SEASONAL VARIATIONS IN WOOL GROWTH AND LIVESTOCK
IN SEVERAL ENVIRONMENTS

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Summary

On the basis of published studies of wool growth and liveweight, the patterns in three environments, the performances of ewes and wethers, the between-pasture differences, the effect of stocking rate, and the differences in wool production between years are presented and briefly discussed in terms of primary climatic factors, and the nutritional composition of the pastures.

It seems likely that, in most years, sheep are producing wool at the maximum rate of which they are capable for only a brief “peak” period. The success of any management or pasture-improvement programme in improving yearly production of wool will depend on the extent to which wool production in the “trough” periods is altered. This requires pasture species which have very different seasonal growth patterns from those already in general use.

I. INTRODUCTION

Few studies of seasonal variation in wool growth and liveweight of sheep at pasture have been made. Recently several studies were initiated by the C.S.I.R.O., Division of Animal Physiology, Prospect, and more studies are proposed by other research groups.

The increasing interest in this field makes it desirable to examine and briefly review the results of published observations, to indicate the type of patterns in wool growth and liveweight that might be expected in various environments, and to draw attention to some important variables probably involved in seasonal variations in wool growth and liveweight. In the absence of any qualification the seasons are defined here as: winter, June/August; spring, September/November; summer, December/February; autumn, March/May.

II. PATTERN OF WOOL GROWTH AND LIVESTOCK IN THREE ENVIRONMENTS

From the studies by Hutchinson and Porter (1958) at Roseworthy, South Australia; by Roe, Southcott, and Turner (1960) at Armidale, New South Wales; and by Arnold and McManus (1960) at Canberra, A.C.T., it is possible to discern three distinct types of wool growth and liveweight pattern. These are shown in Fig. 1.

At Roseworthy, in a winter rainfall environment, the wool growth rate was high in spring, but fell substantially during December/January. Liveweight of the sheep increased in spring, was maintained until autumn, and then fell, rising again with the beginning of new pasture growth (Fig. 1a).
Fig. 1. — Seasonal patterns of relative wool growth rate and liveweight at (a) Roseworthy, (b) Canberra, and (c) Armidale. Wool growth rates are relative to 100 during the period of maximum growth. Net liveweight was used for Roseworthy.
Similar patterns of wool growth and liveweight change were exhibited by wethers at Muresk, Western Australia (Stewart, Moir, and Schinckel 1961), and comparable liveweight patterns have been reported by Davies, Scott, and Fraser (1934) in the Adelaide foothills, South Australia, and by Neal-Smith (1942) at Kybybolite, South Australia. All the pastures in these winter rainfall districts were dominated by annual species of Mediterranean lineage.

At Canberra, winter and spring rainfall is the most reliable, but effective rain falls frequently in summer and autumn; winters are cold. The experimental pastures at Canberra were of two types: subterranean clover (*Trifolium subterraneum*) with *Phalaristuberosa*, and subterranean clover with annual volunteer grasses. There were two peaks for wool growth and liveweight: one in late spring and one in early autumn, with intervening troughs in summer and in winter (Fig. 1 b) . McFarlane and Willoughby (personal communication) observed that the occurrence of an autumn peak depended upon early autumn rains. In the absence of these rains, no autumn peak in wool growth occurred. They also noted that both peaks in wool growth generally reached the same level, as did the two troughs.

At Armidale, in a northern tableland environment, winters are cold, and rain is reliable, although more rain falls in the warm season of October to March. The pasture in this study was a degraded community dominated by *Bothriochloa* sp., a summer grass. There were some winter species such as *Danthonia* sp. and naturalized clovers. Wool growth was inferred from fibre diameter in these studies.

In this environment there was a gradual increase in wool growth, from a low level in August to a peak in January/February and a general decline thereafter (Fig. 1 c) . Liveweight followed a somewhat similar trend, except that it continued to increase until April/May, i.e. for some months after peak wool growth rates were attained. Liveweight usually declined during winter. The decline in fibre diameter in May/June was associated with senescence of summer species. The gradual nature of the decrease in wool growth was in marked contrast to the rapid decline observed in the Roseworthy, Muresk, and Canberra studies.

### III. EWES COMPARED WITH WETHERS

The Muresk study (Stewart, Moir, and Schinckel 1961) included ewes and wethers, and the results showed that the pattern of wool growth and liveweight was similar, though the values for ewes were depressed, particularly during lactation in spring 1940 (Fig. 2).

Of particular importance was the substantial fall in wool production for both wethers and ewes in late spring to approximately the same level. The liveweight patterns differed only in detail, one interesting point being the reaction of the wethers to the apparent pasture response caused by December rain. Wool growth also increased after this rain.

### IV. BETWEEN PASTURE DIFFERENCES

Only the Canberra study by Arnold and McManus (1960) is available for comparison of wool growth rates on different pastures in one environment, although
there are several studies in which liveweight alone has been considered. Unfortunately, the Canberra pastures were rather similar, as subterranean clover was the dominant pasture plant in both cases. Seasonal wool production on two pastures of widely different growth pattern in one environment has yet to be reported.

In Fig. 3 it will be seen that the patterns of wool growth and liveweight were similar for the sheep on both pastures. The fall in rate of wool growth during December/January in both groups is striking. This appears to be the time at which both pastures dried off. In the August/October and February/March periods, the sheep on the subterranean clover-annual grass pasture produced less wool than the sheep on the subterranean clover-phalaris pasture.

Fig. 2.—Seasonal pattern of wool growth rate and of net liveweight of ewes and wethers at Muresk.

