The Efficiency of Wool Growth

By K. A. FERGUSON*

IN the present paper, efficiency of wool growth is defined as the percentage of the food crude protein which is converted into wool.

Efficiency is discussed from two points of view. Firstly, from the point of view of selection of more efficient sheep and, secondly, from the point of view of the grazing management of improved pastures.

If we measure the clean fleece weights of a flock of sheep we are also measuring their efficiencies only if they have all eaten the same amount of food protein during the preceding year. The extent to which wool weight is a measure of efficiency depends on how food intake varies amongst different sheep in the flock.

We know very little of the variation in food intake of a group of sheep on different sorts of pasture, but studies of faecal output are now being made and two papers at this conference are on this subject.

However, we can get some information on this variation from the data we have on the food intake of sheep in pens. Under these conditions we find that food intake does vary considerably. Food intake at the top of the range is about double that at the bottom. This variation in food intake causes a corresponding variation in efficiency.

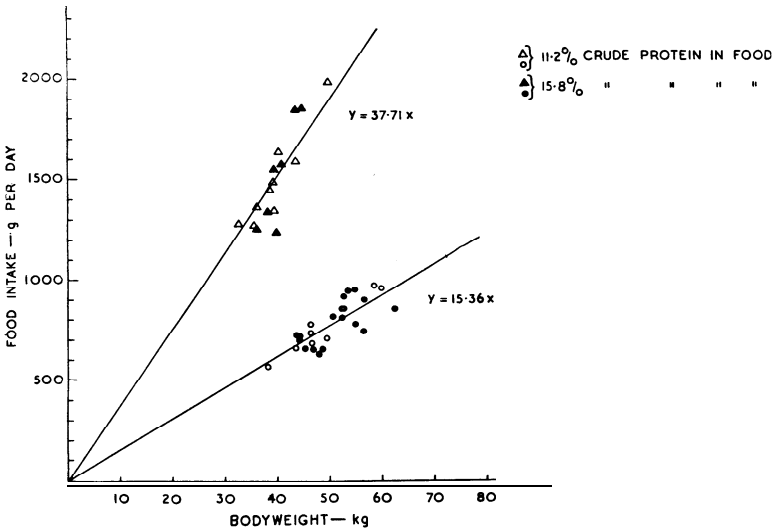

FIGURE 1: The relation of food intake to bodyweight in two groups of medium wool Merino ewes. Upper curve - Group A. Lower curve - Group B.

We find that most of the variation in food intake is due to corresponding variation in bodyweight. Figure 1 shows the relation between food intake and bodyweight for two groups of medium wool Merino ewes, each group being split into two rub-groups receiving food of different protein content. We notice the following:-

1. Food intake is proportional to bodyweight in both groups.
2. Food intake is not affected by the protein percentage of the food between 11% and 16%.
3. The difference in food intake between the two groups. The ewes of Group A with the low food intake were very fat. The ewes of Group B were in average condition. The sheep of both groups were the same age.

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The data which Mr. Weston has shown me indicate that the intake of sheep on pasture is also proportional to bodyweight, and this has also been found in overseas studies with cattle.

The close relation between food intake and bodyweight thus means that we can use bodyweight as a measure of food intake within a group. of sheep run together. If we express wool growth as wool weight per unit of body-weight, we have a measure of efficiency.

