BREEDING PLANS FOR IMPROVEMENT OF MEAT PRODUCTION AND CARCASS MERIT IN THE MEAT BREEDS OF SHEEP

Programmes de sélection pour l'amélioration de la production de viande et la valorisation des carcasses chez les races ovines à viande

Planes de cruzamiento para mejorar la producción de carne y el mérito de la canal en razas ovinas de carne

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All breeds of sheep are to some extent meat breeds. However, some breeds are kept primarily for wool and some for milk production, and in some the first consideration is ability to survive and reproduce in a harsh environment. This paper will be concerned with those breeds in which meat production is the primary purpose. Such breeds may be placed in one of two groups, with potentially some overlap:

1. Breeds kept primarily for meat production, with the slaughter lambs being purebreds. Such breeds must possess, in addition to meat producing ability, adequate adaptability to the environment in which they are kept, and good reproductive capability, including, in some areas, an extended breeding season. Wool production may or may not be considered of some importance.

2. Breeds kept primarily to produce sires of crossbred market lambs. Ewes of breeds in group 2 may lack adaptability to range or hill conditions, they may lack longevity and wool production, and may have a short breeding season.

It is assumed in the discussion which follows that a crossbreeding scheme utilising rams and ewes with complementary characteristics will continue to be the most common breeding practice for the production of slaughter lambs. Although there may be no great advantage in developing specialized sire and dam lines if starting an improvement scheme from a single base population (Smith, 1964), the existence of different breeds which are in fact such specialized lines indicates that they will be used as such, and each type should be improved. In sire breeds used in this scheme, selection may be devoted largely to meat production traits, though soundness and fertility will require some attention. This paper will focus on improvement procedures for such breeds. Similar procedures

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will also be applicable to breeds in the first category, but selection for strictly meat characteristics will be less intense in proportion to the emphasis required for other traits.

Assuming acceptable levels of performance in reproduction within the breed, in ram fertility and longevity, and in survival of crossbred progeny, attention in selection can be directed to:

1. growth rate
2. carcass yield
3. carcass quality, i. e., conformation, composition, and meat quality.

Growth rate

Rapid growth rate of meat animals is frequently stated to be desirable, since it is expected to result in greater weight of meat at a given age and per unit of food consumed, and hence greater efficiency and profitability.

In fact these advantages may not be realized in all circumstances, and the optimum genetic potential growth rate depends on many variables. The topic has been covered in depth in a recent symposium (Proceedings B. S. A. P., 1973).

Selection for rapid growth to normal slaughter weight or age generally results in increased weights at birth and maturity and later attainment of a given degree of maturity (Taylor, 1968), and may lead to a decrease in reproductive efficiency.

Factors favouring rapid growing and thus usually heavier slaughter weight lambs are:

1. ewe overhead costs.

2. labour costs, for the producer and especially for the slaughterer and retail butcher.

3. desire for leaner carcasses.

4. demand for larger cuts, especially from the loin and rib portions.

Factors arguing against very rapid growth in sire breeds include:

1. seasonal forage supply requiring lambs that will reach desired slaughter finish at an early age.

2. small size of «dam line» females, leading to dystocia or possibly inadequate milk supply if the crossbred lambs are too large.

3. demand for smaller cuts of meat, especially legs.

4. the frequently observed lowered reproductive rates of the largest breeds or largest individuals and strains within breeds. Bradford, Weir and Torell (1960) found that Southdown-sired lambs had consistently higher survival than Suffolk crosses, and Fahmy *et al.* (1972) reported the same result, i. e., better survival of the smaller breed lambs. Breed is confounded with size in such comparisons, but this author is not aware of cases where survival has favoured lambs by the larger breed sires. Donald, Read and Russell (1970) reported similar litter size weaned for Oxford Down and Southdown cross lambs, but a significantly larger litter size for lambs sired by the smaller Soay breed.

Because of differences between countries, areas, and enterprises, there is no one optimum solution to the question of size, and in fact a systems approach, considering at least: size of ewes with the best reproductive performance, seasonal variation in quantity and quality of forage, market demand in terms of preferred carcass weight and finish, and labour and other costs incurred on a per head basis, is required to reach an optimum solution for any production situation. Such an analysis should evaluate output in relation to input on a flock basis over at least one sheep generation.

