Influence of winter grazed, dual purpose wheat and canola crops in a pasture system on the performance of Merino sheep

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Abstract: *Benefits and risks of integrating winter grazed, dual purpose crops (wheat and canola) in a pasture system are the subject of a four year grazing study on the NSW Tablelands. The study involves three treatments: pasture only (Control), pasture with dual purpose crops grazed by Merino ewes (ECG), and pasture with dual purpose crops grazed by weaners (WCG). There are three replicates per treatment, each involving one flock of six ewes and six weaners, grazed rotationally on six plots (0.23 ha each). We report treatment effects on the animal performance during the dry 2013 and the more favourable 2014 seasons, as well part of 2015. In 2013, the sheep required grain feeding from January to September, with Control animals needing almost twice the amounts of the ECG and WCG animals. Grain feeding in 2014 was 12–15% of that in 2013. In 2013, liveweight of ewes differed only during the pre-lambing and lactation periods, with ECG ewes being heavier (P<0.05) than the other groups. During the crop grazing period in 2013, ECG ewes and WCG weaners had larger liveweight gain than their Control counterparts (114 vs. 46 and 153 vs. 50 g/hd/day, respectively). During most of 2014 and 2015, treatments did not differ (P>0.05) in liveweight or liveweight gain. Treatments did not differ in reproductive performance or wool yield in either year. Animal performance, pasture production and crop yields in 2014 were higher than in 2013. Inclusion of dual purpose crops has benefits both in poor seasons (reduction in feed gap) and good seasons (larger grain yields and agisted grazing).*

Key Words: Feed gap, permanent pasture, supplementary feeding

Introduction

Crop-livestock integration by using dual purpose crops is now practised throughout southern Australia's cropping zone (Radcliffe *et al.* 2012). It is suggested that dual purpose crops provide risk management benefits, diversify crop rotations, reduce pressure on pastures and can significantly increase both livestock and crop productivity from farms, with little increase in inputs (Bell *et al.* 2014; Dove and Kirkegaard 2014). Dual purpose crops have superior winter growth compared with pastures (Kirkegaard *et al.* 2008), and by providing high quality feed for livestock during winter, dual purpose crops are valuable for filling feed gaps that occur at this time of year, hence enabling farm stocking rate and overall livestock productivity per pasture area to be increased (Moore *et al.* 2009).

A four year study (2013–2016) is being conducted in the NSW Southern Tablelands (Canberra) to explore how the integration of dual purpose wheat and canola crops with a permanent pasture feedbase can be used to fill the feed gap in winter and achieve significantly more meat production from Merino sheep with manageable or lower business risk. Here, we report treatment effects on animal performance (liveweight, reproductive rates and wool yield) during the first two grazing seasons (2013 and 2014) and the start of 2015.

Methods

The experiment is being conducted at CSIRO's Ginninderra Experiment Station near Hall, ACT (35° 12' S, 149° 4' E, 600 m elevation, average annual rainfall 665 mm). Three treatments are involved: pasture only (Control[1]), pasture with dual purpose crops grazed by ewes (ewe crop grazing, ECG) and pasture with dual purpose crops grazed by weaners (weaner crop grazing, WCG). Experimental setup commenced in

1 The pasture is a 40-yr-old permanent pasture comprising 65% Phalaris (*Phalaris aquatica*), 15% Subterranean clover (Trifolium subterraneum), and 20% annual species (mainly grasses) – based on spring DM assessments.

February 2012, and measurements started in November 2012. The grazing year runs between shearings (November to October). The weaners are lambs born in the experiment, with the numbers needed retained following weaning. Each treatment has 3 replicates, each involving 1 flock of 6 breeding ewes and 1 flock of 6 weaners that are grazed separately and rotationally on 6 plots (0.23 ha each). Thus, the study involves 54 grazing plots, 9 flocks of ewes and 9 flocks of weaners. In the 2013 season, the Control treatment involved only 4 plots of permanent pasture (a stocking rate of ~19 DSE/ha), resulting in high supplementary feeding of animals. Consequently, in November 2013, 2 new plots of permanent pasture were added to the Control experimental units, bringing down the stocking rate to 13 DSE/ha.

