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SOME EFFECTS OF AN INCREASED STOCKING LEVEL ON WOOL GROWTH

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SUMMARY

A flock of Romney sheep was split into two sub-flocks. One sub-flock remained as a control at a low level of stocking (5 ewe equivalents per acre) while the other sub-flock was transferred to an intensively grazed area (10.5 ewe equivalents per acre). Body weight, fleece weight and mean diameter of the wool fibres were lower for sheep on the intensively grazed area. Weights of wool samples clipped each month from an area on the side of the sheep indicated a more marked and more prolonged winter and early spring depression of wool growth on the intensively grazed area. This was associated with a greater thinning of the wool fibres and a higher incidence of cotting (fibre entanglement), also there was a tendency for the wool from the intensive sub-flock to be slightly more tender (lower tensile strength).

RECENT REDUCTIONS in wool prices occurring at a time when many farmers are rapidly increasing the number of stock on their land have led to suggestions that increased stocking has resulted in poorer "quality" wool that is more difficult to sell than previously. There is little factual evidence to support or refute these suggestions. Some Australian reports of the effects of increased stocking on wool characteristics suggest that the wool may be slightly "poorer" at the higher stocking levels, but there has been little effect on market value (Roe *et al.*, 1959; Sharkey *et al.*, 1962; McManus *et al.*, 1964). Wool characteristics have been recorded spasmodically in New Zealand trials. The limited data suggest that unsoundness and cotting may increase at higher stocking rates. Lambourne (1956) showed a higher incidence of break and cotting in a small number of twin-bearing ewes grazed at 8 ewes per acre when compared with similar ewes grazed at 4 ewes per acre. Walker (1955) and Collin (1966) reported a greater proportion of fleeces classed as cotts or showing break at the high stocking levels but in neither case was this associated with a lower price per pound.

Break, tenderness and cotting in fleeces are normally due to the same factors. Wool fibres "thin" and may shed from the follicles during the winter trough of the annual

rhythm of wool growth. This annual rhythm is due to three main factors:

- (1) The inherent physiological rhythm, varying in phase with the climatic seasons (Hutchinson, 1965; Hutchinson and Wodzicka-Tomaszewska, 1961).
- (2) Effects of pregnancy and lactation (Coop, 1953).
- (3) Variations in nutrition, Schnickel, 1963; Doney and Eadie, 1967).

In New Zealand, tenderness and crotting are normally due to the combined effects of all three factors, but break can sometimes be due to acute nutritional disturbance alone. Thus, studies of the seasonal rhythm of wool growth are likely to be useful in research into these faults. Story and Ross (1960) have described the seasonal rhythm of wool production of a flock of grazing New Zealand Romney ewes, but there are no published comparisons of seasonal rhythms of wool growth of sheep subject to different grazing environments in New Zealand. The present paper compares the seasonal rhythm of wool growth of sheep grazing at two stocking levels and an attempt is made to relate these rhythms to some wool characteristics.

MATERIALS AND METHODS

THE GRAZING UNITS

In March, 1966, the CPT flock at Massey University, used for many years in animal breeding studies and in which female replacements are selected at random, was divided into two sub-flocks. The same rams are used in both sub-flocks, the principal aim being to compare progeny of each ram in two different stocking rates and to provide evidence on a possible genotype-environment interaction. One sub-flock (Control) was kept in similar circumstances to those that the flock has experienced in the past. The other sub-flock (Intensive) was confined to an area of approximately 25 acres. Each sub-flock consists of approximately 200 ewes. In 1966, the Intensive ewes were grazed over the whole area without replacements but subsequently replacement stock have been run in conjunction with the adult animals. Stocking rates for the Intensive and Control areas were approximately 10.5 and 5 ewe equivalents/acre, respectively (assuming 1 hogget = 0.6 ewe equivalents). Management of the sheep on the two areas was basically similar.

