Sheep CRC Conference Proceedings

Document ID:	SheepCRC_23_5
Title:	Feeding grain to grazing sheep
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Key words:	sheep; feeding; supplements

CHAPTER 5. FEEDING GRAIN TO GRAZING SHEEP

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Introduction

Sheep grazing paddock feed can be fed grain for backgrounding prior to entry into feedlots for finishing, or for the purpose of finishing prior to slaughter. Paddock feed may consist of crop stubbles, senesced annual pastures or perennial pastures. Characteristically the nutrients most limiting in dry paddock feed are the macronutrients energy and protein, although mineral and vitamin limitations may exist as well (Purser 1983). Grain is an appropriate feed supplement for finishing or backgrounding lambs on paddock feed because it contains both energy and protein. This facilitates the utilisation of feed that would otherwise be of variable or low nutritive value to sheep (Purser and Southey 1984). Sheep grazing paddock feed generally have no requirement for fibre from other sources such as hay or silage because their fibre intake is already high.

This chapter provides a brief account of the current state of knowledge of the nutritive value of paddock feed, the liveweight patterns of sheep grazing paddock feed and the response of sheep fed grain whilst grazing paddock feed.

Nutritive value of dry paddock feed

Stubbles

In Australia the area sown to crops is in the order of 11.5 million ha for wheat, 3.7 million ha for barley 784,000 ha for oats, 1.1 million ha for lupins, 823,000 ha for grain sorghum and 1.3 million ha for canola (Anonymous 2001). There are regional differences for crop plantings; in particular grain sorghum is produced mainly in Queensland and New South Wales and lupins are produced mainly in Western Australia. Potentially all of these areas are available for grazing with sheep although farmers may elect not to graze stubbles under certain farming systems. A major benefit of grazing stubbles is utilisation of residual grain that otherwise would be left in the paddock. Upon germination, residual grain may become a weed problem or act as a disease bridge to subsequent crops in some farming systems. Another benefit of utilising grain from stubbles is to introduce sheep to starch diets with a relatively low risk of acidosis, before exposing them to finishing diets containing high levels of starch. This applies particularly to wheat, barley and pea stubbles because the grains of these crop varieties contain high levels of starch.

Stubbles are characteristically heterogeneous in composition because they consist of some components that are high in nutritive value and other components that are low in nutritive value for grazing sheep. Residual grain has the highest nutritive value followed by leaf, cocky chaff (seed husks) and stem material. Sheep tend to consume the high value components preferentially to the low value components such that the nutritive value of stubble paddocks reduces progressively with grazing time. This effect is evident when sheep graze both cereal and lupin stubbles (Table 5.1 and 5.2).

Table 5.1. The consumption and quality of the various components of wheat stubble grazed by sheep (Rowe *et al.* 1989).

Stubble component	Initial quantity (kg/ha)	Final quantity (kg/ha)	Utilisation (%)	Initial digestibility (%)	Final digestibility (%)	Initial protein content (%)	Final protein content (%)
Grain	34	0.2	99.4	80.9	64.6	14.3	11.4
Weeds	220	54	75.4	39.3	47.6	7.3	9.1
Leaf and chaff	550	440	20.0	58.2	49.3	6.2	5.7
Stem	1380	910	34.1	45.3	42.1	3.0	3.2

In the studies of Rowe *et al.* (1989) and Dunlop (1984) the preferential selection of the various components of the stubble was shown to relate to their nutritive values. The grain component which had the highest protein content and digestibility also had the highest utilisation percentage (Table 5.1 and 5.2).

Table 5.2. The dietary selection of the various components of lupin stubble grazed by sheep (Dunlop 1984).

Stubble component	Digestibility (%)	Protein content (%)	Initial quantity (kg/ha)	Final quantity (kg/ha)	Utilisation
Grain	85	30.2	250	7	93.2
Pod	55	2.6	545	260	52.3
Leaf	52	10.4	660	109	83.4
Stem	44	6.4	1054	903	14.3

Of the different stubble components, stem material has the lowest nutritive value and is present in the largest quantities (Table 5.1). For cereal stubbles the nutritive value of stem material depends on a number of factors including species, variety, soil type, and rainfall zone. Stem material from oats and barley is generally more digestible than that of wheat; stubbles grown on heavy soils are more digestible than stubbles grown on light soils and stubbles from low rainfall regions are more digestible than stubbles from high rainfall regions (Aitchison *et al.* 1986). Techniques to improve utilisation of stem material by harvesting it and treating it with sodium hydroxide (alkalage) or urea have been studied in the past. Sodium hydroxide improves the digestibility of straw by hydrolysing ester bonds between lignin and hemicellulose. Urea acts principally by supplying non-protein nitrogen although it has some alkaline activity as well (Morrison 1974; Southey 1981). Techniques to improve straw are difficult and expensive to implement and results have been more variable for sheep than for cattle. Grazing is still the most cost effective way for sheep to use stubbles.

