The effect on sheep reproduction of grazing willow fodder blocks during drought

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ABSTRACT

A trial was conducted in the summer/autumn of 2003 to determine the effect of grazing on willow fodder blocks (6,000 stems/ha) during mating, relative to control ewes grazed on drought pasture, upon ewe production and reproduction. Grazing occurred over 10 weeks, from 19 February including 3 cycles of mating, with ewes randomly assigned to four treatment groups each of 100. The treatments were short drought pasture (typical of drought pasture), long drought pasture (typical of the pasture growing in the willow fodder blocks), short drought pasture with restricted willow access (restricted access) and full access to willow fodder blocks (fenced on the willow all the time; full access). After mating the four groups were joined together and managed as one mob until weaning.

Substantial live weight loss occurred in the short control group (101 g/day), as would occur in severe drought conditions and reproductive rate was low. Ewes in the full access group had significantly ($P<0.05$) less live weight loss of 40g/day, with reproductive rate increased by approx 20% units ($P<0.05$). The increase in reproductive rate in the group with full access to willow fodder blocks was due to increases in fecundity, with more ewes giving birth to twin lambs. Live weight loss during mating in the long control and restricted access groups was intermediate between the short control and full access groups (75-86 g/d) and significantly different from either ($P<0.05$); reproductive rate was also intermediate between the short control and full access groups but was not significantly different from either ($P>0.05$). Grazing willow fodder blocks with full access during times of drought can be used to reduce the decline in reproductive rate, which occurs when ewes are mated on drought pastures.

Keywords: Drought feed; willow (*Salix* sp.*)*; sheep reproduction; fodder blocks.

INTRODUCTION

Climatic variability, especially drought, has a major impact on the viability of East Coast sheep/beef farming systems in New Zealand (Korte & Rhodes, 1993) and predictions indicate that droughts will be more frequent and severe in the East Coast regions of New Zealand in the near future (Salinger, 2000). In East Coast Hill country, lack of sufficient flat area is a constraint to growing supplementary feed on many farms. In the search for alternate drought feed supplements, farmers have begun to feed willow and poplar prunings from trees that were originally planted for animal shelter and soil conservation purposes (Charlton *et al.,* 2003). Moore *et al*. (2003) found that willow supplementation of beef cattle grazing dry summer pastures reduced live weight loss under prolonged summer drought conditions. McWilliam *et al.* (2003; 2004) established that supplementing ewes with poplar and willow cuttings when grazing drought pasture during mating increased reproductive rate and reduced live weight loss. Supplementing willows to sheep and cattle proved to be effective but demanded large labour costs.

Large scale planting of willows originally relied on using rooted stem cuttings, but these are expensive. An alternative is to use unrooted stem cuttings which were as productive as rooted cuttings, whilst being cheaper to establish and easier to handle (Zsuffa,1992). These stem cuttings (stakes) have been used as potential browse plants in dry summer conditions (Oppong *et al.,* 1996). Douglas *et al.* (1996) concluded that willows could be cut, carried and used in coppicing and recommended that farmers could establish special purpose forage banks of the willows, which could be cut or grazed when required.

The present study aimed at reducing the labour costs in using supplementary tree fodder during droughts, by establishing densely planted willows as fodder blocks. The objective was to investigate the effect of grazing sheep on these willow fodder blocks during mating as an alternative to drought pasture for increasing reproductive rate.

MATERIALS AND METHODS

A grazing trial using 400 mixed-age Romney ewes was conducted at Massey University's Riverside Farm, near Masterton, New Zealand, on the North Island East Coast. The experiment involved ewes grazing simulated drought pastures, with and without access to established willow fodder blocks (6,000 stems/ha). Grazing these experimental areas occurred for 10 weeks from 19 February to 30 April 2003 (late summer), including 3 cycles of mating, with ewes randomly assigned to four treatment groups each of 100. Each group of ewes grazed on separate plots. The treatments were short drought pasture (short control; typical of drought conditions), long drought pasture (long control; typical of the pasture growing in the willow fodder blocks), short drought pasture with restricted access to willow

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fodder blocks (restricted access) and full access to willow fodder blocks (fenced on the fodder blocks all the time; full access). All groups were grazed in weekly breaks and were moved on the same day. The feed in the willow fodder blocks comprised of trees as well as herbage grown along with the trees. After mating, the four groups were joined together and managed as one mob until weaning (late spring). Live weight and body condition score of ewes were measured regularly throughout the experiment up to weaning, whilst reproductive rate was measured at ultra-sound pregnancy scanning, lambing, docking and weaning.