MONTHLY WOOL SAMPLING

Initially 10 single and 10 twin ewe hoggets and 10 two-year-old and 10 four-year-old ewes were selected at random from each sub-flock. The size of the hogget groups was reduced to nine animals after deaths and elimination of others to allow orthogonal analysis. Two deaths occurred in the ewe groups and other animals were eliminated owing to barrenness. Thus the final analysis was on results from 8 two-year-old and 10 four-year-old ewes in the Control flock and 7 two-year-old and 8 four-year-old ewes in the Intensive flock.

Commencing December 28, 1966, the animals were wool sampled every 28 days until November 22, 1967. Adult ewes were not sampled on August 31 owing to complications associated with lambing management. A sample was clipped from the right midside while the animals lay on a flat surface. The lengths of the four sides of the clipped patch were measured and the animals were weighed.

Wool samples were conditioned in a humidity room, weighed, degreased with organic solvents and hot water, and conditioned for 48 hr before clean weights were determined. Monthly wool production results are expressed as mg clean wool/sq. cm of skin (area of patch at sampling 1).

Mean fibre diameters and fibre lengths were determined on samples from five sheep from each of the adult ewe groups. Diameter was determined by the airflow technique (Anderson, 1954). Lengths were determined by mounting fibres between two sheets of glass and projecting and measuring an image at known magnification.

WOOL CHARACTERISTICS

As a standard procedure in this flock, a wide variety of wool characteristics are evaluated. Full-length wool samples are clipped from a measured area on the midside of ewe hoggets prior to shearing. Adult ewe midside fleece samples are removed after the fleeces have been weighed on a fleece-weighing table. Most characteristics are graded from appraisals of the midside samples. A 1 (inferior) to 9 (superior) scale is used for most grades, the system being arranged so that distributions tend to follow the normal curve. Fleece weights include the weight of crutchings. Two-year-old fleece weights are not comparable with those of other ewes since hogget shearing is normally about six weeks prior to the adult ewe shear-

ing. Results in this paper are derived from the 1967 shearing.

RESULTS AND DISCUSSION

BODY WEIGHT

Mean body weights of the sheep sampled monthly are shown in Fig. 1 and 2 as an indication of plane of nutrition. The body weights suggest that marked differences in the plane of nutrition between the two flocks occurred only from late July until October. Pasture availability was probably affected by abnormal seasonal conditions. An extremely wet August was followed by a partial drought in September and early October.

THE RHYTHM OF WOOL GROWTH

The group means for clean wool weight per square centimetre are plotted in Figs. 3 and 4. Missing the late August sampling has interrupted the continuity of the adult ewe graph in Fig. 4 but general tendencies are still clear. A pronounced seasonal cycle of wool growth is evident. The decline in wool growth of the ewes in March and April occurred a month earlier than the decline for the hoggets. The seasonal rhythms of wool growth differed between treatments. On the Intensive unit, the trough of wool production was accentuated and prolonged into early spring. In the case of the hoggets, the trough did not occur until October. Clearly this limitation of wool growth is due to a low level of nutrition in late winter and early spring.

The means of the fibre length measurements are plotted in Fig. 5 and fibre diameter means in Fig. 6. No early-August diameter data are available for the Intensive animals since samples were not sufficiently large to measure by the airflow technique. Apart from an anomalous reduction in fibre diameter in the March sample, the diameter and length rhythms are similar. This study supports Story and Ross (1960) in that fibre diameter changes did not occur until about a month after the corresponding changes in fibre length. The reduction in fibre diameter found in the March sample with no corresponding change in fibre length is difficult to explain. There is little information as to the physiology of the relationship between length and diameter. Normally fibre length and fibre diameter are closely related, but Rougeot (1965) has shown that thyroxine treatment will increase growth in length without affecting fibre diameter. Thwaites (1967) has reported a reduction in fibre diameter with no corresponding