Liveweight responses of sheep grazing stubble

The pattern of liveweight change characteristically consists of an initial period during which liveweight may increase, followed by a period during which liveweight decreases (Figure 5.1). This pattern of liveweight change has been attributed to the heterogeneous nature of stubbles and the selective grazing pattern of sheep (Jacob 1984). When sheep commence grazing a stubble paddock they select a diet that is relatively high in grain and leaf material (Table 5.1 and 5.2). Selective depletion of leaf material and grain results in a decline in the value of the material left for grazing to below the maintenance requirements of the sheep for energy and protein. The sheep will lose liveweight if they are not fed grain after this initial period.
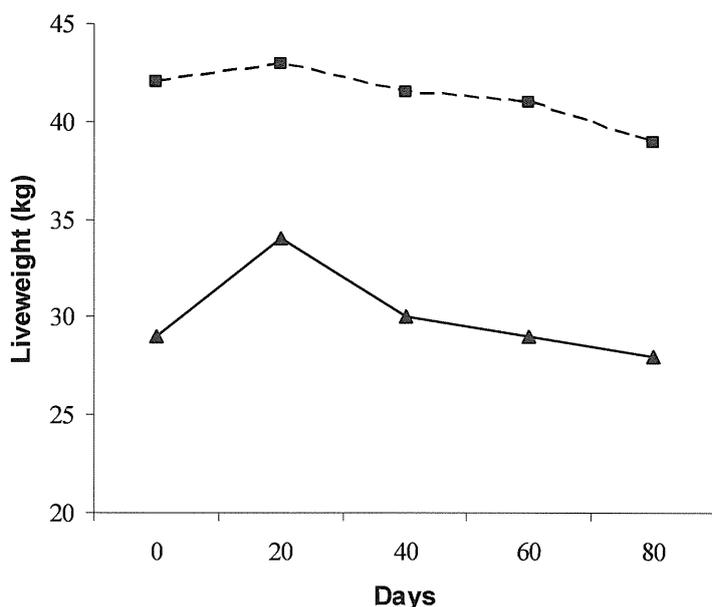
Figure 5.1.   **The liveweight change of sheep grazing wheat stubble (▲) at 10 head/ha and barley stubble (■) at 18 head/ha (Coombe *et al.* 1987).**

The length of time for liveweight gain at the beginning of grazing varies. Croker (K.P. Croker 2003, pers. comm.) measured the residual grain in stubbles in 2002 across the agricultural region of Western Australia and found that the average quantity of wheat grain in these stubbles was 94 kg/ha. It can be hypothesised that if the average grain intake of sheep was 1 kg/head/day then a 94 kg/ha grain reserve would last for 9.4 days when the paddock was stocked at the rate of 10 head/ha. This agrees with anecdotal evidence that the period of weight gain for sheep grazing stubbles often lasts for about 2 weeks. The initial period of liveweight gain can be used as a strategy for backgrounding lambs, provided they are moved to fresh ungrazed stubbles before liveweight loss occurs.

When the grazing period extends beyond the time required for sheep to consume the residual grain, the mean liveweight change for sheep grazing stubbles is often negative because the remaining stubble components are low in protein and energy. Liveweight changes reported for sheep grazing wheat stubbles have ranged from a loss of 176 g/day for animals grazing stubble at 10 head/ha (Rowe and Ferguson 1986) to a gain of 65 g/day for animals grazing stubble at 15 head/ha (Mulholland *et al.* 1976). However, the wheat stubble used by Rowe and Ferguson (1986) had been grazed by ewes at the stocking rate of 8 head/ha for 3 weeks before the trial started. Thus much of the residual grain would have been consumed reducing the total nutritional value of the stubble available before the trial commenced. In the trial of Mulholland *et al.* (1976), significant summer rainfall maintained the growth of green material in the stubble throughout the trial, above 1000 kg/ha at one point, and this green feed was heavily selected for.

Chaff heaps

A practice used to manage herbicide resistance is to dump the chaff effluent from harvesting machines into discrete 'chaff heaps'. This limits the distribution of herbicide resistant weed seeds and the heaps can be burnt, moved or grazed in the paddock. The nutritive value of chaff heaps varies from 7-10 MJ/kg of metabolisable energy and 4-10 per cent crude protein on a dry matter basis depending on the stubble. Therefore chaff heaps may be able to maintain the liveweight of adult dry sheep for short periods of time. Studies have shown that chaff heaps improve the utilisation of stubbles by grazing sheep, particularly if the heaps are placed away from water points (Roberts and Devenish 2001).