The short and the long control groups were fed on pasture alone and had no access to willows. The dry matter allowance provided to the ewes in both the willow groups was a combination of dry matter from trees and herbage present in the willow fodder blocks. The short pasture (herbage) groups were offered 0.8 kg DM/ewe/day and an additional 0.4 kg DM/ewe/day from the willow fodder blocks (trees and herbage) in the restricted access group, while the long control (herbage alone) and full access to willow fodder blocks(trees and herbage) groups were both offered 2.0 kg DM/ewe/day each, respectively. During the mating period (15March to 30 April), two Suffolk rams were run with each group of 100 ewes and rams were randomly reassigned to the groups every two weeks. This was done to ensure that a ram breakdown did not affect reproductive results.

Ewes were scanned for pregnancy using ultrasound on the 9 June 2003 and dry ewes were sent to the abattoir. Ewes lambed between 12 August and 30 September 2003 and reproductive data was recorded at lambing. Lambs were docked on 15 October 2003 and weaned on 25 of November 2003.

Willow fodder blocks

Rush infested swamps and low lying wet areas were identified on Riverside Farm as sites to establish willow fodder blocks. Four such areas of one hectare each were sprayed with glyphosphate (Monsanto, NZ) to control rushes and then planted with willow trees spacing at 1.2 metres (6,000 trees/ha). The species used were *Salix matsudana* Koidz. × *alba* L. (hybrid willow) clone 'Tangoio' (NZ 1040) and *Salix matsudana* Koidz. × *alba* L. clone 'Moutere' (NZ 1184). The willow stakes (0.7 m long) were procured from the Wellington Regional Council's Akura Nursery, near Masterton. The stakes went around 0.35 m deep into the soil. These small trees were 1.5 to 2.5 year old at the time of the experiment. Prior to the experiment, these willow fodder blocks were grazed with sheep followed by cattle in May 2002, and the trees were then cut back to stump height during June 2002. Willow fodder blocks were then shut from grazing in mid August 2002. As more grazing was done during the winter of 2002, a good cover of herbage developed in the willow fodder blocks from volunteer species, mainly grasses with some legumes and herbs.

Forage measurements

Pre and post- grazing herbage mass in both control pastures and willow fodder blocks was determined immediately before and after grazing each break respectively, by cutting eight random quadrats per treatment group per break to ground level, washing and then drying the herbage at 80^{o}C for 18-24 hours. Six exclusion cages were placed over herbage in each break and at the end of grazing the break, hand plucked diet select samples were collected to simulate diet eaten by the ewes.

Mass of willow per ha was estimated before grazing by cutting four trees selected at random to the level of the stumps, cutting the material into approx 2 cm lengths and drying. Willow material remaining after grazing was similarly estimated. Four exclusion cages were placed over willow trees in each break and diet select samples were collected as for herbage.

Animal measurements

Ewes were weighed fortnightly using electronic scales (Tru-test, New Zealand) during the period of supplementation and body condition, scored from 1 to 5, was assessed monthly. After the animals were joined together as a mob, ewes were weighed and body condition scored monthly before lambing. After lambing, ewes were weighed monthly until lambs were weaned.

Laboratory Methods

The Willow and pasture diet select samples were stored at -20^{o}C, freeze dried and ground to pass through a 1 mm sieve. Total nitrogen (N) concentration was determined using the Dumas method (Leco Corporation 1994). *In vitro* Organic matter Digestibility (OMD) was determined by the enzymatic method of Roughan and Holland (1977) and Metabolisable energy (ME) in the diet select samples was calculated as 16.3 x digestible organic matter / 100g DM (DOMD; Drew & Fennessy 1980).

Calculation and Statistical Analyses

Mean and standard errors for each of the different variables describing chemical composition of the diet selected in each of the treatments were obtained. Repeated measurements of live weight and body condition score on the same ewe through the experimental period were analysed using the MIXED procedure of SAS (2001) with a linear model that included the fixed effects of treatment, day of measurement and their interaction and the random effect of ewe within treatment (Littell *et al.,* 1998). Results are presented as least square means and their standard errors. Multiple comparisons between least square means for each treatment in each day were performed.

Reproductive rate, expressed as number of lambs per ewe, at scanning, lambing, docking and weaning was analysed using the MIXED procedure of SAS (2001) with a linear model for repeated measurements (Littell *et al.,* 1998). The model considered the fixed effect of treatment, date (scanning, lambing, docking and weaning), and their interaction and the random effect of ewe within treatment. Least square means and standard errors were obtained for each treatment in each date and multiple mean comparisons were performed.

