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M S U

WOOL VS. LAMB PRODUCTION

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SHEEP 99-4

Most sheep produce a merchandisable, usable fiber. However, the amount and quality varies from extremely high levels in sheep such as the Australian Merino to the meat-type breeds that usually produce minimal amounts of fiber. Most of the variation in fiber producing ability of sheep is a result of selection. Emphasis placed on fiber production in the U.S. varies greatly. The part that fiber production should play in a production system in the present and future of the sheep industry is subject to a great deal of debate among both producers and academicians.

Although the wool producing capacity of sheep is determined by its genetic characteristics, in wool breeds there are few situations in which their genetic potential is realized. Major determinants of wool growth are feed intake, the digestibility of the diet and the metabolic efficiency of the individual animal.

Numerous studies in Australia (Hogan et al. 1978) using sheep of similar genetic origin reported wool production (clean fiber) values ranging from 1.6 to 20.2 g/day (1.2 to 15.8 lb. of clean wool per year). High levels of wool production appear possible only with sheep capable of consuming more than 850 g digestible organic matter (~4 to 5 lbs. of high quality feed) containing at least 250 grams (~1/2 lb. of crude protein per day).

Although the influence of feed intake on wool growth is well recognized, there is no unanimity on the roles of dietary energy and/or protein. Field studies suggest that wool production be linearly related to intake presumably digestive energy with protein intake having very little influence. Ferguson (1959) measured the effects of a range of intakes of diets of varying

levels of crude protein content and contended that the wool growth response to increased feed intake "was due to an increased energy supply in diets containing more than 8% crude protein". A review of numerous studies (Kempton, 1978) suggests that about 2 g of wool is produced for every 100 g of digestible dry matter (Allden, 1978). This value is low as it is associated with net efficiency and is confounded with maintenance costs. Graham and Searle (1982) reported marginal (partial) efficiencies of metabolizable energy for wool production of 16 to 19% (lamb production is around 25%). Using these values, Shelton (1998) suggested that the amount of good quality feed (50% TDN) required to produce one pound of fiber is about 25 to 30 pounds. Similar values based on net efficiency (including a charge for maintenance) are about 150 to 200 pounds and is very similar to the Australian estimates of 2 g of wool/100 g of digestible dry matter reported earlier in this manuscript.

Although it is clear that wool growth is primarily determined by feed intake, understanding the true nutrient requirements or costs of wool production is far more complex. When the rumen is bypassed, or protein passes through the rumen undegraded, there are clear-cut responses in wool growth to protein and only small responses associated with energy – a reversal of the effects noted for diets digested in the rumen (Kempton, 1978).

Predicting the rate of wool growth is dependent on an understanding of the quantitative relationships between diets, and the composition and amounts of protein available for absorption in the intestine. The lack of wool growth response to dietary crude protein supplementation suggests that it is unlikely that supplemented protein reached the abomasum.

Microbial protein available for digestion and absorption in the intestine is more closely

related to the intake of digestible energy by the animal than to the protein content of the diet. Although wool growth increased with increasing digestible organic matter intake, its effect is consistent with its probable effect on microbial protein synthesis in the rumen. Thus it would appear that the apparent response in wool growth to an increase in organic matter or energy intake is to the increased supply of microbial amino acids reaching the lower GI tract. Provided the supply of ATP, nitrogen and sulfur in the rumen is non-limiting, microbial outflow from the rumen will provide about 6.6 g digestible protein/MJ of ME. Thus microbial protein would provide .2 g sulfur amino acids/MJ of ME. In the absence of unfermented or escape dietary protein, it appears that the supply of sulfur-amino acids from microbial protein is the primary factor limiting wool growth. With grazing animals, large amounts of feed are needed to provide sufficient amino acids for maximum wool growth. The large amounts of feed needed to provide the amino acids for maximum wool growth also provide energy and other nutrients well above maintenance which might be used for other functions (Hogan et al. 1978).

