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A Review of the Use of Sheep Coats to Improve the Processing Potential of Wool

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Summary

Damage to or contamination of wool fibres can lead to problems during processing and to severe price discounts being imposed. It is possible to reduce the VM content and/or improve the style of the wool through the use of sheep coats or rugs. Sheep coats have been used since the 1930's with varying degrees of success. Benefits of using sheep coats include protection from heat and cold stress, a reduction in body flystrike and fleece rot, increased clean fleece weight and a reduction in VM and dust content. The benefits of rugging vary from season to season and depend on the amount of protection already provided by the fleece. In a trial conducted by UNSW it has been found that it is necessary to use two coats per wool growing year to accommodate growth of wool and body. Coats incorporating a gusset have proven particularly useful, allowing careful adjustment of the coat off-shears. There have been few problems observed during lambing in coated ewes. In order to do a valid cost/benefit analysis, further data on skirted fleece weights, wool types and VM content would be required.

Keywords: sheep coats, style, vegetable matter

Introduction

It is possible to reduce the vegetable matter content and/or improve the style of the wool in order to improve returns from wool. One means of doing this would be to use sheep coats or rugs. These have been used for a number of years in a variety of environments in Australia. Interest in their use has increased recently due to large discounts being applied by the trade to heavy VM fault wools.

The processing potential of a wool is determined primarily by it's fibre diameter (FD), vegetable matter content (VM), staple length (SL) and strength (SS) and, to a lesser extent, style. Climate, in particular exposure to sunlight, can damage the wool fibre leading to problems during processing which are reflected in the prices paid for different types of wool (Anon. 1966). In addition, the presence and level of certain types of VM will also affect these prices.

This paper describes some factors affecting the processing potential of greasy wool, and reviews the use of coats/rugs and their effects on that potential. Some observations on the use of sheep coats in the field are also reported.

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The Importance of Style during Processing

Style nominates the degree of excellence within a diameter range for Merino and crossbred categories and implies a better or poorer processing capability (R. Sallaway, pers. comm.). Style is influenced by environment, breeding and nutrition. Winston (1988) has defined style as the description of a wool used in marketing to discriminate between wools which are expected to have different processing performance and different end product characteristics. Style can include the extent of dirt and seed contamination, staple conformation and degree of tip weathering (Lipson 1972).

Hunter (1980) stated that, in general, wools from different styles performed differently during processing but unless there are differences in length, diameter and strength, they do not perform differently in the fabric. Wools of a poorer "style" generally performed worse during processing (particularly combing), producing more card waste and noil (Hunter 1980, Lipson 1972). Lipson (1972) stated that 'it would appear that more "stylish" fleeces with better defined staples would produce less entanglement in scouring than the more random staples of less "stylish" fleeces'. (By this, we have assumed that the term 'random' refers to staple definition and alignment.) Less entanglement during scouring could lead to less fibre breakage and waste in carding and combing (Lipson 1972).

More recent attempts by CSIRO to examine the processing consequences of style (Winston 1988) have also shown that card waste increases as style decreases, though these differences were not significant. There was also a tendency for lower style wools to produce more noil.

In terms of the processing consequences of weathered or wasty tip, Walls (1963) has shown that most of the tip (86%) is removed during the early stages of processing. The expectation of greater losses during processing forms the basis of the premium/discount system as applied to style (and VM content) of the wool.

The Effect of VM on Processing Performance

The concentration of the various VM types present influences the processing characteristics of carding and combing wools (Cornish and Beale 1974), and affects the suitability of bales for combination in pre-sale lots and mill consignments (Connell 1976).

Charlton et al. (1981) found that losses during carding and combing increased proportionately with levels of VM in the raw wool. Atkinson (1990), in examining comb efficiency, has shown that burr is removed extremely efficiently. Seed and shive are more difficult to remove, with three times more seed and shive left in the sliver when compared to burr given equivalent input levels.

