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GRAZING VALUE OF DUAL-PURPOSE WINTER WHEATS FOR YOUNG SHEEP

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SUMMARY
The grazing value of two Australian cultivars of winter wheat was evaluated in two preliminary trials. In the first, March-sown crops of Blackbutt oats, Tennant and Gordon winter wheats and a mixture of Tennant and the extreme spring wheat Sunset (2:1) were grazed in July by young crossbred sheep (39.5 kg). Crop growth rates differed initially, so that herbage on offer at the start of grazing was significantly higher ($P<0.05$) for the oats. Crops were therefore grazed at equal initial herbage allowances of 40 kg DM/animal, to assess their capacity to support liveweight gain (LWG). Lambs grazing the winter wheats grew significantly faster (320-369 g/day; $P<0.05$) than those grazing the oats (282 g/day) or the Tennant:Sunset mix (252 g/day). Winter wheat grain yields were also significantly higher (4.45-4.30 t/ha: $P<0.05$) than either the oats (3.29 t/ha) or the mixture (3.72 t/ha), which did not differ. Compared with adjacent ungrazed areas, grain yields were not affected by grazing. In the second trial, Tennant winter wheat was grazed for 56 days by second-cross lambs (34.2 kg), at an initial herbage allowance of 57 kg DM/animal. Weight gains were less than in the first trial, averaging 274 g/day in the first half of the grazing period and 199 g/day in the second half. This occurred despite the forage having very high digestibility (>80%) and crude protein content (>21%) throughout. The mean herbage intake estimated in 10 lambs was 1071 g DM/day. At slaughter, mean fat depth at the GR site was 14.4 mm, indicating that lambs were still lean. The results of the two trials indicate that winter wheat forage can support rapid LWG and finish lambs to market specifications. However, they also indicate the need for closer examination of the factors influencing weight gain during such grazing, in relation to the nutritive value of the crop and herbage intake.

Keywords: winter wheat, dual-purpose wheats, sheep, grazing value, grain yield

INTRODUCTION
Until recently, Australian wheats have been spring wheats which, because of their rapid stem elongation during winter/spring, can be difficult to use for winter grazing without reducing their ultimate grain yield. The release of winter wheat varieties suitable for the High Rainfall Zone (HRZ) (e.g., cultivars Tennant, Gordon, Brennan) has resulted in increased plantings of winter wheats in this zone, and increased use for grazing because the high vernalisation requirement of winter wheats means that stem elongation occurs much later in the season. When sown early (March), winter wheats can produce large quantities of winter feed (Davidson *et al.* 1990) and, in addition, a feed grain crop. The value of the grazing from winter wheats has the potential to offset their production costs, so that the feed grain ultimately produced can provide an income source for HRZ graziers, either in terms of direct sales of feed grain, or through reductions in supplementary feed purchases. There are anecdotal data suggesting that young sheep can be finished to market specifications on winter wheat forage, but there is little objective information or comparisons with other winter forage crops commonly grown in the HRZ, such as forage oats. We report the results of two preliminary studies to obtain such data.

MATERIALS AND METHODS
Experiment 1, 1999
In an experiment at Ginninderra Experiment Station (GES) near Canberra, the grazing value of the winter wheat varieties 'Gordon' and 'Tennant' was compared with 'Blackbutt' oats, the cereal crop used most frequently in the district as a source of extra winter feed. These treatments were also compared with a 2:1 mixture of Tennant and the extreme spring ('express') wheat 'Sunset'. The express wheat, which has no vernalisation requirement, is expected to undergo rapid stem elongation and provide an early feedbank before that supplied by the winter wheat (see Davidson *et al.* 1990).

Crop and animal management. Four plots (0.2 ha) of each of the above 4 treatments were sown in a randomised block design, in early March 1999. The sowing rate for all crops was 80 kg/ha, together with 125 kg/ha of 'Starter 15' fertiliser. Good rains in late March and early April resulted in excellent germination and early growth, especially in the oats. Thereafter, drought conditions and low temperatures reduced the growth of all crops.

In early July, the herbage on offer in all 16 plots was estimated by five experienced assessors, using the calibrated visual scoring method of Morley *et al*. (1964), prior to the plots being grazed by young crossbred sheep of initial liveweight 39.5 (s.e. 0.30) kg. At this time, as a result of the better early growth of the oat crop, the available herbage on the Gordon (G), Tennant (T) and Tennant/Sunset (T/S) plots was much less than that on the Blackbutt oats (O) (Table 1). Hence, to obtain an unbiassed estimate of the capacity of each crop type to support liveweight gain (LWG), different numbers of sheep were allocated to each plot, to achieve an initial herbage allowance as close as possible to 40 kg herbage DM/animal. The actual mean initial allowance over the 16 plots was 40 (s.e. 1.4) kg DM/animal. The mean grazing pressure was 53 lambs/ha, though to achieve the desired herbage allowances, treatment mean grazing pressures ranged from 26 (T) to 95 (O) lambs/ha. As far as possible, equal numbers of ewes and wethers were allocated to a plot.