Rainfall

Rainfall is usually detrimental to the nutritive value of paddock feed. Rain causes leaching of water soluble nutrients from feed material (Purser 1983) whilst microbial action and oxidation may further degrade it (Brown 1977). Grain may be buried by rain and become less accessible to grazing sheep although the nutritive value of this grain may be unaffected by the rain. However if the rainfall has been sufficient to cause germination of weeds then the liveweight of sheep grazing the stubble may subsequently increase. Mulholland et al. (1976) found that if the weight of the green feed was above 40 kg of DM/ha it made up 80 per cent of the diet selected by the sheep. The liveweight change of sheep grazing wheat stubbles at two stocking rates where the weeds had been killed by an application of herbicide were -19 g/day for 15 head/ha and -75 g/day for 30 head/ha. In contrast, liveweight changes for sheep grazing wheat stubbles at the same two stocking rates where the weeds had not been killed, were 13 g/day and -32 g/day. Small amounts of green material may have a complementary effect on forage intake.

Stocking rate

Stocking rate will affect the liveweight response of sheep grazing stubbles. This was demonstrated by Mulholland et al. (1976) who showed that when lambs grazing oat stubble were stocked at 15 head/ha they grew at the rate of 71 g/day, whereas lambs that lost weight at the rate of 71 g/day were stocked at twice the stocking rate (30 head/ha) and were grazing oat stubble that had been sprayed to kill the green weeds (Table 5.3).

Table 5.3. The performance of first-cross Border Leicester x Merino lambs grazing oat stubble at different stocking rates and for different grazing periods (Mulholland et al. 1976).

Age (months)	Weight change (g/day)	Stocking rate (head/ha)	Grazing days	Initial weight (kg)	Final weight (kg)
17	50	13	110	30.8	36.3
17	-5	26	110	30.8	30.3
10	49	15	92	30.7	35.2
10	-43	30	92	30.7	26.7
16	6	15	77	36.0	36.5
16	-71	30	77	36.0	30.5
16	71	15	77	36.0	41.5
16	-13	30	77	36.0	35.0

Cereal stubbles

Although stem material from barley and oat stubbles may have a higher digestibility than that from wheat stubbles (Aitchison et al. 1986), its nutritive value is generally below the maintenance requirements of lambs. Similar liveweight responses have been observed for lambs grazing barley, oat and wheat stubbles. For example, Coombe et al. (1987) reported liveweight changes of -62 g/head/day and -115 g/head/day in 17-month old Merino wethers grazing barley stubbles for 84 days.

The risk of acidosis is generally low for cereal stubbles despite the high starch content of wheat and barley grain. 'Water belly' (Urolithiasis), a condition which causes sporadic deaths in male sheep has been associated with grazing cereal stubbles, particularly oat stubbles (Crosbie et al. 1985; Nottle and Armstrong 1966). High intakes of soluble plant silicates may be the predisposing cause of the disease in sheep grazing oat stubble (Nottle and Armstrong 1966).

Lupin stubbles

Lupin stubbles differ from cereal stubbles in a number of ways. Lupin grain is higher in energy and rumen degradable protein and contains a lower level of starch compared to cereal grains (Corbett 1990). The amount of residual grain in lupin stubbles tends to be higher than for cereal stubbles. Residual grain in lupin stubbles was calculated to be 3 times that of the greatest amount measured in cereal stubbles (lupins 327 kg/ha versus wheat 94 kg/ha) (K.P. Croker 2003, pers. comm.). Similar levels of residual lupin grain have been seen in other studies; 343 kg/ha, 316 kg/ha and 250 kg/ha respectively (Croker *et al.* 1979, 1994; Dunlop 1984).

Lupin stubbles can be toxic to sheep when the fungus *Diaporthe toxica* (formerly *Phomopsis leptostromiformis*) colonises lupin stems and produces the hepatotoxin phomopsin. When sheep ingest phomopsin they may develop the disease 'Lupinosis' and this can be a problem particularly for lupin varieties that are not resistant to *Diaporthe toxica* (Allen and Chapman 1988). Lupins are generally grown on soil types that are prone to erosion due to the effects of overgrazing.

Sheep grazing legume stubble generally achieve better growth rates for similar yields of dry matter when compared to cereal stubble (Table 5.4). This has been attributed to the higher protein in legume stubbles compared to cereal stubbles. However, there may be other factors contributing to these higher growth rates. If sheep actively select the grain component of legume stubble, rumen function will not be upset due to acidosis and feed intake not reduced, compared to the same scenario in sheep on cereal stubble.

