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# Investigating the Angora goat agro-pastoral production system in southern Australia

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ABSTRACT

Australian research on the influence of the rate of stocking on pasture, animal and mohair growth, parasitism, mortality, and other nutritional and husbandry requirements are reviewed. Liveweight of Angora goats is the main determinant of clean mohair production, fibre diameter and meat production, but not of staple length. Both liveweight and fibre diameter are determinants of the incidence of medullated fibre. Changing the frequency of shearing affects all mohair fleece attributes. Body condition is highly correlated to the liveweight of Angora goats, to welfare risk and carcass production. The profitability of mohair enterprises declined as the proportion of does in the flock increased, associated with a decline in mohair quality. Efforts to improve mohair quality and enterprise financial returns need to focus on producing finer mohair.

## 1. Introduction

Merino wool production has been a major industry in Australia in the Semi-arid, the Wheat-sheep and the High Rainfall agricultural zones but the long-term decline in wool price, after adjusting for inflation, led farmers to diversify farm enterprises. Farmers introducing Angora goats in the Semi-arid zone experienced serious problems with predation and vegetable matter contamination (VMC) of mohair, while in the High Rainfall zone gastrointestinal parasitism and cold stress were serious problems. This meant that mohair enterprises have only been successful in the Wheat-sheep zone, which differs from the climatic and agricultural systems found in the traditional mohair regions. As a result, Australian farmers were uninformed of technical aspects essential for profitable farming. In the Wheat-sheep zone, grazing is based on pastures where rates of animal stocking are 10–100 times those in mohair regions of South Africa and Texas. From experiences in South Africa and Texas a dry sheep equivalent (DSE) of 0.75 for Angora goats was promoted in Australia (a DSE is the feed required to maintain a 45–50 kg non-breeding sheep). This recommendation appeared unsound as there was little browse present on Australian pastures grazed by Angora goats and it was likely that Angora goats would be underfed. This paper reviews grazing, nutrition, mohair, husbandry and meat research conducted in the south-east of Australia from 1981, with a focus on the biological drivers of mohair quality and profitable Angora goat production on annual temperate pastures. Topics excluded are genetic improvement, reproduction, animal health other than parasitism, and trace mineral nutrition.

## 2. Grazing requirements for Angora goats

The rate of stocking of pasture is the most important decision affecting the productivity and viability of wool producing farms in Australia. The determination of the optimum rate of stocking is complex depending on different criteria which may conflict. These include production per unit area or labour, stability of pasture, minimum stress on livestock and stock health. There are also potential interactions when Angora goats are grazed with sheep in terms of competition. A replicated stocking rate and mixed grazing experiment was conducted to examine the industry claim that rate of stocking Angora goats was 25% higher than that of Merino sheep. The mid-point rate of stocking was the set rate of stocking of sheep recommended by earlier experiments. The lowest rate of stocking was 25% below that recommended for sheep. Mixed grazed treatments had equal numbers of goats and sheep.

### 2.1. Influence of rate of stocking on pasture, animal and fibre production

As the rate of stocking increased, the availability of pasture decreased, liveweight and fibre production of goats and sheep decreased on a per animal basis but increased on a per ha basis. Below the recommended rate of stocking there was no effect of grazing goats with sheep. At the recommended rate of stocking there were complementary effects of grazing goats with sheep. Merino sheep were heavier and grew 10% more wool. Above the recommended rate of stocking competitive effects were detected when goats grazed with sheep, where sheep were heavier and grew 7% more wool but goats were lighter and

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less productive compared with goats grazed alone at similar high rates of stocking (McGregor, 2010a,b,c). These effects reflected pasture dry matter availability. Pastures grazed by sheep had significantly reduced content and proportion of the legume subterranean clover and more undesirable grasses and weeds compared with those grazed by goats. Increasing the rate of stocking of sheep increased exposed bare ground but not on pastures grazed only by goats. Grazing of sheep caused large and faster changes to pastures which were severely damaged at the highest rate of stocking. It was concluded that with careful management Angora goats on sheep farms may be used to manipulate pasture composition and to decrease soil erosion (McGregor, 2010a).

The pattern of liveweight change and body condition score (CS) during the year was similar for both goats and sheep, with animal growth from pasture germination in autumn until pasture maturation in late spring, followed by weight loss over summer. In winter, sheep grew faster than goats following pasture germination. In mixed-grazed treatments after pasture maturation in late spring and early summer, goats either grew when sheep were losing weight, or goats lost less weight than sheep (McGregor, 2010b). CS was regularly measured with values less than 2 indicating emaciated or thin and values > 3.0 indicating fat (McGregor, 1992, 2011b). CS of goats and sheep were highly correlated with liveweight ($r^2$ > 0.8). The effects of rate of stocking on mohair characteristics were large. An increase in the rate of stocking reduced clean mohair growth and reduced mohair mean fibre diameter (MFD). At the recommended rate of stocking, wool from mixed-grazed sheep had a greater MFD than wool from separately-grazed sheep. Above the recommended rate of stocking, mixed-grazed goats grew mohair finer compared with separately-grazed goats reflecting the depressed liveweight of these goats.