One empirical estimate of the most efficient combination is that by Donald *et al.* (1970) in which it was found that «receipts from lambs were highest when the most fertile ewes were mated to the largest rams». Results of systems analyses of the kind described above are not as yet available for any major types of production enterprises.

Based on the present situation in the United States, characterized by:

1. high labour costs,
2. demand for large chops, and a production technology which can readily apply new cutting and merchandising techniques to heavy cuts such as legs,
3. relatively large ewe breeds,
4. feeding, management and genetic tools available to produce a high percentage of twins, reducing the risk of dystocia problems associated with large single lambs,
5. the existence of a lamb feeding industry, utilising feedlot or pasture, which can finish lambs not ready for slaughter when weaning is dictated by range feed supply or the ewe's reproductive cycle, it is concluded that selection for rapid growth in sire breeds is indicated. This should lead to increased meat production per ewe, lower labour cost per pound of meat, and probably leaner carcasses, all highly desirable. In such a selection program, continuous attention to net reproductive rate of the system is essential, since a lowering of fertility or lamb survival could more than offset the advantages cited for use of sires with rapid growth potential.

Selection methods

The specific objectives of selection for growth rate in sire breeds would include:

1. an increase in growth rate to market weight.
2. no more increase in mature weight than necessary to achieve objective 1.
3. selection on the basis of the individual's own genotype for growth, not on growth due to favourable maternal environment.
4. no adverse effect on survival of crossbred lambs, hence (presumably) little or no increase in birth weight.

The objective is thus in part to change the shape of the growth curve, increasing the slope for the period from birth up to about two-thirds of mature weight, while affecting weights at other ages as little as possible. This is illustrated in Figure 1.

At what age and under what management procedures should growth rate be measured?

From the standpoint of minimum cost and generation interval, early measurement is preferred. However, selection for increased birth weight is not desirable because of the adverse effect of large birth weight on lamb survival, although such selection would be expected to increase post-natal growth rate. Selection for increased weaning weight of lambs nursed by their dams will be selecting in part for milk production. Selection for weight at one year of age or older is more expensive, and increases generation interval. It would also be expected to increase mature weight more than selection at earlier ages.

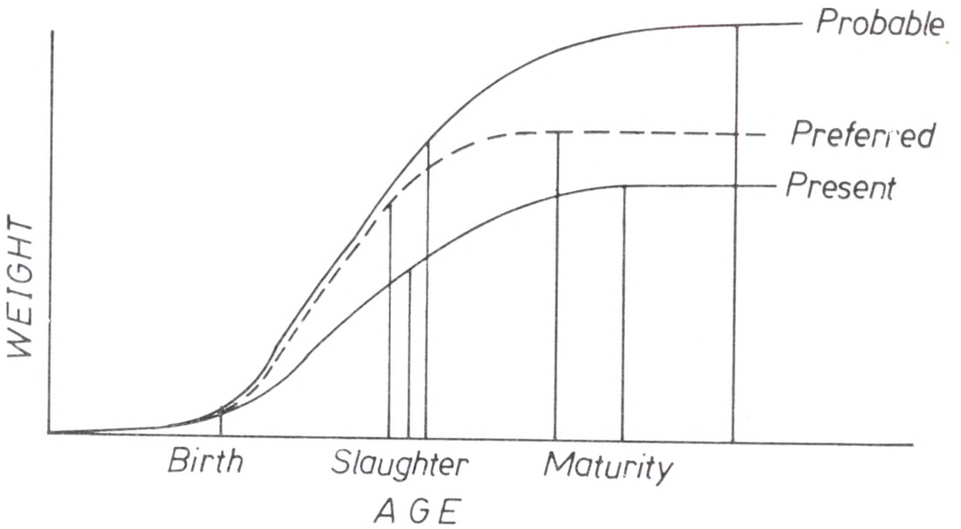

FIGURE 1. Possible effects of selection for rapid growth rate on growth curve.

The best compromise appears to be selection on weight for age following a post-weaning feeding period. BRADFORD and SPURLOCK (1972) found weight at six months, of ram lambs weaned at three to four months, was as good an indicator of their genetic potential for growth as weights at older ages. This was for lambs all of which had been raised as twins, and which were fed for rapid growth after weaning. Under other circumstances, variation due to maternal effects might be larger or persist longer. As a general recommendation, it would seem that weaning at 60 days of age or younger, feeding for rapid growth, and measuring weight for age at five or six months of age should provide a good indication of a ram's genetic potential for early growth. Such selection should largely eliminate the differential heritability for weaning weight in twin and single data reported by VOGT, CARTER and MCCLURE (1967), GJEDREM (1967) and BRADFORD (1972). It is less clear whether it would eliminate the difference in heritability of weaning weight between «Down» breeds (which include many of the meat breeds) and other breeds suggested by BOWMAN (1968), but if such a difference exists, it should be reduced by the procedure proposed. Selection on weight at five to six months would be expected to result in some increase in mature weight.