Other factors such as pregnancy and lactation affect wool growth (Corbett 1979). Wool production is reduced by about 30% during the last two months of pregnancy (the equivalent of 3 to 10% of annual wool production). Lactation generally reduces annual wool production by 5 to 8%. Feed intake increases substantially during lactation, thus efficiency of wool production is only about 40 to 60% or when compared on an annual basis, about 70% of that of a non-lactating ewe. The full cycle of reproduction reduces annual fleece growth by 10 to 14 percent. The higher values apply in general to ewes rearing twin lambs and the lower ones to ewes rearing singles. When nutrition levels are poor, the effects of reproduction on wool growth are more pronounced. In instances when sheep are raised in poor nutritional environments, the reduction in wool production can be as high as 20 to 25 percent.

These results suggest that the nutritional conflict between gestation and lactation is significant. The degree of this conflict probably depends on the genotype of the animal (level of fertility and lactation and genetic potential for wool production) and the nutrient conditions involved.

This conflict is probably most severe at high levels of reproductive performance, high levels of wool production and limited nutritional resources. Data reviewed here also suggests that in wooled sheep when nutritional conflicts occur, gestation and lactation take precedence over fiber production.

The bigger question is what role should wool play in a particular sheep producer's sheep operation. In a recent review, Shelton (1998) implied that wool production comes at the expense of lamb production and thus should not be included in selection programs. The major basis for this suggestion was a series of studies where production parameters between high wool producing Australian Merino sheep were compared to domestic breeds – primarily the Rambouillet. In Australia, very little selection pressure, if any, is placed on reproductive performance and thus one would expect little or no progress in the reproductive traits. Conversely, even moderate selection pressure for the reproductive performance in the US has resulted in some improvement in these traits over the past 50 years. Lowered reproductive rates in Merino and Merino crosses may reflect differences in selection pressure and may or may not be affected by a nutritional conflict with wool production. An international workshop conducted by CSIRO in 1979 (Physiological and Environmental Limitations to Wool Growth) presented an extensive review of the physiological and environmental factors affecting wool growth. Results presented at this workshop confirmed that there is a nutrient conflict between wool and reproduction and that this conflict becomes more significant when high wool producing sheep are raised under marginal nutritional conditions. However, they suggested that when nutritional programs are adequate to support increased reproductive rates, that they are probably also adequate to support a moderate production of high quality wool.

With lowered wool prices, there is a renewed interest in the contributions that can be made by the non-wool-producing breeds of sheep. The use of these breeds in crosses with wool-type sheep poses a particular threat to the US wool industry. These crosses often produce wool that is contaminated throughout with long medulated (hollow) guard hair. These hairs do not dye and therefore this wool is generally not usable in the commercial industry. The average processing lot size in mills is about 100,000 pounds and

therefore wools from a number of sources must be blended together. Small amounts of this type of wool can cause serious problems for processors. There have been a number of cases where small amounts of this type of wool have contaminated the larger processing lot of wool. In several instances, lots of blackface top were rejected because of this contamination resulting in substantial cost to the processor. If this happens very often, mills will choose not to take the risk and avoid all US wools for most uses. It is essential that this type of wool be kept separate throughout the wool marketing channel. Individual growers or marketing agencies can probably slip a little of this wool into the system, but its impact at the mill level will be noticed and eventually lead to reduced end product use and therefore reduced demand for the US wool clip.

Most of the data reviewed for this manuscript suggests that under marginal nutritional status,

which is the case in many range situations, the nutrient supply is not adequate to support high levels of both lamb and wool production. Given long-range price expectation and production potentials for each, lamb must receive priority in selection programs. However, given the management limitations to increased lamb production in extensive operations, there is no doubt that wool production will remain an important commodity on many sheep enterprises. In most situations if nutritional programs are adequate to support ewes giving birth and raising twins, they will additionally be adequate to support a modest amount of high quality wool growth. Selection programs in wool should probably not be concerned with increasing pounds of wool produced, but directed toward improving wool quality--staple length, density, color and uniformity of fiber diameter.

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