Investigations of life time changes showed that clean mohair weight was allometrically related to average fleece-free liveweight, being proportional to (fleece-free liveweight)$^{0.67}$, but only when liveweight was lost at the rate of 5–10 kg during a shearing interval of six months. The relationship at maintenance and positive rates of liveweight change was proportional to (fleece-free liveweight)$^{k}$, where k was considerably less than 0.67. Within an age group of Angora goats, the largest animals were the least efficient in converting improved nutrition to mohair (McGregor et al., 2013a).

### 2.2. Influence of rate of stocking on gastrointestinal parasitism and mortality

The limiting factor in the grazing experiments was the increasing rates of mortality and level of gastrointestinal parasitism in Angora goats as the rate of stocking increased. Worm egg count (WEC) was similar in goats and sheep at the start but thereafter was greater in goats than sheep. This increase was probably because goats ingested more infective trichostrongylid larvae than did sheep (Jallow et al., 1994). Sheep had a greater proportion of nematodes as *Teladorsagia* spp. and goats a greater incidence of *Trichostrongylus* spp. Both goats and sheep developed resistance to *Nematodirus* spp. Mixed grazing with goats provided beneficial effects in WEC for sheep, but the effects for goats depended on rate of stocking, being beneficial at low and moderate rates but harmful above recommended rates of stocking. It was concluded that heavier trichostrongylid burdens of goats compared with sheep, when grazed together, are due in part to greater rates of infection consequent on different grazing patterns as well as greater susceptibility to infection. In this study, Angora goats did not represent a gastrointestinal nematode hazard to non-breeding Merino sheep (McGregor et al., 2014).

The mortality of separately and mixed-grazed goats at above recommended rates of stocking and mixed-grazed goats at moderate rates of stocking were higher (29%) than all other goat and sheep grazing treatments (9%), primarily because of increased susceptibility to cold stress. When cold stress was excluded, the annual mortality for the susceptible treatments was still higher (6.5%) than other goat and sheep treatments (3.0%). This was related mainly to heat stress and gastrointestinal parasitism (McGregor, 2010b). Mortality from gastrointestinal parasitism would have been greater if preventative treatment, based on monitoring, had not been undertaken. Most deaths of goats from cold stress followed a severe weather event, five weeks after the autumn shearing. Mortality was highly related to the CS reached during the preceding two months. For flocks of Angora goats there was no mortality at CS ≥2.5. Mortality increased sharply at mean CS < 2.0. There was no mortality amongst goats provided they grazed at the lowest rate of stocking even when their CS was ≤2.0. For individual Angora goats, rate of stocking and grazing combinations were additive in effect on mortality. Grazing with sheep increased mortality of goats at higher rates of stocking. The individual goat mortality rate was not dependent on individual plot effects suggesting that these results are applicable widely. Liveweight loss was not related to mortality rates of goats once CS had been accounted for. It was concluded that CS and rate of stocking were highly significant determinants of welfare risk in Angora goats (McGregor and Butler, 2008a). Provision of shelter may reduce cold stress mortality.

### 2.3. Influence of rate of stocking and seasonal conditions on other nutritional requirements

When pasture quality declined during summer, Angora goats were better able to use senescent herbage compared with Merino sheep, shown by liveweight advantages and reduced drought feeding provisions. This suggests that goats have an advantage over sheep in either selecting and/or digesting low quality pasture (McGregor, 2010b). The overwhelming evidence from the rate of stocking and associated experiments is that herbage with a digestiblity less than 50% provides poor nutrition for goats, with resulting depressed feed intake and liveweight losses in comparison with goats provided diets of higher digestibility or supplementary fed with grain. As goats were at a disadvantage when grazing short winter annual pastures, it is important that responses to supplementary energy during winter be evaluated, particularly for breeding goats. Subsequent studies have shown advantages when sufficient grain but not hay or straw was fed to grazing goats during winter.

Seasonal and long-term droughts are a feature of this grazing environment. Consequently, a range of experiments related to drought feeding practices for goats were completed (McGregor, 2005). As grain production is a feature of our agricultural enterprises their use and the role of processing and other treatments have been investigated (e.g. McGregor et al., 1994; McGregor, 2006; McGregor and Whiting, 2013). Water requirements for goats have also been investigated (McGregor, 2004). During summer and autumn, the moisture content of dry pasture is very low. Water consumption of adult goats was 36% greater than intake of adult Merino sheep. When allowing for the differences in liveweight and removing fleece weight, water intake was 50% higher in the goats, probably related to the poorer insulating attributes of mohair fleeces compared with the fleece of Merino sheep (McGregor, 1986).

### 2.4. Effect of wear of permanent incisors on mohair production

Wear and loss of permanent incisors reduces liveweight, milk and fleece production in sheep (McGregor, 2011a). With Angora goats, 30% wear of the permanent first incisors reduced greasy fleece production by 20% associated with a reduction in staple length (McGregor and Butler, 2011). Thus, relatively small amounts of wear of permanent incisors can reduce mohair production and financial returns. Farmers must assess the incisors of Angora goats in deciding which animals to cull.