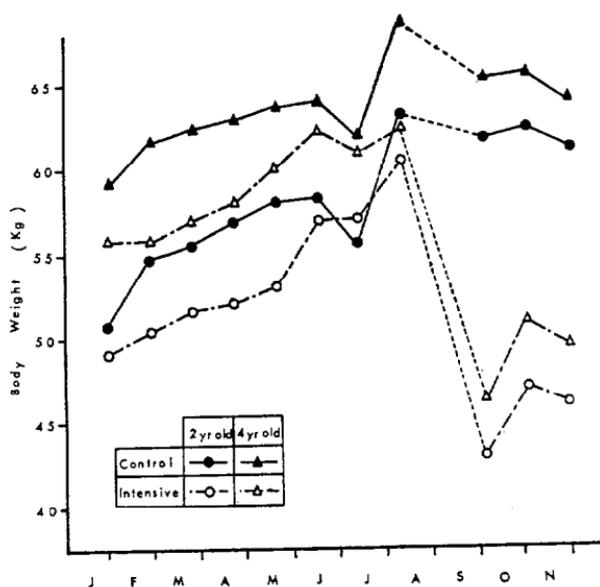


FIG. 1: Body weights of ewes throughout the experimental period (dotted lines represent the change over a 48-day period).

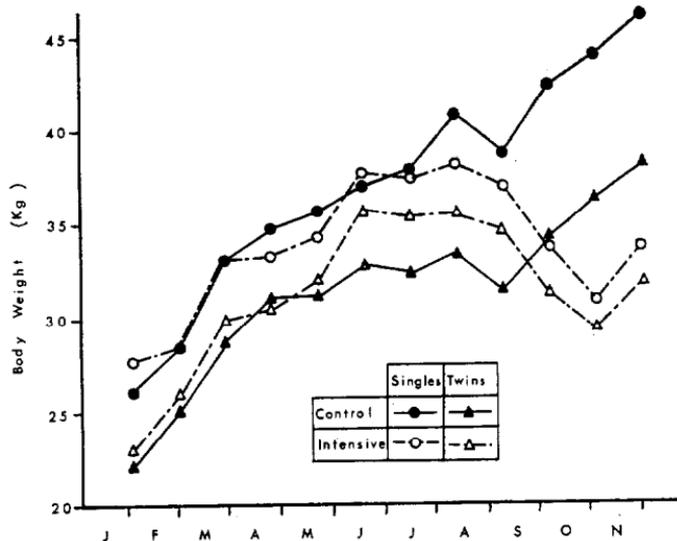


FIG. 2: Body weights of hoggets throughout the experimental period.

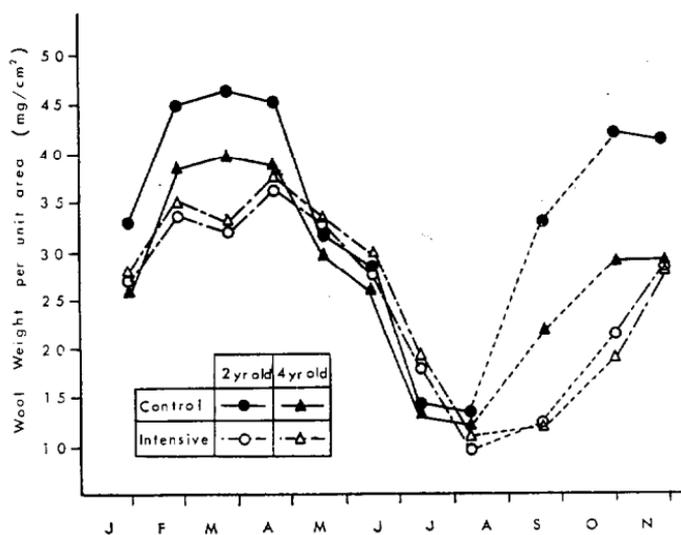


FIG. 3: Wool production per 28-day period from a midside patch on the ewes.

