Delayed Sowing Decreased Lucerne Dry Matter Yield over Two Seasons

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Introduction

Lucerne (*Medicago sativa* L.) can be sown in New Zealand from late spring (October) to early autumn (March). In the establishment season, greatest drymatter (DM) yields are normally attained from sowing early and production lost from delayed sowing is only considered in the establishment season. The objective of this research is to determine if sowing date continues to have an effect on DM yield in year two and how the partitioning of DM between the above and below ground plant fractions is influenced by sowing date.

Methods

Two experiments were conducted at Lincoln University (43° 38‘S, 172 ° 28‘E, 11 m.a.s.l) on two soils with differing plant available water capacity (PAWC). The high PAWC soil was a Wakanui silt loam (*Udic Ustochrept*, USDA Soil Taxonomy) which typically has 2-3 m of fine textured material overlying gravels (Cox 1978) and has a PAWC of about 325 mm to 2.3 m (Brown 2004). In contrast, the low PAWC soil was a Lismore stony silt loam (Udic Haplustept loamy skeletal) (Hewitt 1998) with a shallow topsoil (0.2m) that contains 30-40% stones overlaying coarse gravels. This results in a lower PAWC to 2.3 m of about 125 mm (Moot *et al.* 2008). ‘Stamina 5’ lucerne was sown on five dates; 4 October, 4 November, 2 December 2010, 10 January and 7 February 2011.

DM production was measured at 7 to 14 d intervals using a single 0.2 m quadrant, just above crown height. Perennial DM, consisting of the crown and taproot was excavated to 300 mm from a 0.2 m quadrant at the end of each season (June 2011 and 2012). Material was dried in a forced air oven (60˚C) to a constant weight.

Results

Sowing date affected (P<0.05) annual DM production at both sites in the establishment year and the following season. Delayed sowing from October to February on the high PAWC reduced DM yields from 12 t/ha to 2.6 t/ha in the establishment season, a decrease of 80 kg DM/ha/day (Fig. 1). In the following season, sowing date had less effect on the crops which had been sown in the previous October. These crops produced 21.5 t/ha, a decrease of 50 kg DM/ha/day when sowing had been delayed to February. Crops sown on the low PAWC site showed similar patterns, although severe water stress reduced potential yields in year one to ~3 t DM/ha and the following season to ~7 t DM/ha. This reduced the difference in annual yield from delayed sowing to about 15 kg DM/ha/day.

Sowing date affected (P<0.05) perennial DM production at both sites at the end of the establishment year and second season (Table 1). Crops on the high PAWC soil partitioned 5 t DM/ha below ground when sown up to December. Delaying sowing to February reduced perennial DM to 1.1 t/ha. In the second season crops showed different rates of partitioning with perennial DM yields for the first four sowing dates increasing to 6.7 t/ha and 5.7 t/ha for the February sown crop. Perennial DM was greatest for crops on the low PAWC site when sown before December in both the establishment season (2 t/ha) and year two (4.7 t/ha). Delayed sowing to February decreased root mass by 70 and 30% in the first and subsequent season, respectively.

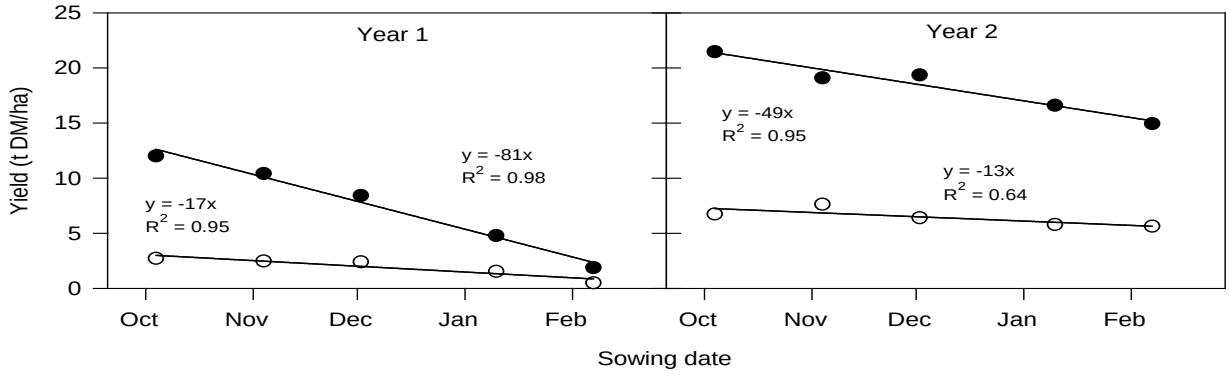

Figure 1 Total annual shoot yield of dryland lucerne sown on five dates at two sites; low (○) and high (●) plant available water content soils in year one (sowing to June 2011) and year two (June 2011 to June 2012) at Lincoln University, Canterbury, NZ.

Table 1. Perennial DM (crown + taproot; t DM/ha) of dryland lucerne sown on five dates at two sites; low and high plant available water content soils at the end of year one (June 2011) and year two (June 2012) at Lincoln University, Canterbury, New Zealand.

	Low PAWC		High PAWC	
Sowing date	Year 1	Year 2	Year 1	Year 2
October	2.2 a	4.8 a	4.3 b	6.7 a
November	2.0 a	4.6 ab	5.7 a	6.6 a
December	1.6 ab	4.0 bc	4.9 ab	6.7 a
January	1.2 b	3.5 c	3.2 c	6.9 a
February	0.6 c	3.4 c	1.1 d	5.7 b
P	<0.001	<0.05	<0.001	<0.05
SEM	0.187	0.244	0.301	0.230

Note: Means within a column with different letters are significantly different (l.s.d α=0.05).

Crop yield, in part is the product of intercepted radiation. Delaying sowing reduces the potential yield in the establishment season. Water stress experienced by crops grown on the low PAWC decreased canopy expansion (Sim *et al*. 2012) radiation interception, and therefore yield. Photoperiod has been shown to affect DM partitioning in both seedling and regrowth lucerne (Teixeira *et al*. 2007; Teixeira *et al*. 2011). There is increased partitioning of DM below ground during periods of decreasing photoperiod. These results suggest shoot DM yields in the second season were affected by the plant prioritizing DM below ground to reach optimum levels of root mass.

Conclusion

Delayed sowing reduced DM production in both the establishment and following season. The cost of delaying sowing from October to February was greatest when potential yield was higher (80 kg DM/ha/day) compared to 15 kg DM/ha/day when yield potential was reduced by water limitations.

The decrease in DM for delayed sowing in year two was associated with greater partitioning of DM below ground in the later sown crops to build root reserves to optimum levels.

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