The issue of VM type in relation to processing performance is additional then to that of the level of VM contamination. A study by Bow et al. (1989) indicated that different species represent different risks during processing. CSIRO have been developing a system for the specification of VM on the basis of VM size and shape and predicted processing risk.

Relative Economic Importance of Wool Characteristics

Analyses of wool price to determine the characteristics having most influence on price have been conducted by a number of workers.

McKinnon et al. (1973) examined the influence of subjectively appraised quality number, style, VM content and SL on the clean wool price. (This work was conducted

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before routine pre-sale measurement.) In all years studied, over 90% of the variation in price was accounted for by various combinations of the above characteristics. In addition, a term denoting the product of style and quality number was of major significance. They suggested that in general, style and quality number were the major factors.

More recently, Pattinson (1981, 1983) reported analyses of clean price at auction based on measured FD and VM content. Appraised SL, style, colour and SS were also included. His 1983 work showed that mean FD had a major influence on price. Additionally, both the level and type of VM present were found to have a large effect.

The above analyses provide evidence that the major determinant of clean wool price is FD. The second most important character was style in McKinnon et al.'s (1973) work, whilst it was VM in Pattinson's (1981) study. Pattinson (1983) found that for both Merino and crossbred fleece wools, appraised style had a relatively minor role in price determination. Pattinson (1981) suggested that this may in part be due to the fact that the measured characteristics account for some elements of style. Wright et al. (1990) suggest that there is a common belief that the appraisal of style by the wool trade is influenced by a number of visual staple characteristics such as crimp frequency, crimp definition, greasy colour, tippiness and dust penetration but confused by other factors such as yield, strength and VM.

The results of Pattinson's (1983) work indicated that the trade consistently applied large discounts to wools which contained high levels of VM. In addition, these discounts were influenced by both the style and diameter of the wool. Wool buyers were found to discount seedy wools compared to burry wools. The price discounts for the presence of VM in raw wool reflect the influence which it has on processing performance. He states that, in view of the major role which VM plays in price determination, growers would be well advised to attempt to reduce VM contamination wherever feasible.

Cottle and Filan (1993), using data for the period from July 1991 to August 1992, analysed the effect of raw wool characteristics on price. The results of this analysis confirm that FD was the major determinant of clean price. Style was relatively unimportant in Merino combing fleece wools but had a larger effect in other categories. An analysis on the basis of VM category indicated that there was a non-significant discount for B fault wools when compared with FNF wools. Discounts are applied with increasing severity to the following categories: S, C, L^1 and D, L^2 (see Table 1 for an explanation of these terms).

Extent of VM Problem

The number of bales and the percentage of the clip in each of the VM fault categories for the period 1987/88 to 1991/92 are shown in Table 1.

Data from the Australian Wool Corporation (AWC) for the first two quarters of season 1992/93 is summarised in Tables 2 and 3 (AWC 1992, 1993). Wools containing more than 3% VM (regardless of type of VM) were being heavily discounted in the marketplace. Historically, about 10% of the clip has fallen into these categories (C,D,L^1,L^2). There remains a great opportunity to improve returns from wool by reducing VM contamination.

Control of VM

For the selling seasons indicated in Table 1, between 37 and 43% of the clip contained more than 1% VM (with 12 to 15% containing more than 3%). In terms of reducing VM contamination, the wool producer is obviously constrained by his production environment (Pattinson 1983). Methods of controlling vegetable fault have relied on the eradication of

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Table 1 Wool sold by VM fault category in Australia for the period 1987/88 to 1991/92.