Table 5.4. **Studies on the performance of Merino wether lambs grazing lupin stubble.**

Age (months)	Weight change (g/day)	Stocking rate (head/ha)	Residual grain (kg/ha)	Grazing days	Initial weight (kg)	Final weight (kg)	Reference
	56	25.0	343	79	22.6	27.0	
	11	50.0	386	79	22.5	23.4	
5	35	9.1	197	91	26.5	29.7	(Croker *et al.* 1979)
	58	8.3	316	83	30.2	35.0	
	80	9.4	183	87	31.5	38.5	
7	21			94	25.0	27.0	(Arnold *et al.* 1976)

Estimates of seed density have been used to make decisions about the length of time sheep should graze lupin stubbles because seed density is relatively easier to measure in lupin stubbles, than cereal stubbles. This technique has been used for preventing Lupinosis, monitoring sheep productivity and prevention of soil erosion. The predictive value of seed density can be inconsistent and sheep monitoring should always be done in conjunction with any paddock seed assessments (A.R. Butler 2004, pers. comm.).

Sheep drink more water when grazing lupin stubbles than when grazing cereal stubbles (Jacob 1989). The reason for this difference is unclear but may be due to increased intake of rumen degradable protein causing an increase in urea excretion when sheep eat lupin grain. The need for water may limit the distance sheep graze from water points in large paddocks (Croker *et al.* 1994). Croker *et al.* (1994) found that moving water points around the paddock in lupin stubbles increased the number of grazing days obtained from these stubbles. Moving the water point on several occasions also reduced the likelihood of wind erosion of the ground close to the water point.

Annual pastures

Annual pastures are a feature of low and medium rainfall cropping-based farming systems. Annual pastures usually consist of mixed swards of annual grasses; ryegrass (*Lolium rigidum*), barley grass *(Hordeum leporinum)*, legume species; subterranean clover (*Trifolium subterreanean*), medics (*Medicago* spp.) and a range of broadleaf species.

Sheep graze senesced annual pastures selectively and weathering is more relevant to these pastures because residual grain is not such a large part of the feed reserve as it is in stubbles. Brown (1977) found that the rate of disappearance of pasture plants due to weathering was associated with the fibre, nitrogen, sulphur, calcium and sodium concentrations of the plant. Clover and capeweed (*Arctotheca calendula*) disappeared at 2 to 3 times the rate of perennial species over a 139 day period at Kybybolite, South Australia. Pastures consisting of a mixed sward will probably become more grass dominant through the summer even without livestock selectively grazing certain species. Metabolisable energy and rumen degradable protein decrease as pasture matures and decays. Freer *et al.* (1985) showed that the crude protein of annual pasture fell from 9.4 per cent to 6.5 per cent in senesced pasture. For this reason, dry annual pasture should be grazed early in the season and prior to stubbles, if possible. The liveweight response of sheep grazing dry pasture cannot be predicted by measuring pasture quantity as is the case with green pasture (Thompson 1989).

Perennial pastures

Perennial pastures provide much of the feed for livestock in the medium to high rainfall temperate areas of the Eastern States of Australia. These perennial pastures consist of species such as kangaroo grass (*Themeda australis*), wallaby grass (*Danthonia* spp.) and weeping grass (*Microlaena stipoides*) mixed with the less desirable annual grass species of barley grass (*Hordeum leporinum*), brome grasses (*Bromus* spp.) and squirrel and rat's tail fescues (*Vulpia* spp.). The addition of subterranean clover (*Trifolium subterranean*) and phosphate fertiliser around the 1950s dramatically improved the productivity of perennial grass pastures. Despite this, livestock production has been limited by the low production of perennial pastures early in the growing season (late autumn and early winter) and by their low nutritive value over the summer months.

Improved technologies and pasture seed availability enable exotic perennial grasses such as cocksfoot (*Dactylis* spp.), phalaris (*Phalaris* spp.) and tall fescue (*Festuca arundinacea)* to be widely sown along with companion legumes (Dear *et al.* 1996). However these pastures also have limitations such as low feed quantity in winter and poor quality over the summer and autumn months.

In the past, lucerne (*Medicago sativa*) has been used to fill the feed gap that occurs in the summer months (Donnelly *et al.* 1985; Reeve and Sharkey 1980). Unfortunately with increasing soil acidification, establishing lucerne is becoming more difficult and costly for producers and more recently chicory (*Cichorium intybus*) has been identified as a useful alternative species because it tolerates more acidic soils than lucerne (Upjohn *et al.* 2002).