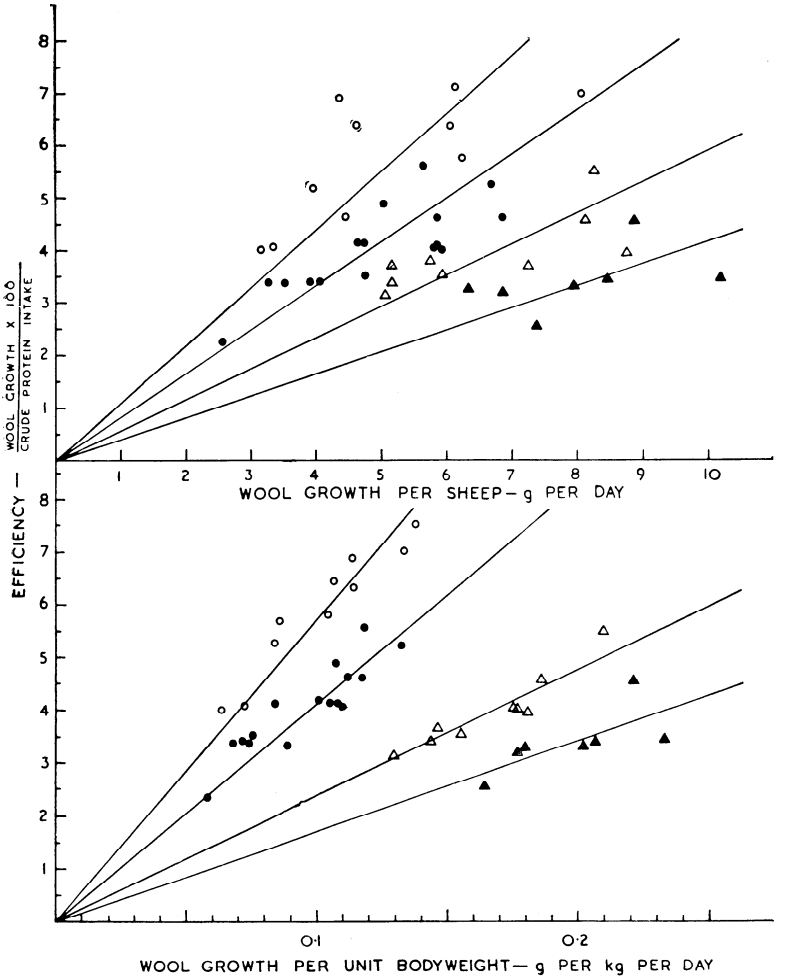

FIGURE 2: The relation of efficiency to wool growth per sheep and to wool growth per unit bodyweight. O — Group B, 11.2% crude protein. ● — Group B, 15.8% crude protein. Δ — Group A, 11.2% crude protein. ▲ — Group A, 15.8% crude protein.

Figure 2 demonstrates how wool weight per unit bodyweight is a better measure of efficiency than wool weight per head. In the top graph is shown the relation of efficiency to wool weight per head for the two groups of sheep shown in Figure 1. In the bottom graph efficiency is related to wool weight per unit bodyweight. In this case the correlation is much better. The efficiency in each group is higher for those sheep on the lower protein ration. This is due to the decrease of efficiency with increasing protein intake and possibly also to a decrease of efficiency with increasing protein percentage of the diet.

I want to pass now to efficiency from the viewpoint of the management of improved pastures.

What data there are, show that the relation between wool growth and food intake follows a curve of diminishing 'returns. Figure 3 shows the relation between wool growth and crude protein intake for sheep of different productive capacity, based on the data of Ferguson, Carter and Hardy (1949). The relation for an individual follows a single curve. The values of A are the asymptotic values at which wool growth flattens out at very high food intakes which may be beyond the capacity of the sheep.

The point of interest for the present discussion is that efficiency falls as intake increases.

This is shown in the Figure 4. In this diagram efficiency is related to protein intake.

For illustration let us consider the efficiency of an average Merino sheep during unrestricted grazing on high quality improved pasture.

Suppose it has an A value of 15 g. per day, which is about 12 lb. of clean wool per year, and an average food intake of 1,600 g. of dry matter per day containing 15 % crude protein, i.e., 240 g. of crude protein. Its efficiency would be 4.3%. Now let us suppose that we restrict the grazing of the sheep on the pasture so that it obtains only half as much feed from it. This would be somewhat above maintenance requirements; it would supply 120 g. of crude protein and the efficiency would be 5.6%, i.e., 30% more than on unrestricted grazing. For a sheep of an A value of 5 g. per day, eating the same amounts, the efficiency would be 65% greater on the restricted intake.

Mr. Hilder mentioned a figure of 70 lb. of wool per acre from sheep during the unrestricted grazing of the C6 pasture at Chiswick Field Station. By doubling the number of sheep per acre and allowing them restricted access to the pasture, either by strip grazing or removing the sheep from the pasture so that the pasture was still allowed to grow at its maximum rate, it should be possible to raise production per acre from 70 lb. to between 90 and 115 lb. per acre, depending on the productive capacity or A value of the sheep. The same result could not be achieved by over-stocking a pasture with continuously grazing sheep. This would depress the pasture growth by lowering the plant size below that required for maximum growth.

The **ad libitum** food intake of sheep does not remain constant throughout the year but decreases as the amount of fleece it carries increases. Food intake does not appear to be appreciably affected by pregnancy, but is considerably increased during lactation. Thus the potential increase in wool production per acre by restricted grazing is not constant but will vary throughout the year due to variation in the appetite of the sheep as well as to the seasonal variation in pasture growth.

REFERENCES:

Ferguson, K. A., Carter, H. B., and Hardy, M. H. (1949). Aust. J. Sci. Res. B. 2: 42.

DISCUSSION ON PAPERS BY DR. FERGUSON AND MR. WESTON.

Dr. FRANKLIN: (Mr. Weston). What was the relative wool production of fine-woolled Merinos at Armidale and at "Gilruth Plains"?

ANS.: Wool production was higher at "Gilruth Plains", 1.3 to 1.

Dr. FRANKLIN: (Dr. Ferguson). How would this information re the protein intake and efficiency of wool production tie in with the hand feeding of valuable stud rams as practised by our stud breeders? In other words, what advice would you give a stud breeder if he asked you to advise him as to the most desirable level of protein in his ration?

ANS.: The likelihood of digestive troubles rises with the rise in protein intake. One has to use high protein roughages for high levels and lucerne may colour the fleece. I have recommended high protein levels to one stud without any trouble being reported. Under hot weather conditions I shouldn't recommend going above 15 per cent. protein.

