective strategies for genetic engineering in these important plant families.

Supervisor´s Name: prof. RNDr. Jana Řepková, CSc. učo 530
Laboratory of Plant Molecular Genetics, Section of Genetics and Molecular Biology, Department of Experimental Biology, repkova@sci.muni.cz
Bachelor Thesis Language: Czech or English
Theoretical Bachelor Thesis