Seasonal variation of taproot biomass and N content of lucerne crops under contrasting grazing frequencies

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Introduction Taproot nitrogen reserves (TN, kg N/ha) a function of N concentration within taproots (N%) and taproot biomass (TBM) are a major determinant of lucerne (*Medicago sativa* L.) growth rates after defoliation and in early-spring (Avice *et al.*, 1997b). Several studies have shown that N% changes with seasons (Cunninghan & Volenec, 1998) and defoliation frequencies (Avice *et al.*, 1997a). However the seasonal pattern of TBM deserves further investigation as the dynamics of root reserves is a weak point in lucerne simulation models (Confalonieri & Bechini, 2004). The objective of this experiment was to assess the seasonal variation in TN through the measurement of TBM and N% of lucerne crops subjected to two defoliations frequencies.

Materials and methods A two year old fully irrigated 'Kaituna' lucerne crop was subjected to 28 or 42-day grazing rotations to induce different levels of N and biomass in taproots. The experiment was conducted at Lincoln University, NZ (43°S and 172°28'E) from 12 June 2002 to 10 June 2003 in a randomized complete block design with four replicates. Taproot biomass (300 mm depth) was excavated at the end of each regrowth cycle. Samples were analysed for total N.

Results From winter to summer TBM decreased at a rate of ~8 kg DM/ha/day for both defoliation regimes (Figure 1a), while from summer to autumn TBM increased and was fully restored to ~3.0 t/ha in the 42-day crop but was 1.0 t/ha less ($P<0.05$) in the 28-day crop. The seasonal pattern for N% was similar and decreased from 2.1% in the winter of 2002 to a minimum of 1.4% in the 42-day crop and 1.0% in the 28-day crop (Figure 1b). Both crops increased the N% in autumn, but the 28-day crops remained 20% lower ($P<0.05$) than 42-day. Increases in TN ($P<0.05$) were greater at ~25 kg/ha in summer to 50 kg/ha in autumn for the 42-day crop than the 28 day crop where the increase was always less than 25 kg/ha.

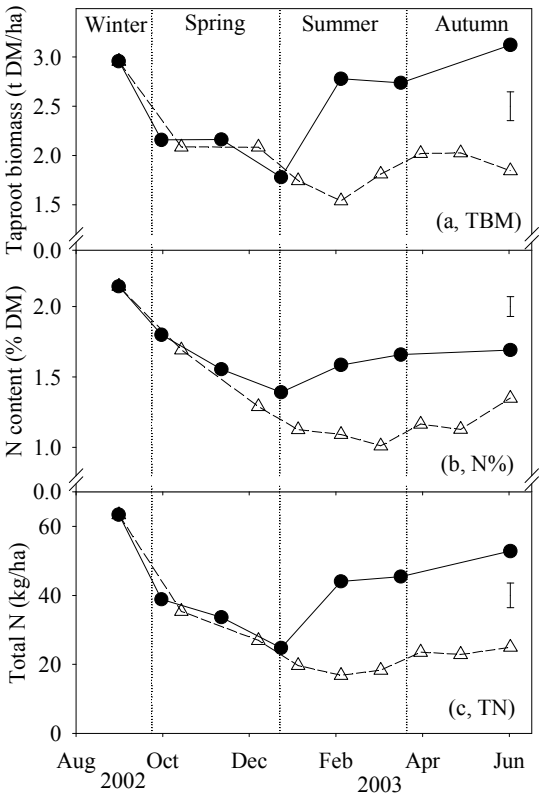

Figure 1 Seasonal variation of TBM (a), N% (b), and TN (c) in lucerne crops subjected to 28-day (Δ) and 42-day (●) grazing rotation. Bars indicate one SEM

Conclusions Seasonal variations and two fold increases in TN were identified between summer to autumn in 42-day crops. This was caused by an increase in both the N concentration in taproots (i.e. N%) and the storage capacity of the root system (i.e. TBM). The similarity in the direction of response of TBM and N% to environmental signals and defoliation managements suggests the inclusion of both variables is required to accurately access shoot growth rates in lucerne simulation models.

References

Avice, J., G. Lemaire, A. Ourry, & J. Boucaud (1997a). Effects of the previous shoot removal frequency on subsequent shoot regrowth in two *Medicago sativa* L. cultivars. *Plant and Soil,* 188, 189-198.

Avice, J., A. Ourry, G. Lemaire, J. Volenec, & J. Boucaud (1997b). Root protein and vegetative storage protein are key organic nutrients for alfalfa shoot regrowth. *Crop Science,* 37, 1187-1193.

Confalonieri, R. & L. Bechini (2004). A preliminary evaluation of the simulation model CropSyst for alfalfa. *European Journal of Agronomy,* 21, 223-227.

Cunninghan, S. & J. Volenec (1998). Seasonal carbohydrate and nitrogen metabolism in roots of contrasting alfalfa (*Medicago sativa* L.) cultivars. *Journal of Plant Physiology* 153, 220-225.