Season	Degree of Vegetable Fault							
	FNF		B/S		C/L		D	
	bales	%	bales	%	bales	%	bales	%
1987/88	1 884 558	45.2	1 182 456	28.4	479 151	11.5	76 057	1.8
1988/89	2 120 227	49.1	1 103 112	25.5	451 027	10.4	73 427	1.7
1989/90	2 664 999	48.2	1 431 101	25.9	607 659	11.0	92 270	1.7
1990/91	2 294 708	43.6	1 517 144	28.8	542 459	10.3	198 238	3.8
1991/92	1 684 021	41.8	1 224 396	30.4	441 886	11.0	151 243	3.8

Source: AWC 1990, AWC 1992

For Merino and Crossbred Combing Fleece, the following definitions apply:

FNF - free or nearly free (0 - 1.0% VM)
B - light burr (1.1 - 3.0% VM)
C - medium burr (3.1 - 7.0% VM)
D - heavy burr (7.1 - 18.0% VM)

In instances where the fault is predominantly seed rather than burr, the letter S replaces B; L^1 replaces C; and L^2 replaces D.

Table 2 VM Discounts (c/kg clean) for Merino Fleece Wools - First Quarter 1992/93

Diameter (μm)	Fault					
	B	C	D	S	L^1	L^2
<20.5	2	49	80	8	50	102
20.6 - 22.5	2	33	61	3	17	36
> 22.6	2	27	57	NS	28	54

Source: AWC 1993

Table 3 VM Discounts (c/kg clean) for Merino Fleece Wools - Second Quarter 1992/93

Diameter (μm)	Fault					
	B	C	D	S	L^1	L^2
<20.5	0	24	50	0	30	71
20.6 - 22.5	0	28	65	2	38	51
>22.6	5	44	67	9	56	96

Source: AWC 1993

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the problem species by pasture management (spray topping, sowing of improved pastures, rotational grazing), or the reduction of wool contamination by animal management (time of shearing). In the more extensive pastoral areas of N.S.W. such as the North-western and Central-western Plains, and the Western Division, the eradication of problem species is virtually impossible (Warr et al. 1979). In these areas, adjustment of time of shearing to avoid long wool when seeds are most prevalent has offered the greatest potential for reducing vegetable fault.

The Use of Sheep Coats

The use of sheep coats would seem to be an option to reduce VM contamination in wool.

The ideal coat should be capable of 'breathing' (i.e. allow a free passage of air around the fleece), be capable of shedding water (so the fleece below is not saturated), be non-contaminating (in comparison with polypropylene), and cover as much of the fleece as possible.

Since the 1930's there have been numerous trials investigating the use of sheep coats/rugs. Early covers used in South Australia were of crude design, being made on the farm from fertiliser or grain sacks (Duncan 1938). Duncan (1938) stated that the value of rugging under many conditions had been proved beyond doubt, and that the size of flocks rugged was in the thousands.

Montgomery and Blumer (1942) concluded that the advantages due to rugging were protection of the fleece from dust and burrs, and reduced fleece rot (and hence reduced body fly strike). Further, in drier, hotter areas, wasty tip and weathered backs may be eliminated (CSIRO 1972).

During the 1950's, further rugging trials were conducted because of concerns about price discounts for burry wool. The results of the trials conducted were published by Lipson et al. (1970). Coats trialled during 1956-58 were constructed of canvas and polyethylene sheet. Fig. 1 shows a sheep wearing a canvas rug. The only material which satisfactorily protected the wool was a 12 oz. duck canvas. Lipson et al. (1970) commented that these rugs would be too expensive for general use. It was shown that rugs markedly reduced vegetable fault and weathering but that cheap and durable rugs could not be made from the canvas, plasticised or other material then available (CSIRO 1972).

The early 1970's saw renewed interest in the development of suitable rugs from woven split film plastic materials. A trial at the UNSW Fowlers Gap Arid Zone Research Station examined the readily available canvas rugs and 2 prototype rugs (one of PVC and one of reinforced PVC) (Charlesworth 1970). Charlesworth (1970) suggested that the canvas rugs would be the most economical.

At around the same time, CSIRO, UNSW (School of Wool and Pastoral Science), the NSW Department of Agriculture, the Australian Wool Board, the Bureau of Agricultural Economics and a commercial company began a co-operative program to develop sheep coats. Prototype coats made from a white split-film polyethylene fabric were trialled extensively throughout NSW in 1972/73. The durability and retention of the coats overall was poor, but the trial provided valuable information as to improvements which could be made in coat design.