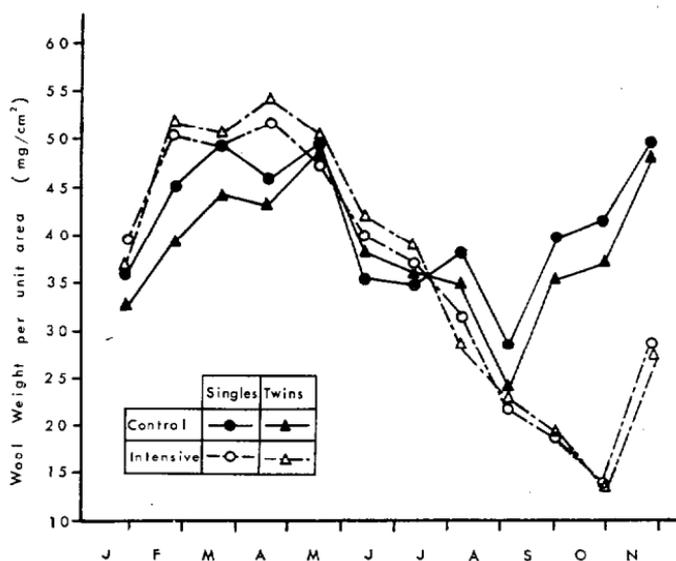


FIG. 4: Wool production per 28-day period from a midside patch on the hoggets.

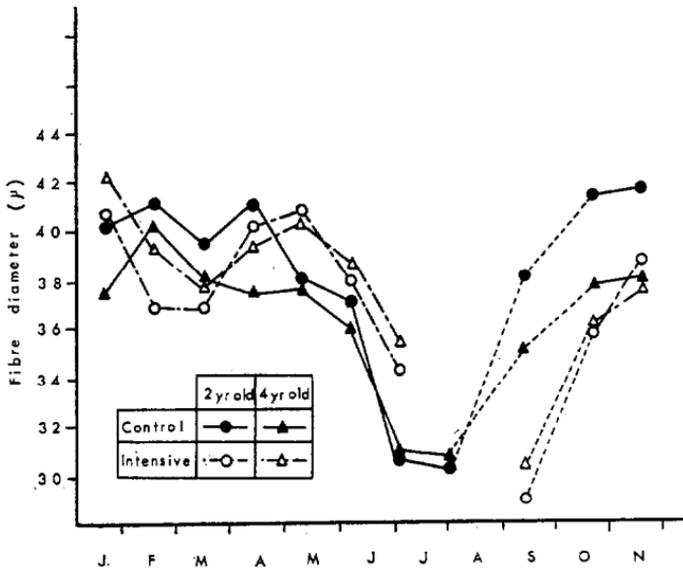


FIG. 5: Changes in fibre diameter in 28-day samples.

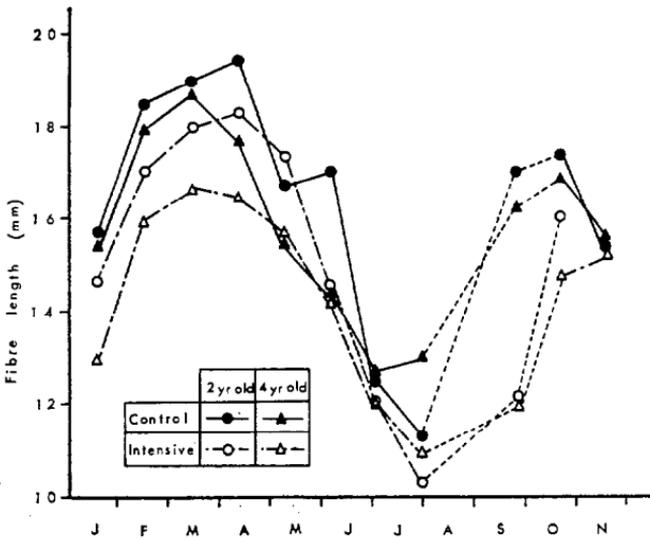


FIG. 6: Changes in fibre length in 28-day samples.

change in fibre length after exposure of sheep to 14 days heat stress in a hot room. Perhaps the effect in the present experiment was due to the delayed effects of high temperatures.