Conclusions

Paddock feeds are heterogeneous feed sources that change in nutritive value with grazing and weathering. Rainfall has negative impacts on the grazing of dry paddock feeds unless substantial germination occurs subsequent to the rainfall event. Sheep will tend to lose weight when grazing dry annual pasture except in the early part of the season. Although some basic principles exist, it is difficult to predict the grazing value of stubbles in large paddocks. For the purpose of backgrounding or finishing lambs, some level of grain feeding

will normally be required if the grazing period extends beyond the initial period of liveweight gain attributed to residual grain. Monitoring of sheep liveweight and paddock observations are required to facilitate decisions about grain feeding strategies for sheep grazing dry paddock feed.

Feeding grain to sheep grazing paddock feed

Feed intake of sheep fed grain

Grazing sheep have the opportunity to select their own diet, and the feeding of grain can have an influence on their forage intake. Generally three outcomes are recognised in relation to the effect of grain intake on feed intake. These outcomes are: complementation, supplementation, and substitution (Dove 2002). When the dry matter intake of forage is increased by the feeding of grain, the grain is complementary to grazing. When the dry matter intake of forage is unchanged by the feeding of grain, the grain is supplementary to grazing. When the dry matter intake of forage is reduced by the feeding of grain, the sheep are substituting forage for grain. The rate of substitution is the reduction in pasture intake per unit increase in the intake of the grain (Dove 2002). This aspect of feeding grain to grazing sheep is complex and still being researched. Dove (2002) cites a number of general factors that determine the rate of substitution including factors relating to the forage available, the grain fed and the physiological status of the sheep. Although it is not possible to use these factors to predict the response to a supplement, they are important considerations when grain is being fed to sheep grazing paddock feed.

Substitution is likely to be greater when either the quantity or the quality of standing paddock feed is low (Dixon and Stockdale 1999; Langlands 1969). Sheep show a preference for a readily accessible supplement compared to expending energy to procure feed through grazing (Dove 2002). The rate of substitution is generally increased by increasing the quantity of the grain fed, although this has not been consistently found in all experiments. For example, Freer *et al.* (1985) found that giving a supplement of 400 g/head/day of oats and sunflower meal to lambs increased their pasture intake from 710 g/head/day to 820 g/head/day but when the supplement was increased to more than 400 g/head/day, the intake of pasture decreased. When supplement levels reached 800 g/head/day, the pasture intake was reduced to only 350 g/head/day. However in Langlands' (1969) work, increases in the quantity of a wheat supplement fed to grazing sheep did not lead to greater levels of substitution.

The type of grain can affect the degree of substitution. Starch fermentation causes a reduction in the pH of the rumen and a reduction in the fermentation of cellulose and hemicellulose (Rowe 1983). Grains high in starch may therefore depress fermentation of fibre by rumen microbes and reduce the intake of forage (Dixon and Stockdale 1999). On the other hand, a protein supplement may overcome a deficiency of rumen degradable protein and increase microbial fermentation of fibre (Dove *et al.* 2000).

Sheep that have high nutritional requirements (Dixon and Stockdale 1999) tend to have a low rate of substitution. Dove *et al.* (2000) found that lactating ewes grazing on pasture had a lower rate of substitution when supplemented with pellets compared to pregnant ewes fed the same supplement.

The frequency and method of feeding may also influence the rate of substitution but the evidence in the literature is equivocal and difficult to interpret in a practical sense (reviewed by Dove 2002).

The value of complementary and supplementary grain feeding systems is that paddock feed has some nutritional and financial value. This represents an advantage for feeding grain in the paddock compared to feeding a complete mixed ration in a feedlot, because the cost of the roughage component of the diet can be lower in real and relative terms. However the

nutritive value of the paddock feed diminishes as the level of substitution increases. Furthermore if the additional energy supplied by supplementary grain is being used to fuel movement for sheep to graze paddock material, then there is no net benefit of feeding the grain in terms of animal production.