Cropping within each replication of the WCG and ECG treatments is contained within four plots (out of six), which rotate from year to year following the sequence: pasture → canola → wheat → pasture. Hence, in any grazing season, each replication in the WCG and ECG treatments includes one plot each of canola, wheat, first year pasture and second year pasture, and two plots of permanent pastures. Grazing of wheat and canola does not follow a pre-established sequence, but timing of grazing is decided on the basis of forage availability within the window of utilisation (e.g. winter grazing may be limited by pesticide withholding period) and to minimise the penalty on grain yields. Grazing rotations on pastures are conducted on the basis of forage availability and the nutritional requirements of the animals. Wheat stubbles are grazed by ewes (ECG and WCG) soon after grain harvest in December.

Management of flocks follows accepted husbandry practice. Supplementation with grain (wheat) was carried out when forage availability was judged to limit feed intake needed to meet maintenance requirements. A loose lick mineral supplement Causmag®:salt:lime (1:1:1) was provided to animals grazing wheat crops, and 1% w/w agricultural lime was added to supplementary grain. Animals were routinely weighed at times of plot rotation. Except for pregnant and lactating animals, liveweight was measured after overnight fasting. Ewes were removed from the experiment for joining and replaced by placeholder wethers. During lambing, lambs were identified and weighed. At shearing, fleece weights were measured and mid-side samples taken for laboratory measurements. Ewes used during 2012–2014 (five year-old) were replaced at shearing in October 2014 by a new group of ewes (three year-old) that will be used for the remainder of the study.

Effects of treatments were evaluated at each measurement point using one-way analysis of variance.

Results and discussion

Rainfall in 2014 (674 mm) was higher and more evenly distributed than in 2013 (584 mm); in particular, autumn in 2013 was drier than in 2014. Rainfall during the second half of February in both 2013 and 2014 allowed early sowing of dual purpose crops and pastures. Sowing of dual purpose crops in 2015 was even earlier (the first week of February), but crop establishment was initially patchy due to a lack of rainfall, but it recovered by end of April 2015.

Canola and wheat dual purpose crops were grazed in the period May to August (Fig. 1). Ewes in the ECG treatment grazed canola and wheat both in 2013 and 2014, whereas WCG ewes grazed wheat only in 2013. Weaners in the WCG treatment grazed canola both in 2013 (2012 drop weaners) and 2014 (2013 drop weaners). In 2014, the wheat plots in the WCG treatment were grazed by agisted wethers over 21 days (26 animals/plot; 110 g/hd/day LW gain). In 2013, due to feed shortage, the sheep required supplementary feeding from January to September, with Control animals needing more grain than ECG and WCG animals (90, 29, 54 kg/ewe and 48, 45 and 7 kg/weaner, respectively). Grain feeding in 2014 was minimal (12–15% of that fed in 2013) and occurred only in summer. In 2015, ECG and WCG sheep were fed grain from February to April.