TABLE 1: Pregrazing and post grazing mass, dead matter content and chemical composition of diet selected for control drought pastures (short and long) and willow fodder blocks grazed by ewes during the experiment (mean values with standard errors).

	Control		**Willow fodder blocks**				
			Restricted access			Full access	
	Short drought pasture	Long drought pasture	Short drought pasture	Herbage	Trees	Herbage	Trees
Forage mass (kg DM/ha)(n = 10)							
Pre grazing	1639±169.5	3776±284.9	1587 ±196.4	5673±205.1	556±119.1	5207±258.13	549 ±108.3
Post grazing	745±158.2	2065±202.0	858±120.9	2843±326.9	339.5±62.7	2958±117.4	370±68.7
Dead matter content (%)(n = 10)							
Pre grazing	66±9.4	64±3.3	63±7.5	52±3.85		51±4.98	
Post grazing	80±8.23	86±3.14	78±7.15	87±4.12		80±3.49	
Chemical Composition (n = 10)							
N[1] (g/kg DM)	22.7±1.35	16.0±0.70	22.4±1.20	17.6±0.50	17.4±0.42	18.0±0.64	15.5±0.66
OMD[2]	0.50±1.35	0.50±1.33	0.52±1.06	0.52±1.51	0.72±1.69	0.54±1.28	0.72±2.18
ME [3] (MJ/kg DM)	7.7±0.23	7.4±0.18	7.8±0.15	7.7±0.23	10.8±0.23	8.1±0.18	10.7±0.31
Estimated DM intake (n=10)							
Kg DM/ewe/day	0.42±0.074	0.88±0.06	0.31±0.119	0.21±0.028	0.01±0.004	0.82±0.103	0.06±0.017
Total DMI [4] (kg)	0.42	0.88		0.53		0.88	

[1]N: Nitrogen; [2]OMD: Organic matter digestibility[3]; ME: Metabolisable energy; [4]DMI: Dry matter intake

RESULTS

Pasture measurements are presented in Table 1. Pre and post grazing herbage mass for short drought pasture was 1639 kg DM/ha and 745 kg DM/ha respectively, with a pre-grazing dead matter content of 66%, typical of drought pastures. Tree yields in the young willow fodder blocks were low, but pasture masses in the willow blocks were high (approx 5,500 kg DM/ha), with a pre-grazing dead matter content of approximately 50%.

Short drought pasture and long drought pasture were of low nutritive value, with a digestibility of approx 50% and a ME value of approx 7.5 MJ/kg DM, again typical of drought pasture. Herbage growing in the willow fodder blocks was of similar nutritive value to both long and short drought pasture, with the trees being higher in OMD and ME content but similar in N content. The estimated DM intake (kg DM/ewe/day) for long control and full access groups was similar at 0.88, while a lower value of 0.42 DM intake was estimated in the short control with the restricted access being slightly higher than short control with 0.53.

Mean initial live weight and body condition score was similar between the four groups with the short control, long control, restricted access and the full access groups weighing (mean ± standard error) 55.7 ± 0.45 kg, 55.6 ± 0.45 kg, 55.8 ± 0.44 kg, and 55.7 ± 0.45 kg respectively, with body condition scores of 2.8 ± 0.06, 2.9 ± 0.06, 2.8 ± 0.05 and 2.7 ± 0.06 for the four treatment groups. Ewes grazing short drought pasture during mating had a large live weight loss of approx 100 g/d and very low reproductive rate, typical of drought conditions (Table 2). Full access to willow fodder blocks markedly reduced the loss of both body weight and condition score during mating ($p<0.05$) and significantly increased reproductive rate ($p<0.05$). Live weight loss in the restricted access and long control groups was intermediate between the full access and short control groups and significantly different from either ($p<0.05$) Reproductive rate in the restricted access and long control groups was not significantly ($p>0.05$) different from short drought pasture group and the full access group (Table 2)

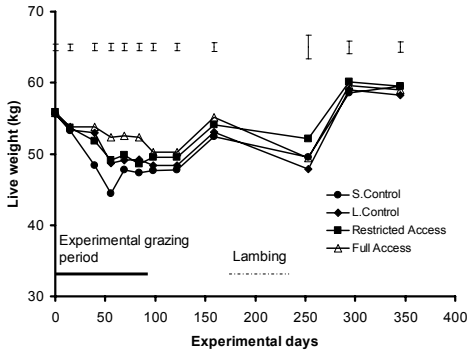
Figure 1 shows the pattern of live weights in various groups from the start of experiment up to weaning. There was a loss of weight in all the treatments in the supplementary period, but this recovered after the ewes in the four treatments were joined together as one mob. Differences in live weights between the four groups diminished as the experiment progressed.

