Master projects on red clover

Contact: Åshild Ergon, ashild.ergon@nmbu.no

Red clover is an important species in agriculture in northern areas of the world. It produces forage of high quantity and quality, it is capable of fixing atmospheric nitrogen and thereby eliminating or reducing the need for artificial fertilizer, and its deep root system improves soil structure. However, although red clover is a perennial species, it tends to disappear from sown perennial grasslands after just a few years. Improving plant persistence is an important goal in breeding of new red clover cultivars.

A. Interactions between infection with *Sclerotinia trifoliorum* and abiotic stresses in red clover

Limited resistance to infection by the clover rot fungus, *Sclerotinia trifoliorum*, is thought to be one of the reasons for low persistence of red clover. In general, there is too little knowledge about the interaction of different stresses, this is one of the reasons why it is difficult to predict effects of climate change on plants. In this master project you will find out something about the interaction of different winter stresses on winter survival of red clover. The project is linked to the EU project EUCLEG (http://www.eucleg.eu/).

You will do experiments to characterize the resistance to *S. trifoliorum* in some Nordic or wider European red clover material. You will also study the effects that abiotic stress has on resistance. Does mild cold stress and cold acclimation induce resistance? If yes, is this induction dependent on light? Does freeze stress prior to infection enhance or reduce resistance? Or are infected plants more or less freezing tolerant than non-infected plants?

B. Validation of candidate genes for freezing tolerance in red clover

Freezing tolerance increases in temperate perennial plants when they cold acclimate in late autumn. Numerous genes are up- or downregulated during the process of cold acclimation, leading to a range of changes of which some are related to the increase in freezing tolerance. Our collaborator at Agriculture and Agri-Food Canada has identified several candidate genes that appear to be more strongly upregulated in freezing-tolerant genotypes than in sensitive genotypes during cold acclimation. In order to validate the role of these genes you will

- characterize their expression during cold acclimation in another set of red clover populations (tissue samples are available)
- compare gene expression with biochemical data from the same plants (data available)
- if time permits, you can also do one plant experiment yourself to validate gene expression results within one or two populations

C. Characterization and validation of candidate genes for earliness in red clover

In previous studies we have identified candidate loci and genes for earliness of stem elongation (the initial stage of flowering) in red clover. This is an agronomically important character, linked to competitive ability and yield. In this master project you will investigate some of these candidate genes: verify the association between allelic variation and phenotype and characterize how gene expression varies between genotypes and is affected by environmental conditions (temperature and photoperiod). You will mainly work in the molecular biology lab, but also do some work in the greenhouse.