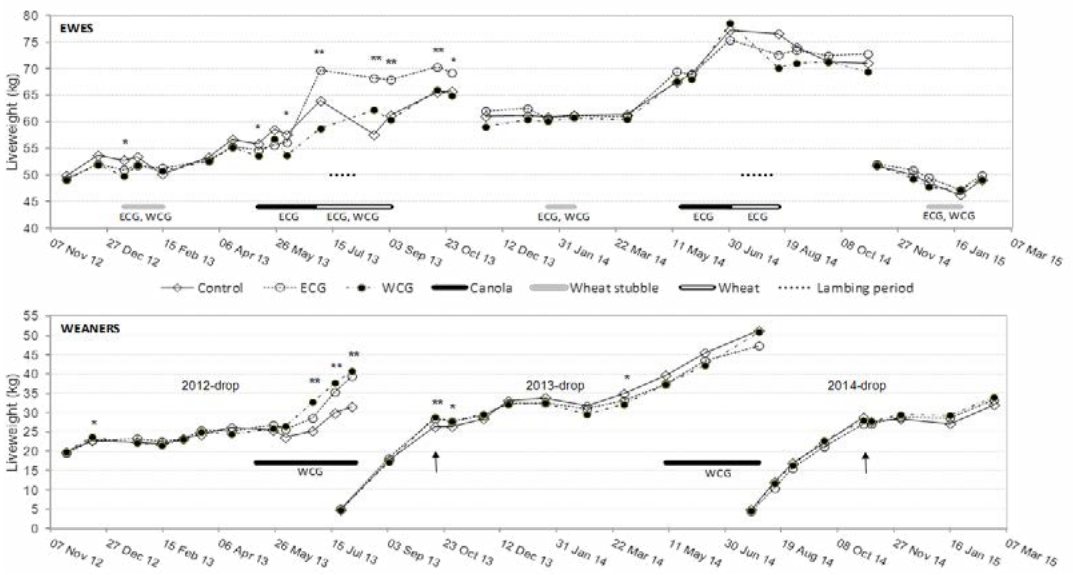

Figure 1. Mean liveweight (kg/hd) of ewes (top) and weaners (bottom) measured throughout the grazing seasons. Flocks of ewes used in Year 1 and Year 2 were culled at shearing in October 2014 and replaced by a new group of ewes. Weaners are the lambs born during the experiment and retained after weaning. Statistical significance of treatment effects at each measurement are: n.s., not significant (P>0.05), not shown in graph; *, P<0.05; **, P<0.01. Arrows indicate weaning dates. Grey, dark and hollow bars indicate (respectively) periods during which wheat stubble, canola and wheat were grazed by the named flocks (ECG and/or WCG). The Year 3 grazing season, which includes the new group of ewes and the 2014-drop weaners, is in progress.

In 2013, ECG ewes were heavier than their Control and WCG counterparts during the period of crop grazing, lactation and when shorn at the end of October (Fig. 1). In the same year, WCG and ECG weaners (2012 drop) were heavier than Control animals during the crop grazing period (Fig. 1), thus confirming the effect of dual purpose crops on filling the winter feed gap. Treatments did not differ (P>0.05) in ewe liveweight either in 2014 or in early 2015. The 2013 drop weaners differed in their liveweight around their weaning date, Controls were lighter than the ECG and WCG weaners, but a tendency for heavier Controls was observed from the start of summer 2014. No treatment effects on ewe or weaner (2014 drop) liveweight were observed on measurements conducted in 2015.

In 2013, ECG ewes and WCG weaners had higher (P<0.05) liveweight gains than Control animals, both during the crop grazing period and the period leading to shearing (of ewes) (Table 1). Nevertheless, on pasture only, liveweight gain by ECG weaners matched that of WCG; the reasons for this result are unknown. In 2014, however, treatments did not differ (P>0.05) in liveweight gain of ewes or weaners during the crop grazing period, but Control ewes tended to gain more liveweight than the others. In the period from weaning to sale of the weaners, ECG ewes had the lowest liveweight gain (Table 1). Grain supplementation during February–April 2015 precludes a meaningful interpretation of animal performance at this stage.

Treatments did not differ in reproductive performance in either year, except that in 2014 lambing rate (lambs/ewe) for Control was lower than for ECG and WCG ewes (1.36 vs. 1.67 and 1.83, respectively). No treatment effects were

Table 1. Liveweight gain (g/head/day) by ewes and weaners on the experimental treatments – Control (pasture only), ECG (pasture with dual purpose crops grazed by Merino ewe flock) and WCG (pasture with dual purpose crops grazed by weaner ewe flock).

	Liveweight gain (g/head/day)			
	Control	**ECG**	**WCG**	**P-value**
		Year 2013		
Ewes, during crop grazing	46	114	58	<0.01
Ewes, start of crop grazing to shearing	58	85	66	0.05
Weaners, during crop grazing	50	133	153	<0.01
		Year 2014		
Ewes, during crop grazing	101	35	28	0.08
Ewes, start of crop grazing to shearing	21	20	11	0.66
Weaners, during crop grazing	139	120	163	0.32
Weaners, weaning to sale	87	66	77	0.04
		Year 2015		
Ewes, shearing to 24 Feb 2015	–30	–23	–29	0.74
Weaners, weaning to 24 Feb 2015	28	54	52	0.06

observed in greasy and clean fleece weights or fibre diameter. Nevertheless, reproductive performance and fleece weight of ewes in 2014 were higher than in 2013. For example, the mean lambing rates and marking survival rates for 2013 and 2014 were 1.33 vs. 1.62 and 0.69 vs. 0.87, respectively. Further, in 2014, pasture production and grain yields from dual purpose crops were superior to those in 2013 (Pinares-Patiño *et al.* 2015).

Conclusion

In a poor growing season (2013), including dual purpose crops in the grazing system significantly reduced the impact of winter feed shortage on animal liveweight gain and the need for supplementary feeding. However, effects of inclusion of dual purpose crops on performance of the experimental flock were not evident in a good growing season (2014), except that the crops enabled extra livestock production via agisted stock and returned grain profit. As expected, a favourable growing season resulted in improved animal productivity as well as superior grain yields from dual purpose crops.

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