Amount of improvement that can be made in weight for age will be a function of heritability, reproductive rate, and selection and mating plan.

Heritability estimates for weight in sheep vary widely, as shown by the values summarized by Bowman (1968). However, as shown in that review, heritabilities at post-weaning ages are generally fairly high. We will assume a heritability of individual differences in six month weight of 0.30. We will assume a standard deviation in six month weight of 6 Kg, an average of 120 lambs weaned per 100 ewes bred, selection of the best 8 % of rams and 40 % of ewes, and a generation interval of one year for males (use of ram lambs only) and three years for females. These assumptions lead to an estimate of 1.27 Kg genetic improvement per year within the sire breed for truncation selection on six month weight. Half of this should be transmitted to crossbred progeny.

If heritability is as high as assumed here, or even somewhat less, progeny testing to improve growth rate is not recommended, although progeny testing males, selected on growth rate, to improve carcass characteristics may be advantageous as discussed later.

If survival of crossbred lambs decreases due to increased birth weights resulting from selection of this kind, a selection index with positive emphasis on six month weight and negative emphasis on birth weight could be used. No experimental tests of such a procedure have been carried out with sheep or cattle, but Abplanalp *et al* (1963) showed that shape of the growth curve in turkeys could be modified readily by selection. This may be true also for sheep. Whether it would be worthwhile to include also negative emphasis on mature weight in the index is questionable. To do so would cause a marked increase in cost of getting the selection information, as well as increasing generation interval. It would also be expected to reduce the rate of improvement of early growth rate. It each meat breed ram is the sire of one hundred to several hundred crossbred lambs in his lifetime, the extra cost per lamb resulting from increased maintenance cost of heavier mature weight breeding stock of the sire breed will be very small. The difficulty of attempting to prevent an increase in mature weight in such breeds does not appear justified.

As growth rate and mature weight are changed, optimum slaughter weight will change also.

The above emphasis on growth rate and size is based on the conclusion reached by several workers, including Swiger *et al.* (1965), Pearson (1969), and Bradford and Spurlock (1972), that live weight is the most accurate single estimator of amount of meat in animals of the same species, general type and age. Quantitative consideration of the relative economic importance and probable heritabilities of different traits in meat breeds also suggested that weight for age is of primary importance (Bradford, 1967). Nevertheless, differences in carcass yield (dressing percent), carcass composition and meat quality do exist between and within breeds, and should be considered in breeding programs for meat breeds.

Carcass yield

Dressing percent is a trait with an intermediate optimum, from a total industry standpoint, since the higher yield emphasized by packers is usually associated with a higher carcass fat content which is costly to produce and, beyond a certain point, objectionable to the consumer.

Useful genetic variation in dressing percent is indicated by breed differences in components other than carcass fat. For example, MEYER and BRADFORD (unpublished) found Finnish Landrace × Targhee crossbred lambs to have lighter pelts (shorn) and lower offal weights than Targhees. Similar differences between breeds are known in cattle. Estimates of genetic variation within sheep breeds are scarce. CARPENTER (1968) cited estimates of heritability of dressing percent in lambs of 0.07 ± 0.28 and 0.13 ± 0.29; BOTKIN *et al.* (1969) reported values of 0.41 ± 0.12 and 0.27 ± 0.25 by two methods; BRADFORD and SPURLOCK (1972) obtained an estimate of 0.94 ± 0.36 from half sib analysis, but a value of only 0.38 from sire-progeny correlation in the same data. Obviously, more data are needed. However, it may be assumed that dressing percent has a sufficiently high heritability that it will respond to selection. Where progeny testing in practiced, selection on carcass weight for age will select for dressing percent, and circumvent the negative genetic correlation between live weight for age and dressing percent suggested by the data from BRADFORD and SPURLOCK (1972). Selection for heavy muscling should improve dressing percent without increasing fatness, assuming the results obtained with cattle and swine by KAUFFMAN *et al.* (1973) are applicable to sheep.