Liveweight responses to grain feeding

As might be expected from the variation in the nutritive values of paddock feed components and the liveweight response of lambs grazing paddock feeds, the liveweight response to grain feeding is variable and difficult to predict. Butler and McDonald (1986) achieved 155 g/day increase in the growth rate of nine-month old Merino weaners grazing wheat stubble by offering 686 g/head/day of an oat/lupin mix containing 15.2 per cent crude protein. In comparison, Morcombe and Ferguson (1990) reported an increase in growth rate of only 40 g/day and 81 g/day when they supplemented Merino weaners with 500 g/head/day of wheat or lupin grain. Several aspects of this variation have been investigated including type of stubble, type of grain fed, amount of grain fed, and stocking rate. Other factors might also be important, such as lamb genotype and age, but definitive data on these factors is difficult to find in relation to finishing or backgrounding lambs grazing paddock feed. GrazFeed™ is a simulation model that can be used to predict liveweight responses of sheep fed grain when grazing pasture (Freer *et al.* 1997).
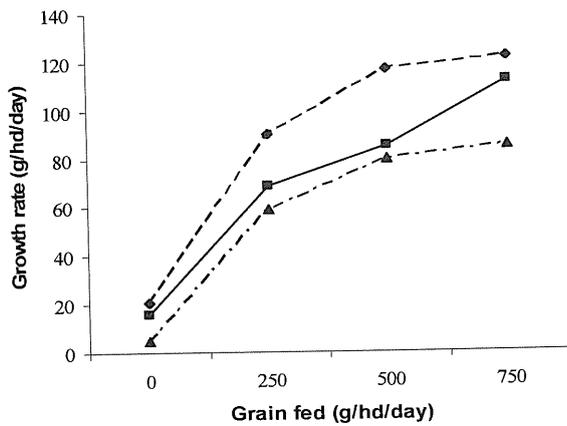

Figure 5.2.   Growth rate of lambs grazing lupin (◆), pea (■) or vetch (▲) stubble and supplemented with grain (Arnold *et al.* 1976).
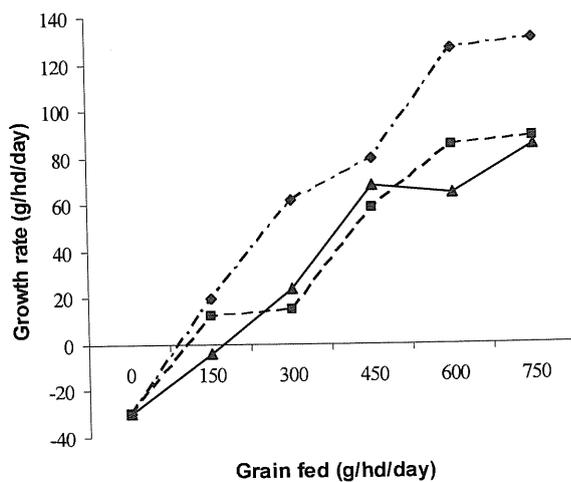

Figure 5.3.   Growth rate of Merino wether lambs fed lupins (◆), oats (■) or barley (▲) when grazing wheat stubble (Rowe *et al.* 1989).

Type of paddock feed

Comparison of paddock feeds is inherently difficult because of the variation within a large paddock. Arnold *et al.* (1976) found that the response to grain supplement was greater on lupin and pea stubbles than vetch stubbles. In their experiment, seven-month old Merino wethers weighing 25 kg were grazed stubbles for 90 days at a stocking rate of 50 head/ha. Lambs on lupin stubble were fed lupin grain, those on pea stubbles were fed pea grain and those on vetch stubble were fed vetch grain (Figure 5.2).

Type of grain fed

Several studies have shown the value of high protein supplements to lambs grazing cereal stubbles (Suiter 1990). In the trial of Butler and McDonald (1986) oats and urea supplemented at 477 g/head/day resulted in a growth rate 35 g/day higher than the same sheep supplemented only with 496 g/head/day oats. At all the different levels of supplementation in the trial of Rowe *et al.* (1989) sheep supplemented with lupins had higher growth rates than those supplemented with either oats or barley (Figure 5.3).

Morcombe and Ferguson (1990) reported that sheep grazing wheat stubble supplemented with peas and lupins had higher growth rates than sheep supplemented with the same level of wheat (Figure 5.4). They speculated that the lower liveweight change found with wheat compared to lupins was due to a greater rate of substitution effect for wheat, due to low rumen pH induced by the higher starch content of the wheat. However they did not measure feed intake or rumen conditions to be able to confirm this. Pereira and Bonino (1998) increased liveweight gain by 6 per cent compared to non-supplemented lambs, by supplementing 10-month old Corriedale lambs with sorghum grain from June to September, on a grass-legume pasture (950 kg DM/ha, 10 head/ha). Grain conversion rate was 28.7:1.
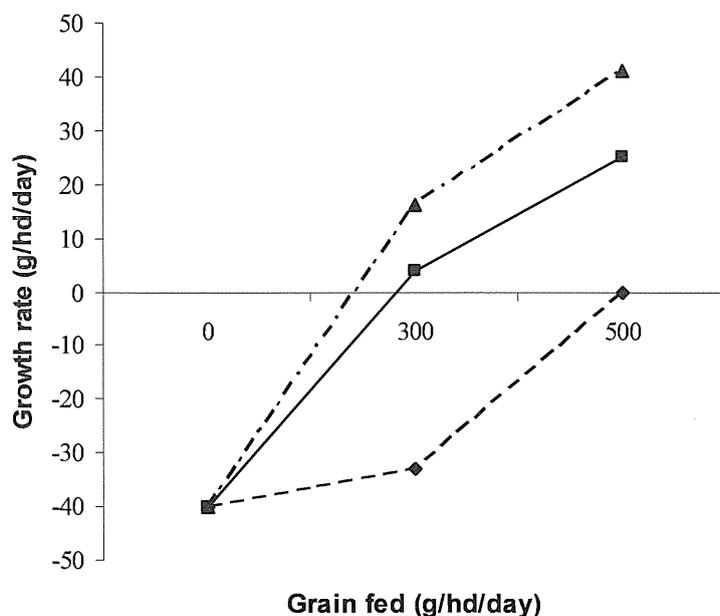