The Gollin sheep coat, with elasticised neck, rump and sides, and leg straps cut into the fabric, was thus evolved (Fig. 2). It has proven to be effective in protecting against a variety of hazards, the durability of the coat varying with the method of use. The manufacturers suggest that two to three years life can be anticipated when used for short

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Fig. 1 An example of the early coats used in trials (Source: Lipson et al. 1970)

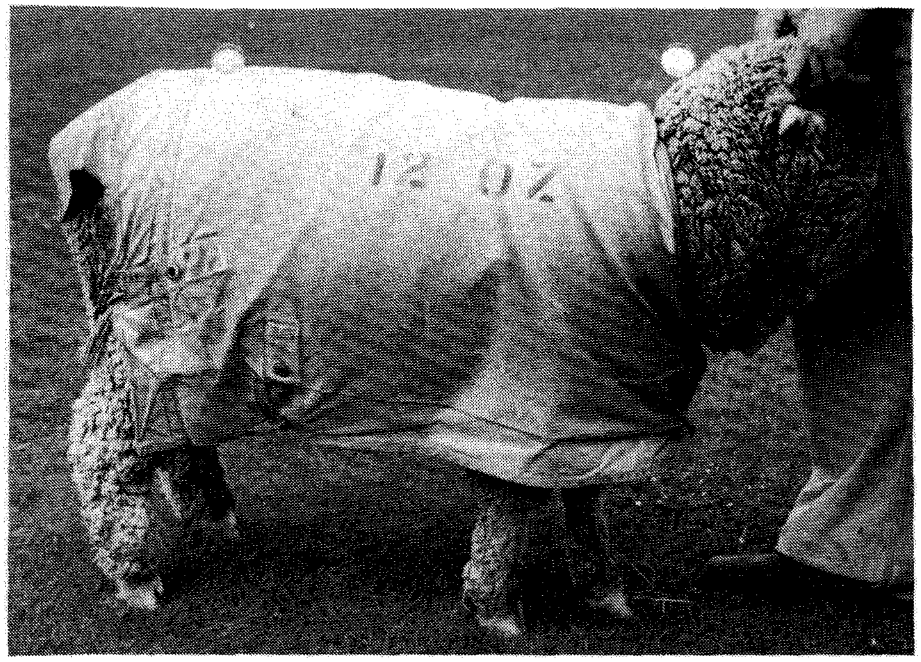
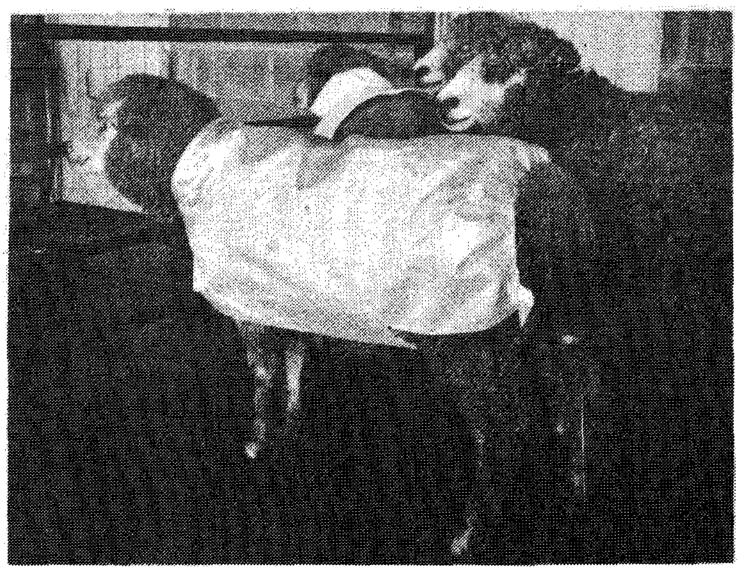


Fig. 2 The Gollin sheep coat (Source: Gollin and Company)



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terms of two to five months to combat specific hazards. Used 24 hours a day, the sheep coat has lasted twelve months in some areas, though in areas of excessive ultra violet (UV) and solar radiation, the sheep coat has lasted eight months with continuous use.