CARCASS CONFORMATION

Shape of the meat animal or its carcass has long received attention from breeders, and carcasses which have plump muscles and are wide in relation to length sell for a premium in some markets. However, the relationship of conformation to quantity or quality of lean meat in the carcass, or its distribution, is low. Two advantages of good conformation, as exemplified by the difference between improved meat type animals and those not so improved, are a higher lean: bone ratio for the former (FOURIE *et al.*, 1970; KAUFFMAN *et al.*, 1973), and a better distribution of fat, i. e., more subcutaneous in relation to perirenal fat depots. The latter authors also found a higher dressing percent for more muscular animals. Within improved breeds, however, the value of preferred conformation as an indicator of real carcass merit is very dubious, since conformation scores tend to be positively associated with percent fat in the carcass (TIMON and BICHARD, 1965; SPURLOCK *et al.*, 1966). VESELY and PETERS (1966) concluded that conformation had little bearing on actual retail value of carcasses; DONALD *et al.* (1970) found little difference in price paid for carcasses from lambs sired by rams of breeds differing markedly in conformation. Visual evaluation of degree of muscling of an animal or carcass might be of some value in improving muscle shape and dressing percentage, but this requires experience in discriminating between muscling, and thickness due to excess fat.

CARCASS COMPOSITION

The component responsible for by far the greatest amount of variation in carcass composition is degree of fatness, and this in turn is very strongly influenced, in growing animals maintained continuously on a high plane of nutrition, by the weight of the animal at slaughter in relation to its potential mature weight

(e. g., LAMBUTH *et al.*, 1970; VESELY and PETERS, 1972). Thus slaughtering animals at the appropriate degree of maturity is an essential step in producing a carcass of desired composition.

The question of optimum slaughter weight has been examined for some breeds of cattle by JOANDET and CARTWRIGTH (1969). For sheep, HOGUE (personal communication) has suggested that lambs should be slaughtered at a weight equal to 25 to 30 % the sum of the mature weights of the sire and dam. The values for mature weight be used assume rams more highly selected and in relatively better condition than ewes. Another approach is to use mature weight of ewes of the sire breed as an indication of size. With feeding to permit continuous growth, it appears that wether and ewe lambs should be slaughtered at a maximum of two-thirds of mean parental (ewe) weight to avoid overfatness; 60 % of this weight would be preferable. Some examples of the resulting weights obtained are shown in Table 1.

TABLE 1

Mature weight (Kg) of ewes of		Recommended range of slaughter weights (Kg) to avoid overfatness
Sire breed	Dam breed	
90	90	54-60
70	70	42-46
50	50	30-34
90	70	48-53
	50	42-46
70	50	36-40

Slaughtering at lighter weights than the lower value suggested here would be expected to produce even leaner carcasses. However, lighter lambs may lack the finish required for preferred carcass grades, and if slaughter weight is too low in relation to maintenance cost of the parent breeds, costs of production will not be met by sale of lambs.

If shape of the growth curve of one or both parent breeds were changed markedly by selection, the recommended slaughter weights presumably would also change. Marked changes in shape of the curve for individual animals due to differences in feeding plan might also change optimum slaughter weight; it is assumed here that lambs will be fed for continuous growth.

Table 1 implies the feasibility of a frequently recommended practice, i. e., the mating of large breed rams to small breed ewes. However, at a certain point this is expected to lead to difficulties. Successful selection for lighter birth weights in relation to post-natal growth rate might shift the point at which dystocia problems occur, but is unlikely to eliminate all problems associated with genetically large lambs born to small mothers. The range of compatible sizes is probably quite wide, though empirical data are limited. Some general considerations related to birth weight were discussed by BRADFORD (1972).

Among animals fed similarly and which have attained the same percentage of mature weight, there are differences in proportion of fat, distribution of fat, size and shape of muscles and, to a lesser extent, lean to bone ratio, and these are the items which need to be considered in a breeding program aimed at improving carcass quality. However, it cannot be over-emphasized that comparisons between and within breeds relating to the above carcass quality parameters must be made among animals of similar nutritional history and, insofar as possible, similar degrees of maturity.

Which of the above traits are most important?

