Changes in total biomass, and N content of taproots ofalfalfa crops under contrasting defoliation frequencies

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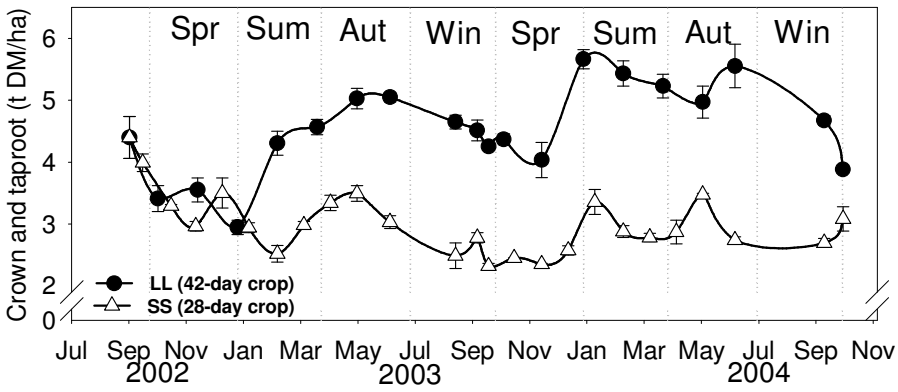
Lucerne crops mobilize carbon and nitrogen reserves stored in perennial organs (i.e. crown and taproot) to meet the demand imposed by regrowing shoots. This is particularly important immediately after defoliation and during early-spring regrowth as it impacts on crop yield and persistence (Avice *et al.*, 1997; Volenec *et al.*, 1996). In temperate climates, the level of perennial reserves follows a seasonal pattern of accumulation in autumn and depletion in spring. Defoliation management, particularly the frequency of defoliation, also regulates the level of perennial reserves by modulating the time available for photosynthesis and nitrogen assimilation (mineral uptake and atmospheric fixation) during each regrowth cycle. However, it is unclear how defoliation management impacts on the seasonality of perennial reserves. This knowledge is essential to define the optimum frequency and timing of defoliations and to understand the mechanisms that control dry matter partitioning in lucerne crops. To create lucerne crops with contrasting levels of reserves, four defoliation regimes were imposed during two growth seasons in Canterbury, New Zealand. In two treatments crops were defoliated consistently at short (SS, 28 days) or long (LL, 42 days) regrowth cycles. In the other two treatments, the defoliation frequency was switched in mid-summer from short to long (SL) and long to short (LS). Dry matter (DM) yield of LL crops was 23 t DM/ha/year with SS crops at ~55% of these. The switch treatments had intermediary yields of 15 t DM/ha/year for SL crops and ~5 t DM/ha/year more for LS. The amount of DM in perennial organs to a depth of 300 mm cycled from ~3.0 to 5.5 t/ha for LL crops but only from 2.2 to 3.5 t/ha for the SS crops (Figure below). The concentrations of starch in taproots were consistently reduced by frequent defoliations and ranged seasonally from ~4 to 30% DM. Nitrogen reserves accumulated in autumn to ~1.8% DM and were depleted in spring to 1.2% DM in the LL crop and 1.0% in the SS crop. In frequently defoliated crops, the levels of soluble sugars declined abruptly from 9 to 4% DM but recovered to levels similar to the LL crops in the long-term. In the 2003/04 season, the switch in defoliation frequency in mid-summer from a short to a long regrowth duration restored carbon and nitrogen in taproots to twice the levels of the SS crop. The pool of taproot nitrogen (kg N/ha) during winter was the best predictor (R^2=0.76) of spring shoot growth rates. The seasonal patterns in perennial DM and the concentration of carbohydrates and nitrogen in taproots occurred regardless of defoliation regime. This indicates that environmental signals impose a strong control over the mechanisms of DM partitioning to lucerne roots in temperate climates.



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