WOOL CHARACTERISTICS

The lack of adequate measurement techniques to evaluate wool characteristics creates difficulties in a study of this nature. Subjective appraisal may be used, but this introduces problems of repeatability between and within assessors. Since normally only a few grades are used, statistical analyses are also of doubtful validity. While the present grading system was designed to alleviate the statistical problems, it was not an ideal method of evaluating wool characteristics for experimental purposes. The characteristics which showed clear-cut effects were evaluated by measurement rather than appraisal.

There were no significant differences in "quality" characteristics normally associated with growth rate in the hogget fleeces. Hogget fleece weights were greater ($P < 0.005$) in the Control flock (4.4 kg) than in the In-

TABLE 1: GROUP MEANS FOR FLEECE CHARACTERISTICS AND BODY WEIGHT

Flock	Age (yr)	Fleece Weight (kg)	Fibre Diameter (μ)	Quality Number	Soundness	Cotting	Body Weight (kg)
Control	2	6.28	38.4	46/8's	4.7	6.6	56.8
	3	5.44	39.3	46/8's	5.5	6.9	58.8
	4	5.45	40.0	46/8's	5.6	6.9	60.9
	5	4.97	40.0	46/8's	5.9	6.7	58.9
Intensive	2	5.80	38.2	46's	4.3	6.3	46.1
	3	5.16	38.8	46's	5.5	6.4	49.9
	4	4.80	38.6	46's	5.1	6.7	49.6
	5	4.42	38.6	46's	5.4	6.4	49.7

TABLE 2: MEAN SQUARES DERIVED FROM AN ANALYSIS OF VARIANCE

Source	df.	Fleece Weight	Fibre Diameter	Quality Number	Soundness	Cotting	Body Weight
Stocking							
Level	1	24.9***	72.8***	32.9***	11.8*	10.1***	10,685.3***
Age	3	34.4***	26.5*	1.6	29.3***	2.0*	312.8**
Residual	425	0.6	7.1	1.6	2.9	0.5	41.7

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.005$.

tensive flock (3.8 kg). The means of some fleece characteristics for each age group of the adult ewes are given in Table 1 while the mean squares derived from an analysis of variance of data for the fleece characteristics are given in Table 2. The fleece weights were clearly affected, with the Control animals producing heavier fleeces. These results are in line with those of many workers, including Walker (1955), Suckling (1964) and Collin (1966). The results from the animals which were sampled monthly suggest that the lower fleece weights were due to the reduction in wool growth in early spring.

Analysis of quality number (count) appraisals indicates that the fleeces were judged to be coarser at the higher stocking intensity. This highly significant difference in quality number has two particularly interesting implications. First, Walker (1955) presented no information on the quality number changes at different stocking rates, but suggested that the reason why the wool from the higher stocking rate fetched a higher price, was that the wool was finer. Either Walker's response differed from that in the present trial or the buyers' appraisal of fineness was not a factor in the higher price paid for the wool from the higher stocking level. Secondly, airflow measurements of fibre diameter indicate that the wool from the Intensive flock was significantly finer than the wool from the Control flock. The apparent contradiction in these two results suggests that the change in stocking rate may have affected the relationship between quality number and fibre diameter. This effect is apparently due to the wool being more lustrous at the higher stocking level.

Although the advantage was not great, the Control fleeces tended to be both more sound and less cotted as graded on the midside samples. The increase in unsoundness and cotting at the higher stocking rate agrees with Walker's (1955) results but the effect appears much less dramatic than the high levels of cotting reported by Collin (1966) at his higher stocking level. Cotting data based on an evaluation of the whole fleece showed no significant difference in the level of cotting. This indicates the lack of sensitivity of some subjective appraisals to the small differences in wool characteristics induced between the two sub-flocks.

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