DISCUSSION

The objective of this work was to evaluate if grazing ewes on willow fodder blocks during mating would improve their reproductive performance, relative to ewes mated whilst grazing drought pastures. The study showed that grazing of ewes (full access) on willow resulted in increased reproductive rates by 20% units and

greatly reduced the live weight loss. These results were only marginally better than for long drought pasture alone, suggesting that much of the benefit of the "full access" willow group was due to the herbage growing in the young willow fodder blocks; tree yields can be expected to increase with increasing age (Douglas *et al.,* 2003). Whilst restricted access of ewes to willows when grazing short drought pasture reduced the loss in live weight and body condition score, it did not significantly affect reproductive rate. Use of the willow fodder blocks for full access during mating was therefore successful in increasing numbers of lambs weaned, compared to ewes grazing short drought pasture, the normal feed during drought.

FIGURE 1: Changes in mean live weight of ewes through the experiment. The solid line indicates the experimental grazing period (75 days). Broken line indicates lambing. I indicate pooled standard error.



The increase in the reproductive rate of ewes that grazed on full access to willow was multifactorial. The most significant reason was due to the increase in fecundity, with a higher proportion of multiple pregnancies in this group compared to the short drought pasture group, as also found by Mc William *et al.* (2004) for poplar supplementation of ewes grazing short drought pasture. Establishment of willow fodder blocks in areas of the farm that have negligible pasture production has had beneficial effects on sheep performance. Further, it was found to be more advantageous over supplementing willow prunings or cuttings as the later incurs large labour costs (Moore *et al., 2003).*

McWilliam *et al.* (2004) suggested that forage tree supplementation during mating increased the reproductive performance of ewes grazing drought pastures due to increasing DM intake and to increasing the amount of protein absorbed from the small intestines. Similar reasons may apply in this work. The pre and post grazing masses with a dead matter content of approx 65% and OMD of 50% in control short drought pasture is indicative of a typical drought pasture in the East Coast regions like Wairarapa. The higher OMD and ME values in willow trees over the pasture confirms a higher nutritive value than drought pasture and suggests its use as a supplementary feed (Douglas *et al.,* 1996).

Although grazing of willow fodder blocks during mating has proved to be beneficial for increasing reproductive rate, the herbage in the willow blocks needs to be better managed in the future. A major weakness of the willow fodder block system was low nutritive value of the herbage that accumulated in them, which in fact was of similar low nutritive value to drought pasture (approx 50% digestible). A contributing reason was the early closure of the willow blocks in mid August 2002, giving a 6 month growing season. Our current experiment evaluates using also the willow fodder blocks for lambing and not closing until mid Oct 2003, giving a four month growth period before using them for mating in Autumn 2004. In the future it is clear that the willow fodder blocks will have to be managed as a tree/pasture system, and not just as a tree system as was done in this experiment.

TABLE 2: Least square means ± standard errors for live weight change (g/day) and body condition score change (units), during the 75 – day experimental period and reproductive rate (lambs / 100 ewes mated) for ewes grazing drought pastures and willow fodder blocks during mating in 2003.

	Control		**Willow fodder block**	
	Short drought pasture	Long drought pasture	Restricted access	Full access
Change in live weight (g/day)	- 101 ^{d} ± 3.7	- 75 ^{b} ± 3.7	- 86 ^{c} ± 3.7	- 40 ^{a} ± 3.7
Change in BCS (units)	- 1.17 ^{c} ± 0.046	- 0.86 $^{a\,b}$ ± 0.046	- 0.92 ^{b} ± 0.046	- 0.75 ^{a} ± 0.046
Reproductive rate:				
Scanning	124^{a} ± 6.4	135^{ab} ± 6.4	129^{a} ± 6.4	148^{b} ± 6.4
Lambing	122^{a} ± 6.4	131^{ab} ± 6.4	125^{ab} ± 6.4	137^{b} ± 6.4
Docking	92^{a} ± 6.4	111^{b} ± 6.4	108^{ab} ± 6.4	114^{b} ± 6.4
Weaning	90^{a} ± 6.4	105^{ab} ± 6.4	103^{ab} ± 6.4	109^{b} ± 6.4

$^{a,b,c\ \&\ d}$ Means within rows with different superscripts differ significantly ($p<0.05$)

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