Lucerne Crown and Taproot Biomass Affected Early-Spring Canopy Expansion

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Introduction Leaf area index (LAI) quantifies canopy expansion in crops and is used in lucerne (*Medicago sativa* L.) simulation models to predict daily PAR interception (PAR_i). This then drives yield through radiation use efficiency (RUE) (Gosse *et al.*, 1984). In perennial crops, like lucerne, the level of biomass stored in crown and taproot may affect canopy expansion in subsequent regrowth cycles (Avice *et al.*, 1997). In temperate regions the impact of this is likely to be greatest in early-spring, when low temperatures delay development. The objective of the current research was to identify whether contrasting levels of winter biomass in crown and taproots affected LAI expansion in early-spring regrowth crops.

Materials and methods A two year old fully irrigated 'Kaituna' lucerne crop was subjected to 28 or 42-day grazing rotations from 12 June 02 to 10 June 03 to induce different levels of crown and taproot biomass. Treatments were arranged in a randomized complete block design with four replicates at Lincoln University, NZ (43°38'S and 172°28'E). Taproot biomass (300 mm depth) was 3.0 t/ha in the 42-day crop but ~33% lower for the 28-day crop by 02 June 03 (Teixeira *et al.*, 2005). Shoot yield, radiation interception and main LAI components (stem population, leaves per stem and leaf size) were measured in the following early-spring regrowth cycle (Jun-Oct 03). Bell-shaped functions (Dwyer and Stewart, 1986) were used to describe changes in leaf area with node position.

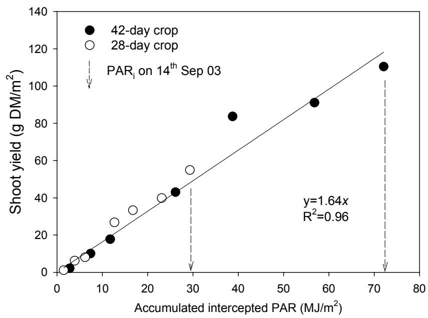

Figure 1 Relationship between intercepted PAR and shoot yield of lucerne crops

Results By 14 September 03, accumulated shoot yield in the 42-day crop was twice (P<0.05) that of the 28-day crop (Figure 1). Differences in shoot yield were explained (R^2=0.96) by a single linear relationship against PAR_i with an RUE of 1.64 g/MJ (Figure 1). PAR_i was limited in the 28-day crop due to a slower LAI development caused by smaller leaf area/node on primary and axillary nodes. This was expressed as a reduction in the parameter Y_0, which represents the largest leaf area per node position (Figure 2). The position of the largest leaf (X_0) was similar (P<0.16) in all treatments, being node 7-8 and 4-5 for primary and axillary leaves, respectively.

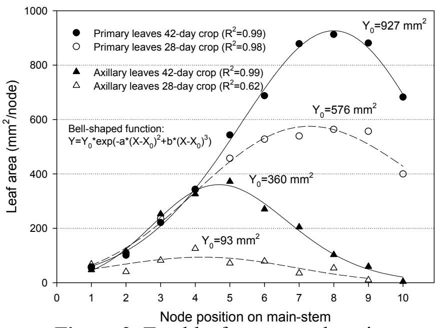

Figure 2 Total leaf area at each main-stem node position of lucerne crops on 1 Oct 03

Conclusions Early-spring shoot yield was reduced in lucerne crops with limited amount of winter crown and taproot biomass. The causal mechanism was a decrease in LAI development through reduced expansion of individual leaves. This limited light interception. Other LAI components and RUE had a minor influence on yield differences. These results indicate that mechanistic approaches are required to quantify the effect of crown and taproot reserves on lucerne shoot yields.

References

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

Dwyer, L. M. & D. W. Stewart (1986). Leaf area development in field-grown maize. *Agronomy Journal* 78, 334-343.

Gosse, G., M. Chartier & G. Lemaire (1984). Predictive model for a lucerne crop. *Comptes Rendus de l'Academie des Sciences, III Sciences de la Vie* 298, 541-544.

Teixeira, E. I., D. J. Moot, H. E. Brown & M. Mickelbart (2005). Seasonal variation of taproot biomass and N content of lucerne crops under contrasting grazing frequencies. In 20th International. Grassland Congress, Dublin, Ireland.