The effects of cultivation date and method on the establishment of lucerne in the UK

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Abstract

Dairy farmers are under increasing pressure to maximise their use of home-grown high-protein forages to achieve sustainable intensification. The use of shallow tillage, such as direct drilling, is one approach farmers could use to reduce the establishment costs when incorporating these forages into high-output pasture-based systems. Lucerne (*Medicago sativa*) is a high yielding forage with high crude protein concentration which is highly palatable to ruminants. An experiment investigated the effect of establishment date and method on lucerne establishment. Findings showed that competition from grass was the main factor affecting the lucerne establishment. The yield of lucerne, established after either a first or second silage cut, either by ploughing or direct drilling, did not differ among treatments where herbicide was used. If lucerne is to be successfully established without the use of herbicide, it should be sown after ploughing not by direct drilling, and after a first silage cut.

Keywords: *Medicago sativa*, establishment technique, shallow tillage, yield

Introduction

Dairy farmers are under increasing pressure to maximise their use of home-grown high-protein forages to achieve sustainable intensification. Lucerne (*Medicago sativa*) is a high-yielding forage with high crude protein concentration and is highly palatable to ruminants (Marley *et al.*, 2007). The use of shallow tillage, such as direct drilling, is one approach farmers could use to reduce the establishment costs when incorporating these forages into high-output pasture-based systems. Furthermore, many farmers aim to establish new forage crops after harvesting a second silage cut, with an aim to harvest a sufficient dry matter (DM) yield of forage as winter feed for livestock. However, this could alter the success of establishing a subsequent forage crop depending on the establishment technique employed. Here we present the findings of an experiment investigating the effect of establishment date and technique on the yield and quality of a lucerne stand when compared to the existing sward.

Materials and methods

The experimental plots (10×2.8 m) were established in 2013 in a randomized block design on an area of stony, well-drained loam of the Rheidol series at Gogerddan (52°26'24.64'N 4° 1'39.77'W). Prior to the experiment, on 12 December 2012, calcium lime was applied to the area, at 5 Mg ha^{-1}, to achieve a soil pH of 6.2. Previously, the experimental site was sown in autumn 2006 with a perennial ryegrass mix and managed for silage, followed by sheep grazing annually. This established ryegrass sward was used as a control and received a target N application of 270 kg N ha^{-1} $annum^{-1}$ in 2013 and 2014. Lucerne (cv. Timbale) plots were established at a target sowing rate of 22 kg ha^{-1} either after a first or second silage harvest; the cut was removed and plots were sown either by conventional reseeding or by direct drilling and either with or without a pre-cultivation herbicide. The treatments comprised of a 2^3 factorial + control, giving a total of 27 plots in a randomised complete block with three replicate blocks (Table 1). P and K were applied to achieve soil indices above 2. Lucerne plots did not receive any N post-establishment but ammonium nitrate was applied to treatments 5-9 until after 2nd cut silage in 2013. The DM yield of all plots was determined for 1st silage cut on 4 June 2013 and then treatments 1-4 were established on 18 June. Plots requiring herbicide (1, 2, 5 and 6) received glyphosate (360 g l^{-1})

Table 1. Treatments used to compare the effects of different lucerne establishment methods.

Treatment no.	Sowing date	Herbicide treatment	Sowing method	Herbicide 2014
1	June	pre sowing herbicide	ploughed & broadcast	yes
2	June	pre sowing herbicide	direct drill	yes
3	June	no herbicide	ploughed & broadcast	no
4	June	no herbicide	direct drill	no
5	August	pre sowing herbicide	ploughed & broadcast	yes
6	August	pre sowing herbicide	direct drill	yes
7	August	no herbicide	ploughed & broadcast	no
8	August	no herbicide	direct drill	no
9	Control	no herbicide	no cultivation	no