Figure 5.4. **Growth rate for sheep fed lupins (▲), peas (■) or wheat (◆) when grazing wheat stubble (Morcombe and Ferguson 1990).**

Gardner *et al.* (1993) proposed that poor utilisation of the pasture caused by insufficient protein accounted for the performance of sheep fed barley being poor compared to those fed lupin grain (Figure 5.5).
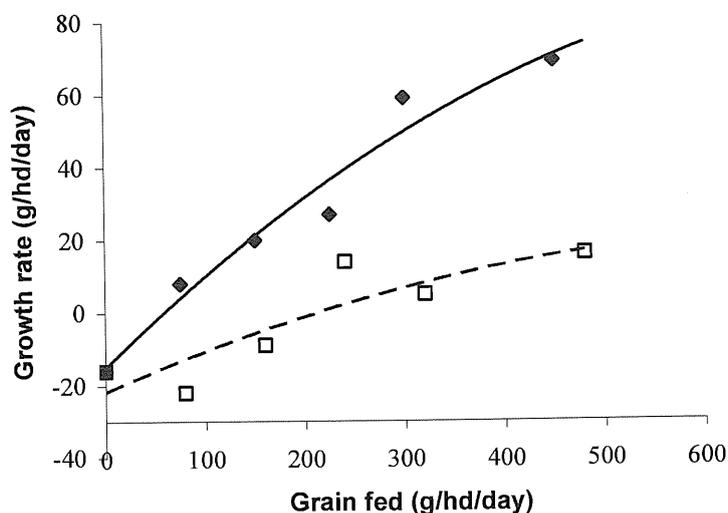
Figure 5.5. Growth rate for sheep fed lupins (◆) or barley (□) when grazing annual pasture (adapted from Gardner *et al.* 1993).

Amount of grain fed

Rowe *et al.* (1989) assessed the response of Merino wethers grazing wheat stubble to incremental increases in lupin, oat and barley grain feeding and found that the relationship between the amount of grain fed and growth rate was curvilinear (Table 5.5). At the higher end of feeding, the growth responses diminished indicating a decrease in feed efficiency with each 150 g increase in the amount of grain fed. This trend is consistent with the concept proposed by Freer *et al.* (1985) that as more grain is made available to grazing sheep, the rate of substitution of forage for grain increases. Some studies have shown negative responses to very high levels of grain feeding (Rowe and Ferguson 1986).

Table 5.5. The incremental increase in growth rate for sheep grazing wheat stubble with each 150 g increase in supplementation of lupins oats and barley (Rowe *et al.* 1989).

Feeding rate (g/head/day)	Incremental increase in growth rate (g/head/day)		
	Lupin grain	Oat grain	Barley grain
150	50	42	26
300	42	3	28
450	18	44	44
600	47	26	-3
750	4	4	20

The reduced efficiency at higher levels of supplementation can be seen again from the growth rates obtained by Arnold *et al.* (1976) (Table 5.6). The reduction in efficiency in the response to increases in supplements for both lupins and vetch was reduced to an increase of 5 g/day when the supplement was increased from 500 to 750 g/head/day.

Table 5.6.   The increase in growth rate for sheep grazing stubble with each 250 g increase in supplementation of lupin grain, pea grain or vetch grain (Arnold *et al.* 1976).