Amount of fat, as indicated by backfat thickness of weight of kidney fat in carcasses of a standard weight has a high heritability (CARPENTER, 1968; BOTKIN *et al.*, 1969; BRADFORD and SPURLOCK, 1972; BOWMAN and HENDY, 1973), and thus selection for less fat should be effective. A minimum fat cover is desired, for keeping and shipping qualities; SMITH and CARPENTER (1973 *b*) have suggested that a fat depth of 2.5 mm over the center of the *longissimus dorsi* at the 12th rib is adequate. This is less than commonly found on carcasses in at least the United States and Britain. Lowering fat to this level, by breeding and by management (slaughtering at the right weight for the breed or cross) would significantly improve value of carcasses from the standpoint of providing protein for human food.

Distribution of fat is also important. Estimates of the heritability of fat distribution within breeds do not appear to have been reported, but breeds differ markedly in relative amounts of total fat present as internal (kidney) and muscle-associated fat (DONALD *et al.*, 1970; MCCLELLAND and RUSSELL, 1972), with the meat breeds generally superior, i. e., with more muscle-associated and less internal fat. Such breed differences suggest a large genetic component.

Another aspect of fat distribtuion is the relative amount deposited inter-and intramuscularly. Little is known as yet about genetic variation within breeds in this trait. If marbling is an important determinant of grade, a high ratio of intra- to intermuscular fat is desirable. On the other hand, a lower intramuscular fat content would lead to lowered animal fat intake in human diets for a given level of meat consumption, an objective considered desirable by some health scientists though still much debated. At present there is insufficient knowledge about selection objectives or about genetic variation to justify a recommendation on breeding procedures to change intramuscular fat content.

Although conformation, which affects shape of muscles, may have little effect on prices paid for carcasses in most markets, long term demand for lamb may be benefitted by having larger rib eye area, leading to more attractive chops. *L. dorsi* area is also a useful indicator of total carcass cutability, particularly of heavier carcasses (SMITH and CARPENTER, 1973 *a*). Heritability of *L. dorsi* area is usually found to be high (CARPENTER, 1968; BOWMAN *et al.*, 1968; BRADFORD and SPURLOCK, 1972), and selection should be effective.

Bone is the third major constituent of the carcass. Since it is much less variable than amount of fat and is more difficult to measure, and breed differences are not large, it appears that selection to modify amount of bone is probably not justified at this time.

We conclude then that it would be desirable to reduce total amount of fat, thereby increasing the relative amount of lean, improve fat distribution such that

that major depot is an even subcutaneous layer, and (possibly) increase cross sectional area of some of the major muscles, in particular the *L. dorsi*.

Meat quality

Factors affecting meat quality would include tenderness, flavour, and, possibly, relative numbers of the different muscle fibre types.

Knowledge of the relative importance and heritability of these parameters in sheep is very limited. With proper pre- and post-slaughter treatment of young lambs, tenderness and flavour are usually good, although improvements might be possible. Little is known about muscle fibre types and the consequences of changing them in sheep, but a relatively high proportion of α-white fiber types is known to be involved in low muscle quality and related problems (p. s. e. and p. s. s.) in swine.

Biopsy techniques have been shown to provide reasonably accurate indications of intramuscular fat in the *L. dorsi* (Spurlock *et al.*, 1962), and of quality characteristics of depot fat (Cramer and Marchello, 1964). The relative numbers of different muscle fibre types could also be measured from a biopsy sample (Ashmore, personal communication). Stickland and Goldspink (1973) have shown in experiments with swine that a small muscle (*M. flexor digiti V brevis*) which can be removed entirely by biopsy can be used as an indicator of muscle fibre numbers in the whole animal. This might also be used in sheep as an indicator muscle for fibre number and possibly fibre types.

Although these techniques offer possibilities for improvement of meat quality (and quantity) in sheep, it seems probable, based on economic considerations, that breeding for the finer points in quality will be deferred until such items as growth rate and muscling have been improved substantially above present levels.

Progeny testing for carcass and meat quality

Improvement of most of these traits at present depends on use of the progeny test. Live animal indicators of some predictive value for certain items have been developed, e. g., the seventh rib probe as an indicator of fat thickness (Spurlock *et al.*, 1966) but their accuracy is low (Baker *et al.*, 1971), and no live measure which simultaneously predicts all of the important carcass and meat quality traits is available.

Because of the cost of the progeny test, its use is likely to be limited. However, progeny testing in a small number of flocks at the top of the breeding pyramid would result in improvement in the entire sheep population.