Sheep were weighed onto the plots and on two subsequent occasions until they were removed from the plots in early August, when they were weighed again. Following grazing, all plots received a top-dressing of 100 kg N/ha and remained ungrazed until grain harvest in late December 1999 (O) or mid-January 2000 (G, T, T/S). During the grain development stage, one replicate of the oat crop was 'invaded' by kangaroos, which inflicted severe grazing damage and reduced the ultimate grain yield. This replicate was treated as a missing value in the statistical analysis of grain yield.

Statistical analyses. The results of the first study were analysed as a randomised block design. Actual values for herbage allowance on each plot were used as covariates in the analyses of daily LWG. Differences in the response of ewes and wethers were not significant and were therefore incorporated into the error term. Treatment means were compared using least significant differences ($P<0.05$).

Experiment 2, 2000

The second grazing trial was conducted mainly to obtain further data about LWG, the yield and nutritive value of Tennant winter wheat forage, and the intake and digestibility of wheat forage by animals similar to those in experiment 1. Moreover, animals were slaughtered to obtain carcass data and an indication of the capacity of winter wheat forage to finish lambs to market specifications. Initial herbage allowances were greater than in the previous year, to permit a longer period of grazing.

Crop and animal management. Four adjacent plots of 0.2ha were sown to Tennant winter wheat in early March 2000, using a sowing rate of 120 kg/ha and fertiliser rates (N, P) of 24 and 16 kg/ha, respectively. The amount of herbage on offer was assessed by calibrated visual scoring (Bell *et al.* 1991) immediately before animals were introduced (July 4) and two months later, after the grazing period finished. Each 0.2 ha plot was grazed by 10 second-cross wether lambs of initial live weight 34.2 (s.e. 0.54) kg (empty weight 30.7 (s.e. 0.53) kg). The grazing pressure was thus 50 lambs/ha, similar to the mean grazing pressure in experiment 1, but the mean initial herbage allowance was higher (57 (s.e. 0.8) kg DM/head). Animals were weighed weekly, while herbage samples for later chemical analysis (nutritive value and alkane concentrations) were taken after 2, 4, 6 and 8 weeks of grazing. At the end of the 56-day grazing period, lambs were weighed and transported to an abattoir. They were weighed again after an overnight fast, then slaughtered using commercial procedures. Carcass weights were measured and the fat depth measured at the GR site (110 mm from the mid-line of the carcass over the 12th rib). After grazing ceased, all plots received a top dressing of 47 kg N/ha as urea (September 9) and were not grazed again until grain harvest.

Estimation of herbage intake. On day 20 of grazing, five animals from each of plots 1 and 2 were dosed orally with intra-ruminal alkane controlled-release devices (Captec Alkane®) delivering 50 mg/day of each of C32 and C36 alkanes. Commencing 7 days later, rectal grab samples of faeces were obtained twice-daily (0730h, 1530h) from each of the 10 animals and bulked within animal over 5 days of sampling (days 27-32). Herbage intake was estimated from the herbage and faecal concentrations of C33 and C32 alkanes and the known dose of C32 alkane (Mayes *et al.* 1986). *In* *vivo* digestibility was estimated from the intake estimate, and an estimate of faecal output based on the known dose of C36 alkane and faecal C36 concentration.

Chemical analyses. Samples of wheat herbage for the estimation of nutritive value were oven-dried prior to the determination of *in vitro* OM digestibility, crude protein (CP) and neutral detergent fibre content. Samples for alkane determination were freeze-dried prior to alkane analysis using the methods of Dove *et al.* (1996).

RESULTS

Experiment 1

The initial herbage mass of the oat crop (O) was significantly higher than the other treatments ($P<0.05$; Table 1). However, when the crops were grazed at the same initial herbage allowance of 40 kg DM/animal, daily LWG on both Gordon (G) and Tennant (T) winter wheats was significantly greater than on the other two treatments ($P<0.05$). The 15% difference in LWG between T and G only approached significance ($0.10>P>0.05$). The LWG on T/S did not differ significantly from the oats.

Table 1. Treatment means for initial and final herbage mass, liveweight gain and grain yield (Expt 1)

	O	G	T	T/S	s.e.
Initial herbage mass, kg DM/ha	3293	1674	1023	2103	143.0
Final herbage mass, kg DM/ha	953	1075	1205	975	101.0
LWG, g/day[A]	282	320	369	252	26.9
Grain yield, t/ha	3.29[B]	4.45	4.30	3.72	0.311

[A] Daily gains adjusted by covariance for differences in initial herbage allowance from the intended 40 kg DM/animal.
[B] One replicate excluded due to damage by kangaroos.

The grain yields of the grazed crops (Table 1) did not differ significantly from those of adjacent ungrazed areas (Ungrazed: O 3.07; G 4.46; T 4.13; T/S 3.88 t/ha, cf. Table 1). The yields of the grazed winter wheats (G,T) did not differ significantly but were significantly greater than the yield of the oats or the winter/express mixture ($P<0.05$), which themselves did not differ significantly.