(Clinic Ace, Nufarm UK Ltd., Bradford, UK) at a rate of 4 l ha^{-1} prior to establishment and carbetamex (600 g kg^{-1}) (Crawler, Makhteshim-Agan Ltd., Thatcham, UK) applied at 3.5 kg ha^{-1} on 10 March 2014. Ploughed treatment plots were ploughed to a depth of 150 mm, power harrowed and rolled prior to surface sowing using a Fiona D784 seed drill (Westmac Maskinfabrik A/S, Bogense, Denmark) before being lightly harrowed and rolled using a flat roller. Plots for direct drill were sown with a Duncan Eco Seeder direct drill (Willow Farm Machinery Ltd., Ludford, UK) into slots 15 mm deep. Lucerne seed was inoculated with *Rhizobium meliloti* (Legume Technol. Ltd., Eastbridgford, UK). All plots received metaldehyde (15 g kg^{-1}) slug pellets (Tempt, Chiltern Farm Chem Ltd., Bowes, UK.) at a rate of 2.5 kg ha^{-1} after each establishment date. After the 2nd grass harvest on 31 July, the above process was repeated for treatments 5-8. Plots were managed to simulate a silage system followed by light grazing pre-winter. Plots were harvested using a plot harvester (J. Haldrup a/s, Løgstør, Denmark) at a height of 8 cm for silage cuts and 6 cm pre-winter. In 2013, plots with forage material above 8 cm were harvested on 31 July, 21 August, 1 October and 15 November. During 2014, all plots were harvested on: 13 May, 23 June, 4 August and 18 September, with a pre-winter cut on 31 October. DM yield was determined by weighing the material cut from an area of 10×1.5 m within each plot. Sub-samples of harvested forage were taken to determine DM and botanical composition. Data were analysed by ANOVA using GenStat® Release 13 (Payne *et al.*, 2011).

Results and discussion

The average DM yield of Cut 1 taken as determined from all plots in the establishment year was 5,914 kg DM ha^{-1} (standard deviation 568.4). Perennial ryegrass yield data confirmed visual observations and research (Bishop and Gramshaw, 1977) that the establishment success of lucerne is mostly affected by competition from grass, with the yield of lucerne on plots established after either a first or second silage cut, either by ploughing or direct drill, not differing among treatments where herbicide was used. In the first harvest year, plots established by direct drilling after a second silage cut and without herbicide had a lower DM yield compared to all other treatments, resulting overall in this treatment having the lowest lucerne yield (Table 2).

Conclusions

Competition from grass was the main factor affecting the success of lucerne establishment. The yield of lucerne established after either a first or second silage cut, either by ploughing or direct drilling, did not differ among treatments where herbicide was used. If lucerne is to be established without the use of herbicides, it should be sown after ploughing not by direct drilling, and early in the season, after a first silage cut.

Table 2. Effect of establishment method and date on the total dry matter (DM) yield (kg DM ha^{-1}), lucerne yield and perennial ryegrass yield during the establishment and first harvest year of lucerne plots compared to an existing ryegrass control sward.

		2013 yield			2014 yield		
		DM	Lucerne	Perennial ryegrass	DM	Lucerne	Perennial ryegrass
Control							
Existing grass		5,576 [e]	-	5,318 [d]	13,808 [b]	-	12,210 [e]
Ploughed							
Post 1st cut	Herb	2,896 [a]	1,815 [b]	5 [a]	13,917 [b]	13,538 [d]	26 [a]
	No herb	3,124 [ab]	1,267 [b]	29 [a]	15,138 [b]	13,351 [d]	1,373 [b]
Post 2nd cut	Herb	3,940 [d]	0 [a]	3,915 [c]	14,030 [b]	13,842 [d]	21 [a]
	No herb	3,767 [bd]	0 [a]	3,710 [c]	14,360 [b]	11,123 [c]	2,671 [c]
Direct drill							
Post 1st cut	Herb	3,179 [abc]	1,601 [b]	117 [a]	13,961 [b]	12,825 [d]	647 [ab]
	No herb	2,487 [a]	255 [a]	2,065 [b]	13,969 [b]	8,981 [b]	3,842 [d]
Post 2nd cut	Herb	3,820 [bcd]	2 [a]	3,606 [c]	13,845 [b]	13,476 [d]	141 [a]
	No herb	4,426 [d]	16 [a]	3,915 [c]	7,628 [a]	2,711 [a]	3,946 [d]
sed[2]		251.1	300.3	205.4	669.1	596.7	419.3
Probability		***	***	***	***	***	***

[1] Within columns, treatment values with different lower case superscript differ significantly ($P<0.05$).

[2] sed = standard error of a difference.

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