Consider a sheep population of one million ewes. At a 20 % annual replacement rate, 40 to 50 % of the total population will need to be devoted to breeding of replacement ewes. This will leave 500,000 to 600,000 ewes to be mated to meat breed rams to produce crossbred market lambs. Assuming each ram mates with 150 ewes in his lifetime (the number could be much larger but is often smaller), 3300-4000 meat breed rams will be needed annually. The 8000-10,000 meat breed ewes required to produce these will be mated to 250-300 rams. If all rams in breeder flocks were replaced annually, and only progeny tested rams were used in such flocks, this would require progeny testing 750-1000 rams annually. A further stratification within the meat breeds such that the best progeny tested rams were used in the top flocks and their sons in multiplier flocks, could reduce the number of rams to be progeny tested to about 100 without impairing effectiveness of the program in the long run. For example, if the 8000-1000 ewes referred to were kept in 25 flocks of 300-400 ewes each, a good progeny testing program in 5 of the best flocks could supply sons of superior progeny tested sires, or the sires themselves after one year use, to the remaining purebred flocks. In this way improvements in dressing percent, proportion of lean in the carcass, rib eye area, distribution of fat and possibly muscle quality factors could be infused into all strata of the population. The cost of such a scheme should be amply returned in improved value of the 600,000-750,000 crossbred lambs marketed annually.

The existence of large (300 + ewes) breeding flocks offers other advantages, including a higher probability of an adequate recording scheme within the flock, more intense selection, and the possibility of developing a closed population with well defined performance parameters, without excess inbreeding.

If progeny testing is used, rams should be tested as lambs, permitting selection on the basis of the progeny test at yearling age and thus minimising generation time for this selection scheme. An equally important point is that the very best rams should be used in the top stratum, since rate of improvement in the latter determines rate of improvement in the total population.

Ram lambs from the best progeny tested sires should be selected for the next cycle of testing on the basis of their own growth rate, and any live animal measures shown to be useful predictors of carcass or meat quality. In deciding numbers of progeny to aim for for each sire, the limitations on total resources usually prevailing argues for testing large numbers of rams with fewer progeny each. A reasonable compromise, between accuracy of the progeny test and potential selection intensity among tested rams, is 10-12 lambs per sire. Although relevant data are scarce, it appears that genotype-environment or genotype-genotype interactions are not important for carcass traits, suggesting that testing rams in one location on one breed of ewe is adequate for such traits.

Use of artificial insemination (A. I.) in commercial flocks would permit much more widespread use of the best progeny tested rams, and would mean that many slaughter lambs would be offspring of such rams, rather than one or two generations removed. With adoption of A. I., progeny testing becomes both more practical, in that the costs can be more easily recovered, and more essential, in that only proven superior males should leave as many progeny as this technique permits. However, the technique has not been applied widely to sheep except in areas of relatively low labor costs.

SUMMARY

Meat breeds kept primarily to produce sires of crossbred slaughter lambs should be selected for rapid growth rate, decreased total fat content in the carcass while maintaining or improving dressing percent, a shift in fat distribution from internal and localised to an even subcutaneous distribution, and an increase in muscling.

Growth rate should be measured on individual animals at five to six months of age, following weaning at 60 days or less, to minimize maternal influence and maximise selection for the individual's inherent growth rate. Evaluation of sire breeds should include net reproductive rate of the commercial ewe flock, and size of sire breeds should not be increased to the point where reproduction of mates is impaired.

Progeny testing to permit selection for dressing percent, optimum amount and distribution of fat, rib eye area, and possibly muscle quality should be practiced in the top stratum of sire breed flocks. The numbers of sheep in progeny testing flocks need not exceed 20 % of the total meat breed population, or 0.2 % of the total population.

Live animal evaluation tools which would permit selection for some or all of these carcass traits without slaughter of progeny should be used as they become available, but at present none is of sufficient accuracy to eliminate need for the progeny test.

Rams should be progeny tested as lambs, selected and used in purebred flocks at one year of age, and replaced annually from the best of the next crop of progeny tested rams. Development of large (300 or more ewes) flocks, at least in the top stratum, will facilitate recording and selection.

Carcass quality of market lambs will be improved if the lambs are slaughtered at the appropriate degree of maturity, suggested as not more than 60-65 % of mature weight. Improved recommendations on optimum slaughter weight can be made if reports of results of research and testing programs with sheep routinely include mature weights of breeding animals.

