

Lucerne crown and taproot biomass affected early-spring canopy expansion

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Keywords: alfalfa, modelling, morphology, root reserves

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.

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.

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

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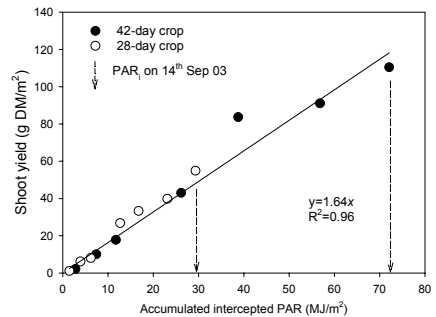


Figure 1 Relationship between intercepted PAR and shoot yield of lucerne crops

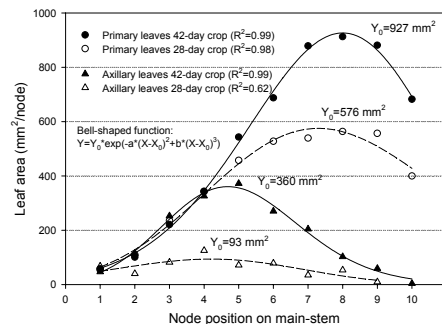


Figure 2 Total leaf area at each main-stem node position of lucerne crops on 1 Oct 03