Sheep coats have also been used on the tablelands to protect sheep from cold stress off-shears. Cold, wet winds in the first fourteen days after shearing can kill many sheep. This subject is not reviewed here.

Benefits of Using Sheep Coats

The trials reported by Lipson et al. (1970) were based at three locations in Victoria with varying degrees of VM contamination. In all cases, growers remarked on the good condition of the rugged sheep. The protection afforded by a coat, particularly during cold conditions after shearing can be quite significant. Lipson et al. (1970) suggested that there is also an advantage in protection from heat. Skin temperatures taken on a hot day were 10° C lower in the rugged sheep. It was also noticeable that rugged sheep did not seek the shade on a hot day as did unrugged sheep. These findings may be of benefit in areas of high temperature with regard to avoiding heat stress, particularly in rams.

Abbott (1979a) stated that little systematic work has been done on the effect of rugs on the health of the sheep. It has been claimed, however, that the rugs may reduce body fly strike and fleece rot by keeping the wool drier (Duncan 1938), and can lead to increased weight gains in animals grazing under adverse weather conditions. Abbott (1979a) suggested that the benefits of rugging vary from season to season and depend on the amount of protection already provided by the fleece and any prior susceptibility of the animal to fleece rot or fly strike.

Duncan (1938) reported that rugged wool had a less wasty tip, contained more grease and less dirt, and had a slightly longer staple than unrugged wool. Lipson et al. (1970) found that the use of rugs tended to decrease greasy wool weights and increase clean wool weights. The decrease in greasy wool weights in rugged sheep is due to lower contents of dust and VM than rugged sheep (see Table 4).

Table 4 Components of the Fleece

Component	Content (%)	
	Rugged	Unrugged
Wax	15.1	10.7
Suint	6.1	6.9
Dirt	3.1	6.9
VM	0.9	3.0
Dry Wool	59.9	55.5

Source: Lipson et al. 1970.

Charlesworth (1970), found that rugging significantly increased clean fleece weight. In the semi-arid environment of Fowlers Gap, there was a reduction in the amount of

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weathered tip. Rugged wool exhibited a greater uniformity of FD throughout the staple, a better defined crimp and a marked reduction in vegetable fault (Charlesworth 1970). He also found that rugged fleeces remained intact during shearing, picking up was easier and more effective skirting was possible (Charlesworth, unpubl. data). The use of rugs reduced the dust content of the fleece by 50%, and the style of wool was upgraded from good topmaking to best topmaking.

Ford (1993) reported that in fine wool sheep at Fowlers Gap, coated wool was one style grade superior to uncoated wool (best top making c.f. good top making), with the same pattern observed in the wools from Hay.

Wheeler et al. (1977) suggested that increased wool production following rugging is due to the absence of wear rather than increased growth. Rugs protect the fibre tips from sunlight and abrasion, both of which can cause severe damage to the rug itself (Abbott 1979b).

Processing Performance of the Wool

Lipson et al. (1970) found that carding losses of rugged wool are significantly lower than those of unrugged controls. These differences include the greater burr and seed present in the latter, and the absence of degraded fibre tips in the rugged samples. The tear (ratio of top to noil following combing) of the rugged batches processed was higher than those of the unrugged batches, mainly due to a reduction in noil (by up to 27% of the unrugged result). Abbott (1979a) also found that the tear increased with rugging. Lipson et al. (1970) estimated that rugged wools yield 4-7% more top and noil (i.e. useable clean wool).

Tops from rugged wool contained substantially fewer residual VM particles than those from the unrugged wool (Lipson et al. 1970) but the number of neps/kg of top was unchanged (Abbott 1979a).

Abbott (1979a), on the basis of 22 Noble combing trials, found a general increase in the mean fibre length in the top (Hauteur) associated with rugging. While the effect of rugging on Hauteur varied considerably with location and year, the average increase in Hauteur was 1.7mm (with a maximum of 7.3mm).