RESUME

Les races à viande sont exploitées fondamentalement pour produire les pères d'agneaux de croisement. Elles devraient être sélectionnées pour un taux de croissance rapide, une augmentation dans la proportion du muscle, et une diminution du contenu total de graisse de la carcasse, tout en conservant ou en améliorant le rendement à l'abattage.

Le taux de croissance devrait être mesuré chez les animaux à l'age de 5 ou 6 mois, et sevrés après 60 jours ou moins, afin de minimiser l'influence maternelle et d'augmenter au maximum le taux inhérant de croissance de l'animal. L'évaluation des races paternelles devrait inclure la capacité nette de reproduction du troupeau des mères.

Le testage de la descendance pour permettre la sélection pour le rendement à l'abattage, la quantité optimale et la distribution de graisse, la section musculaire et, si possible, la qualité du muscle, devrait être verifiées dans les meilleurs troupeaux paternels. Le nombre d'animaux dans les lots de testage de la descendance n'a pas besoin de surpasser le 20 pour 100 de la population totale productrice de viande, ou le 0,2 pour 100 de la population totale.

Les systèmes d'évaluation de l'animal sur pied qui permettent la selection pour quelques unes ou toutes les caractéristiques de la carcasse sans l'abbatage de la portée devraient être utilises dès qu'ils deviennent disponibles. Jusqu'à présent, aucun de ces moyens n'offre la précision suffisante pour justifier l'élimination du testage de la descendance.

Les béliers devraient être testés en tant qu'agneaux, sélectionnés et utilisés en lots pur à l'age d'un an, et remplacés pas les meilleurs béliers testés dans la prochaine saison. L'usage de grands lots (300 brebis ou plus facilitera l'enregistrement et la selection.

La qualité de la carcase des agneaux de marché devrait s'améliorer si les animaux sont abattus à un degré de maturité approprié; on suggére qu'il ne soit pas plus élevé que 60-65 pour 100 du poids à l'état adulte. On pourra introduire des recommandations sur le poids optimal à l'abattage si les résultats de l'investigation et des programmes ovin de testage incluent les poids à l'âge adulte des animaux reproducteurs.

RESUMEN

Las razas de carne, mantenidas esencialmente para producir los padres de los corderos híbridos para el mercado, debieran seleccionarse para rápida tasa de crecimiento, escaso contenido total de grasa en la canal, manteniendo o mejorando el porcentaje de rendimiento a la canal, cambiando la distribución de grasa, de interna o localizada, a uniformemente subcutánea, y aumentando la proporción de músculo.

La tasa de crecimiento debería medirse individualmente entre cinco y seis meses de edad, después del destete efectuado a sesenta días o menos, para minimizar la influencia materna y maximizar la selección para tasa de crecimiento particular de cada individuo. En la evaluación de razas paternas debería considerarse la tasa reproductiva neta del rebaño comercial de hembras y el tamaño de las razas paternas no debería aumentarse a tal punto que sea un impedimento para la reproducción.

Pruebas de progenie que permitan seleccionar para porcentaje de rendimiento a la canal, óptima cantidad y distribución de grasa, área del *L. dorsi* y posiblemente calidad muscular, debieran practicarse en los rebaños de padres más altamente seleccionados. El número de ovinos en los rebaños destinados a pruebas de progenie no necesita exceder del 20 % del total de la población productora de carne, ó 0,2 % de la población total.

Las técnicas de evaluación del animal en vivo que permitan seleccionar para todos o para algunos caracteres de la canal, sin el sacrificio de la progenie, debieran ser usadas cuando tales técnicas sean logradas; por el momento, ninguna de ellas es lo suficientemente segura para eliminar la necesidad de la prueba de progenie. Los carneros debieran ser sometidos a prueba de progenie a edad temprana, y aquellos seleccionados deberían usarse al año de edad en rebaños puros; los reemplazos anuales deberían hacerse en base a los mejores carneros provenientes de la siguiente producción de carneros probados. El desarrollo de grandes rebaños (300 ó más ovejas), por lo menos en el nivel superior, facilita los registros y la selección.

La calidad de la canal de los corderos para mercado puede ser mejorada si los corderos son sacrificados con el apropiado grado de madurez, sugiriéndose que no sea más allá del 60-65 % de su peso a edad adulta. Mejores recomendaciones sobre peso óptimo de sacrificio pueden hacerse si la información proveniente de la investigación y de los programas de pruebas de progenie incluyen en forma rutinaria los pesos a edad adulta de los reproductores.

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