Mr. PANARETTO: How did you determine bodyweight? Have you ever considered using other terms of reference for your rations; for example, lean body mass?

ANS.: Certainly bodyweight has deficiencies. Appetite possibly is more closely related to body size. Both bodyweight and size are only relative measures of food intake within groups of sheep treated alike.

Miss TURNER: (1) In the relation of wool production to efficiency, Mr. Weston's graph shows a positive relationship. A similar positive relationship has been found in dairy cows when milk production is positively related to efficiency. This is, of course, a strong argument for selection on production. (2) Dr. Ferguson's statement that wool production per unit of bodyweight would be a useful criterion for selection does not seem to agree with Mr. Weston's two columns of figures, which rank strains from two environments, first, on wool weight and then on bodyweight. The bodyweight ratios in the two environments are similar, but the ratios of wool production vary. Would the speakers like to comment?

Further, I'd like to mention our own high and low wool weight selection groups, in which everything but clean wool weight per head was ignored in selection. The results of the first lot of progeny show a big difference in clean wool weight, but the mean bodyweights are the same.

ANS.: (Dr. Ferguson). Efficiency is related to wool growth per head, but in our data it is more closely related to wool growth per unit of bodyweight.

ANS.: (Mr. Weston). Our data agree with those of Dr. Ferguson. The ratios of wool production could vary, firstly, because the levels of production in the two environments differ and, secondly, because there is a possibility that the S.N.P. strain does not perform so well in the Tablelands environment.

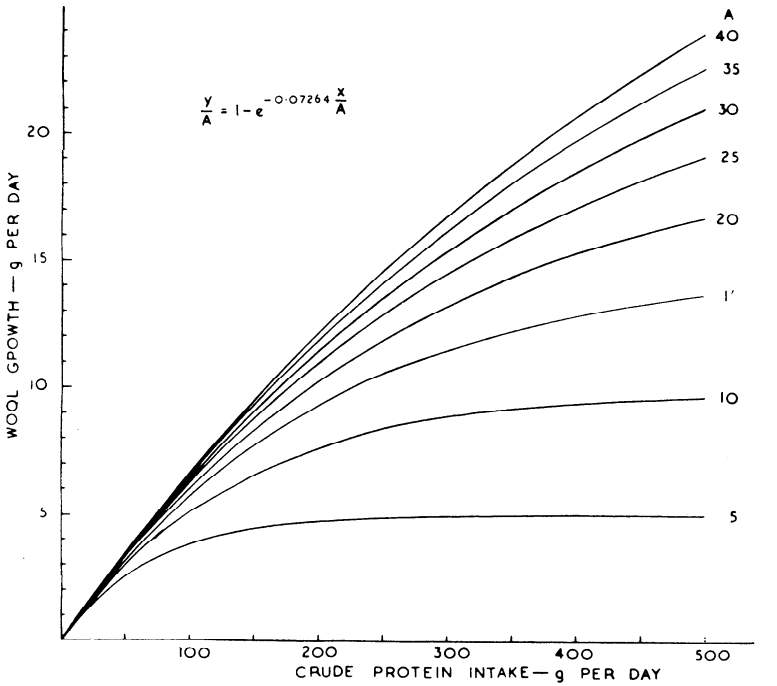

FIGURE 3: The relation of wool growth to crude protein intake.

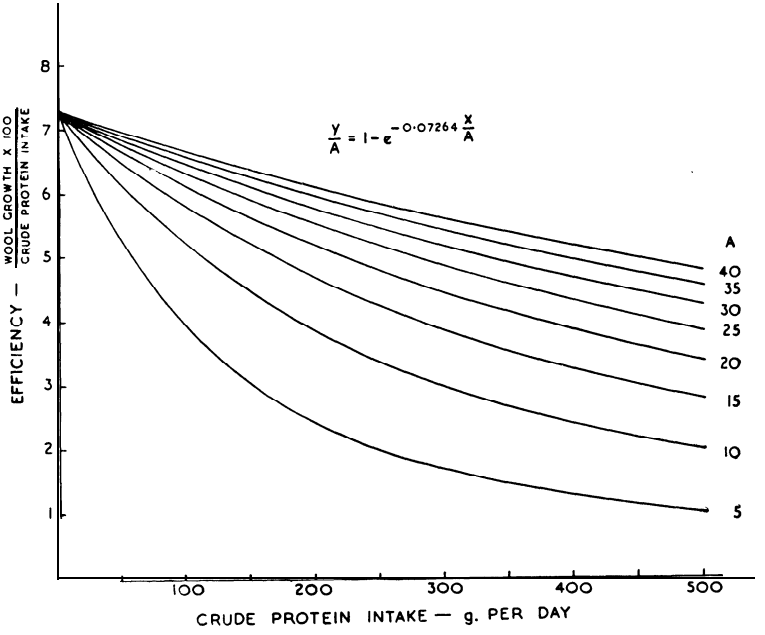

FIGURE 4: The relation of efficiency to crude protein intake.