Experiment 2

Nutritive value of winter wheat forage. At the start of the grazing period, the mean herbage on offer was 2868 (s.e. 40.6) kg DM/ha and by the end of the grazing period, this had declined to 2013 (s.e. 168.4) kg DM/ha. The winter wheat forage was of very high nutritive value throughout (Table 2), with a mean *in vitro* DM digestibility of 83.3% and a mean crude protein content of 22.4%.

Table 2. Nutritive value of the winter wheat forage on offer during Experiment 2

	Stage of grazing period (days)			
	14	28	42	56
In vitro DM digestibility	87.8	83.7	81.1	80.4
Neutral detergent fibre	43.4	46.2	47.8	49.6
Crude protein	23.8	23.4	21.1	21.2

Animal responses. The mean LWG of animals grazing Tennant wheat was 236 g/day (empty LWG 223 g/day), considerably less than that observed on the same cultivar in experiment 1. The LWG in all plots was higher in the first half of the grazing period than in the second (Table 3). The mean empty live weight prior to slaughter was 44.5 kg, and the mean carcass weight 24.7 kg (Table 3). Dressing percentages (relative to pre-slaughter empty weight) were very similar in each plot. Herbage intake was estimated in only two plots, and averaged 1071 (s.e. 68.4) g DM/day (plot 1, 1119 g DM/day; plot 2, 1023 g DM/day). Estimated *in vivo* digestibility of consumed herbage was 75.9 (s.e. 0.71) % (plot 1, 75.3%; plot 2, 76.5%).

DISCUSSION

The results of the first experiment indicate that, at equivalent grazing pressures, the weight gains obtained with vegetative winter wheats were very high and on average, 13-30% higher than those obtained with forage oats. Grazing did not reduce grain yield, which was significantly higher in the winter wheats. The Tennant/Sunset mixture was included as a treatment in the hope that Sunset, an express spring wheat, would produce a feed bank early in the season, before the extra feed from the Tennant component. Although this mixture did provide more feed at the start of grazing than did either of the winter wheats alone, LWG on the mixture was the lowest (Table 1). The Sunset component of the mixture was severely damaged by frost during June 1999. Although measurements were not made, the yellow-brown, frost-damaged herbage was almost certainly of lower nutritive value.

Table 3. Plot and mean values for LWG, carcass weights, dressing percentages and fat depths (Expt 2)

	Plot 1	Plot 2	Plot 3	Plot 4	Mean	s.e.
LWG 0-28d, g/day	268	264	263	300	274	8.9
LWG 28-56d, g/day	221	196	196	180	199	8.4
Carcass weight, kg	24.9	24.3	24.5	25.0	24.7	0.17
Dressing percentage	55.9	54.4	56.1	55.7	55.5	0.38
Fat depth, mm, GR site	14.3	12.8	16.1	14.4	14.4	0.67

Herbage samples taken in experiment 2 indicated that the herbage from Tennant winter wheat had a very high nutritive value, with estimated *in vitro* digestibility always above 80%. Digestibility estimated *in vivo* using alkanes was lower (75.9%). Despite these high nutritive values, LWG was not as high as the very high LWG observed in the first experiment. This could be related to the higher grazing pressure on the Tennant sward in the second year (50 lambs/ha v. 26 lambs/ha on the equivalent sward in experiment 1), though the initial herbage allowance in the second year was about 45% higher (57 v. 39 kg DM/head). It is of interest that LWG in the first 28 days of grazing (a timespan comparable to the first experiment), was considerably greater and was more comparable with (though still less than) experiment 1. Rainfall between days 28-56 of the second trial was over 90 mm (with four days in excess of 10 mm), compared with 34 mm for days 1-27; this may have affected grazing behaviour and LWG. An assessment of the 'expected' LWG in experiment 2 using GrazFeed (Freer *et al*. 1997), suggested a LWG of 215 g/day, compared with the observed empty LWG of 223 g/day. Herbage intakes were estimated in only two of the four plots, and then only over five days. The estimated intake of 1071 g DM/day corresponds to about 2.6% of live weight, and is considerably less than the intake predicted by GrazFeed (1750 g DM/day) for lambs under these circumstances. This lower-than-expected actual intake corresponded to the start of the period of lower LWG. There is no evidence that the procedures of intake measurement disturbed the normal grazing of this subgroup of 10 animals, since their LWG was not obviously different from their cohorts on the same plot, or from the animals on plots 3 and 4.

Taken together, these preliminary studies demonstrate that winter wheat is a potentially valuable source of winter forage of high nutritive value, capable of supporting high rates of LWG and finishing lambs to market requirements. Larger-scale studies are now required to investigate the effects of grazing management strategies on the utilisation of winter wheats as a dual purpose (grazing/grain) crop, especially in relation to the likely trade-off between high LWG while grazing the wheat and increased overall stocking rates prior to the grazing period. The observation of a possible temporal trend in LWG over the grazing period also warrants further investigation.

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