ABSTRACT

Legumes fix atmospheric nitrogen (N) via symbiotic biological N fixation where part of the fixed N by legumes can be transferred to non-legumes. Identification of genotypic variability for N transfer among different legume cultivars enables improving N transfer to non-legumes under mixed stands throughout the growing season.

Six diverse red clover (RC) cultivars which include three diploid (AC Christie, Tapani and CRS 15) and three tetraploid (Tempus, CRS 18, CRS 39) were selected to evaluate genotypic variability for N transfer. The above RC cultivars were characterized for root hair deformation, nodulation, growth, and N uptake under different levels of N supply during growing period and for starter N supply under In vitro conditions. Significant genotypic differences among the red clover cultivars were found for above attributes where the cultivars responded differently to N applications during early seedling growth.

The above RC cultivars were also evaluated for root N exudation in the form of NO$_3^-$, NH$_4^+$ and total dissolved N (TDN) during early plant growth stage under In vitro conditions. Significant genotypic differences were found for root N exudation and in general root N exudation was higher in tetraploids compared to the diploids. NO$_3^-$ exudation was positively correlated with root growth and root N concentration while, NH$_4^+$ exudation positively correlated with active nodule number.

Nitrogen fixation, N transfer ability and soil N profiles of the above six RC cultivars were evaluated with bluegrass under field conditions. Significant genotypic differences were found for N fixation and N transfer but, these attributes were not associated with the ploidy nature of the selected RC cultivars. Generally, N transfer increased as the season and production year advanced. Nitrogen transfer was positively correlated with RC yield and N fixation. Soil mineral N and potential N leaching were affected differently by the selected red clover cultivars under mixed stands, thus showing genotypic differences for soil N cycling. The results of investigations in this thesis highlight the dynamics of N flow between legumes and companion grasses may assist in developing management protocols and plant breeding strategies to identify genotypes with efficient N cycling profiles.