Abbott (1979a) suggested that there are several savings to be made in processing rugged wool through to top. These include more wool grease and less dirt in scour effluent, more top plus noil per sheep, less VM in both top and noil, a longer Hauteur in the top, and a lower proportion of noil. Abbott (1979a) concluded that rugs were of greatest benefit when they significantly reduced VM contamination and thereby increased top and noil yield. Charlesworth (1970) also suggested that the use of sheep rugs would appear to have the greatest potential in very dry, dusty and burry regions.

Some Observations on the Use of Sheep Coats

Since April 1991, members of the Department of Wool and Animal Science have been running a trial involving the use of sheep coats. The initial objective was to investigate the effects on wool quality of running fine wool sheep in the pastoral zone. Coats have been used primarily to protect against dust penetration and UV light degradation, particularly at Fowlers Gap Research Station. VM contamination is more of an issue at Hay Field Station.

Size of Coat

The size of the coat fitted to a particular group of sheep has a great impact on coat retention, and on the incidence of flystrike as a result of chafing. Coats have been used for

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the duration of the project, and it has been necessary to use two coat sizes throughout each wool growing season. The coats cover a range of sizes - some having a gusset to accommodate extra length as the wool grows. When coats were initially used, the sheep were still growing out and were six weeks off shears. A very small coat (that for a lamb) was required, which was subsequently replaced with a larger coat at crutching. This pattern has continued throughout the duration of the experiment with a small coat being applied off shears, to be replaced with a larger coat at crutching (or before, if necessary).

If a coat is too small, chafing of the neck or hind legs may occur. The presence of an open wound may then predispose a sheep to fly strike. Sheep must be regularly observed to ensure that the coat is not causing any distress. This may preclude the use of sheep coats in extensive pastoral regions where sheep are usually handled infrequently.

Gussets

The value of sheep coats incorporating a gusset has been demonstrated in our trial. When applied directly after shearing, they can be adjusted to give a comfortable fit on a closely shorn sheep. The gusset can then be let out as the wool grows. The manufacturer suggests that the larger coats are designed to expand and accommodate twelve months growth of bodyweight and wool when fitted off shears. However, in the UNSW trial we have found that one coat is too large off shears, while a smaller size becomes too small by crutching time. The coat with a gusset has been particularly useful for the fine wool sheep in this trial as they show more development in the apron than the plainer bodied South Australian sheep.

We have observed that the coats in which the gusset is fully extended tend to sit a long way back on the neck of the sheep. The value of the coat in protecting the back of the neck and head (the scrag) from excessive dust and VM may therefore be reduced. Minor modifications to the design of the gusset may be appropriate for use in dustier, drier regions.

Construction of the fabric

Some of the first coats used during the trial were made from a fabric with a closer weave than coats which have been purchased subsequently. While coats, in general, are adequate in preventing the majority of dust contamination, the more open weave coats appear to allow finer dust to penetrate. This may, in part, explain the reduction in dust in coated wools at Fowlers Gap rather than a total eradication (though it is to be expected that some dust will enter around coat edges). At Hay, the issue of dust contamination is less important - there is little difference between coated and uncoated wools with respect to dust.

Flystrike

Whilst the work of Abbott (1979a) and Duncan (1938) has indicated that the use of rugs is usually associated with reduced fly strike, mortality results at Hay do not support this. The occurrence of fly strike was evenly spread throughout both coated and uncoated groups for the sheep at Hay during a period which coincided with a severe fly wave.