Fig. 3.—Seasonal pattern of wool growth and liveweight of wethers on subterranean clover-phalaris and subterranean clover-annual grass pastures at Canberra.
V. EFFECT OF STOCKING RATE ON WOOL PRODUCTION AND LIVESTOCK WEIGHT

At Canberra (Arnold and McManus 1960) sheep on a low stocking rate (2 sheep/acre) produced 29 per cent more wool than sheep on a high stocking rate (6 sheep/acre). Differences in rate of wool growth were generally greatest in those periods when feed supply was lowest (Fig. 4a).

At Armidale (Roe et al. 1960) the difference between low and high stocking rate (0.75 sheep v 1.25 sheep/acre) was only about 6 per cent. Again, the period differences were greatest when feed was in shortest supply. Body weights were lower at the higher stocking rates in both regions.

Fig. 4.—Seasonal pattern of wool growth and liveweight of wethers at high and low stocking rates at (a) Canberra and (b) Armidale.
VI. DIFFERENCES BETWEEN YEARS IN WOOL PRODUCTION

Few observations have been outlined over a sufficient period of years to enable a close study of yearly differences to be made. However, there is a strong suggestion in the results of Marston (1948), and of Stewart et al. (1961)—lambing ewes in 1940 and 1941—that the pattern of wool growth reflects the pattern of effective rainfall.

VII. PRIMARY CLIMATIC FACTORS AND SEASONAL CHANGES IN WOOL GROWTH

There is ample justification for believing that the reported seasonal patterns of wool growth and liveweight considered here reflect the nutritional status of the animals. These patterns may have been modified and influenced by primary climatic factors (temperature, light), but it is unlikely that such factors were the immediate cause of the seasonal patterns. This conclusion is justified on two grounds: firstly, there was no consistent association between the wool growth pattern and climatic factors; and secondly, the magnitude of variation from maximum to minimum wool growth rates was much greater than that observed in any of the experimental observations on the relationship of wool growth to temperature or to light (reviewed by Hutchinson and Wodzicka-Tamaszewska 1961), but is consistent with known effects of nutrition on wool growth.

VIII. ANIMAL NUTRITION AND THE PASTURES

Nutritional state is a function of the amount of dry matter consumed and the nutrient composition of this material. There is at present no unequivocal evidence of the relative significance of amount and composition as causes of the variations in wool growth and liveweight observed under the various pasture conditions, but there is adequate evidence that the nutrient composition of pastures varies with species, fertilizer application, and stage of growth. In addition, the dry matter intake of grazing sheep also varies with the first and last of these factors (Hutchinson and Porter 1958; Fels, Moir, and Rossiter 1959; Vercoe, Tribe, and Pearce 1961).

IX. PASTURES AND SEASONAL CHANGES IN WOOL GROWTH AND LIVESTOCK

The pasture characteristics with which changes in wool growth rate and liveweight appear to be most closely associated are the stage of growth, and the amount of available forage per unit area of land. A decline in the rate of wool growth is nearly always associated with the senescence and drying off of the pasture. This is particularly marked in pastures of Mediterranean-type species. Light-weight does not usually decline for some months after the rate of wool growth declines (Hutchinson and Porter 1958; Roe et al. 1959; Arnold and McManus 1960; Stewart et al. 1961).

Development of green feed, following autumn or winter rain, is usually associated with a marked response in wool growth rate and liveweight—particularly with Mediterranean-type species in southern Australia. In the Armidale area, however, the availability of green feed in the natural pastures during winter is very low—presumably due to low temperatures—and little response in wool growth is observed before spring.
Roe et al. (1960) emphasized the close relationship of fibre diameter to green forage rather than to total forage available. Willoughby (1959) also has inferred an association between wool growth and the amount of green forage, rather than the total forage available.

Biddiscombe, Hutchings, Edgar, and Cuthbertson (1956), at Trangie, obtained significant differences in greasy fleece weight between high and low stocking rates only when the amount of green feed differed significantly between the stocking rates.

There is little doubt that the conclusions drawn by Willoughby (1959) apply to most pastures. Briefly these conclusions were:

(a) Dry forage was irrelevant to animal production when green forage was present (see also Roe et al. 1960);

(b) Small increases of green forage in stress periods (autumn and winter at Canberra) gave large increases in liveweight and wool production;

(c) Increases in the amount of dry matter for summer consumption by sheep reduced their liveweight loss only slightly;

(d) There is little point in increasing pasture production at a time of the year when there is already a surplus (as in spring).

X. MODIFICATION OF THE ENVIRONMENT

It seems likely that, in most years, sheep are producing wool at the maximum rate of which they are capable only for a brief “peak” period during spring or summer, depending on the particular regional environment. Differences in fleece weight from year to year and region to region largely reflect the depth and duration of the “trough”. The success of any management or pasture-improvement programme (environmental modification) in improving yearly production will therefore depend on the extent to which production in the “trough” periods is altered. Hutchinson (1961) has made an approach to this problem in South Australia, by suggesting supplementary irrigation.

Clearly, if an improved pasture merely reproduces the growth cycle of the natural pasture that it replaces, then very little more wool per sheep will be grown, although more sheep per area may be grazed. This seems to be a relatively common experience in southern Australia. On the other hand, substantial increases in cut per head would be expected, for example, from the introduction of winter/spring species into a summer pasture regime, such as might occur on the northern tablelands of New South Wales. Responses in wool growth per sheep are likely to be observed only if the pasture species used in the improvement programme have very different seasonal growth patterns from those already in use. Williams (1961) has set out some of the difficulties involved in producing out-of-season forage for the pastoral industry.

XI. REFERENCES


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