Feeding rate (g/head/day)	Growth rate increase (g/head/day)		
	Lupin grain	Pea grain	Vetch grain
0	0	0	0
250	69	53	54
500	27	16	21
750	5	27	5

Stocking rate

Stocking rate can have a significant effect on the response to grain feeding when paddock feed is an important contribution to the sheep's diet. This was demonstrated by the experiment of Mulholland *et al.* (1976) (Figure 5.6). The lambs in this study were 16-month old Border Leicester x Merino cross wethers. When fed 132 g/head/day of a wheat mixture on wheat stubbles for 77 days, the higher stocking rate had a negative effect on their growth rate. This effect was greater when the stubble had been sprayed to remove green weeds. This is consistent with paddock feed making a significant contribution to the dietary intake of sheep fed grain at supplementary levels.
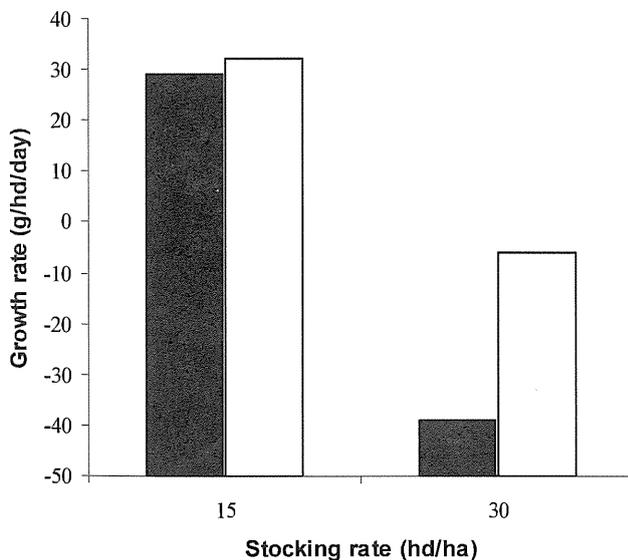

Figure 5.6.   The effect of stocking rate (head/hectare) on the growth rate of lambs fed grain on weedy (■) or weed free (▨) wheat stubbles (Mulholland *et al.* 1976).

Feeding method

Feeding method and the frequency of feeding are important considerations in terms of the time required to feed the grain, control of grain intake, grain wastage, the rate of forage substitution, the type of grain that can be fed, and the performance of the sheep being fed. Methods include self-feeders, troughs, trail feeding, and spinning out with a fertiliser spreader.

Self-feeders and trough feeding are suitable for high rates of grain feeding when high rates of forage substitution are expected. Rowe and Ferguson (1986) investigated the method of spinning out lupin grain to weaners grazing wheat stubble at intervals of 1, 2 and 4 weeks.

This was found to be a successful technique for the purpose of body weight maintenance when the level of lupin grain fed was equivalent to 150 g/head/day.

Carcase attributes

Although the liveweight responses to grain supplementation of lambs grazing paddock feeds have been investigated, there is little information on the effects of these feeding regimes in relation to body composition or meat eating quality. It is possible that grain feeding might influence body composition as well as growth rate and such an effect might depend on the nature of the stubble and the grain fed (Maloney 1998).

Some processors believe that legume stubbles predispose lamb meat to the condition known as 'dark cutting' and impose restrictions through protocols that discourage the grazing of legume stubbles during the final phase of finishing prime lamb. Gardner (2001) however, found no evidence to suggest that the high intake of rumen degradable protein associated with lupin grain would cause meat to be dark cutting due to low glycogen concentration and high ultimate pH (pHu).

Perennial pastures

Grain supplements have been used to overcome the poor quality and low biomass of perennial pastures in summer and autumn. Supplementation strategies allow producers to maintain high stocking rates, manage the risk of poor seasons and improve profitability through alternative animal production systems. In the eastern states of Australia the most commonly supplemented grain is oats because it is produced on-farm and there is a relatively low risk of acidosis associated with oats compared to other cereal grains. Lupins, oilseed meals or lucerne hay are generally added to the oat supplement when there is a need for protein supplementation. More recently triticale (a hybrid of wheat and rye) has been grown as an alternative to oats.

There have been a limited number of studies conducted on the supplementation of young weaner sheep grazing reasonable quality perennial pasture. Holst et al. (1997) reported that the growth rates of five-month old mixed sex Poll Dorset x (Border Leicester x Merino) supplemented with 282 g/head/day oats while grazing lucerne was 153 g/day for induced cryptorchid wethers and 112 g/day for ewes. Holst et al. (1998) reported better growth rates in sheep from chicory than lucerne. Further research is required to determine the factors affecting variation in growth rates of lambs supplemented with grain whilst grazing various legume and grass perennial pastures.

Conclusions

Grain feeding improves the growth rate of lambs grazing standing paddock feed. The feed conversion efficiency of the grain fed will be better when grain feeding rates are kept low. Grain feeding rates of less than 300 g/head/day are desirable when backgrounding lambs on paddock feed in order to avoid high rates of substitution. To satisfy the protein requirements of lambs, legume grains, particularly lupins, may achieve better results than cereal grains. Alternatively, cereal grain fortified with non-protein nitrogen in the form of urea may also give better results than cereal grains fed alone.

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