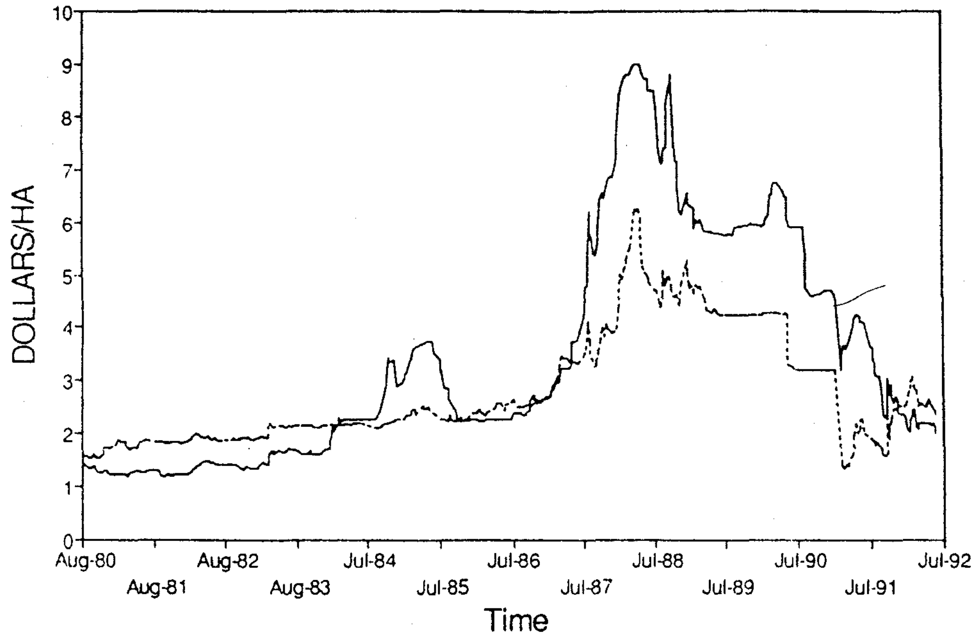
Lambing and Joining

Few problems have occurred with ewes wearing coats during lambing. The danger remains that the ewe may become cast and be unable to regain her feet. Once again, the correct size of coat is important. The results of ultrasound scanning indicate that the coated and uncoated ewes joined equally well (26 of 27 coated ewes were pregnant, while 25 of 27 uncoated ewes were pregnant). As with the uncoated ewes, the rams take a couple of days to adjust to the coats on the ewes but soon settle down to work.

Economics

Previous studies have suggested that the most gain could be achieved through the rugging of finer woolled sheep due to a higher premium for style and low VM in finer wools. With the current market suggesting that coarser, heavier cutting sheep are more profitable, the value of using coats on fine wool sheep is markedly reduced. Estimated gross margins per hectare for sheep cutting 19 m and 23 m wool respectively over a long period of time (Fig. 3) suggest that relative returns from either wool type have fluctuated with the wool market so that neither is consistently superior (Ford 1993). Given the discounts being applied to heavy VM wools at the current time, the use of coats may prove economically viable for producers with coarser, heavy cutting sheep.

Fig. 3 Estimated gross margins for fine and strong wool sheep (Source: Ford 1993)



Assumptions:

Stocking Rate 1 sheep to 7 ha
1 strong wool sheep = 1.3 fine wool sheep
Strong Wool Clean Fleece Weight 3.9 kg
Fine wool Clean Fleece Weight 2.2 kg
Variable Costs $5/sheep

Currently, the costs of using coats are quite variable. The major cost is that of the coat, which varies with size and construction. On average, the price of a coat is between $4 and $4.50. If two coats are required per growing season, then the initial outlay on coats is approximately $10 per head. If it is assumed that the coats will be useable for two years then the cost per head per year is $5. Associated costs include those of labour in fitting (and removing) the coats (the rate of fitting coats varies with experience from 35 to 50 coats/hour/person), and additional mustering costs. There may also be increased costs at crutching depending on whether the coat is totally removed or only partially removed. By the end of the project, we hope to have enough data to calculate a cost/benefit analysis.

Given the current price of wool, and the large stockpile, the possibility of constructing a sheep coat from one of the cheaper, lower lines of wool to produce a less expensive coat may exist. The progress made in this direction would, of course, be dependent on the technical feasibility and economics of manufacture (compared to coats currently in use) and the expected volume demand.

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