INTRODUCTION

The structure of beef production varies very much from one country to another. In some countries the calves reared for beef are mainly purebred dairy or dual-purpose calves. Other countries have adopted large-scale crossbreeding with beef bulls in dairy herds as the basis of beef production. In countries with suckler calves as the main source of calf supply some kind of a hybrid program is mainly adopted.

In some countries all bull calves intended for beef are castrated. In others, the majority of the male calves are reared as uncastrated bulls because of the reduction in growth and feed conversion ability which castration per se introduces (Brännäng, 1966, and others).

The feeding regimes vary from extensive grazing to intensive barley-beef programs. Slaughter weights, degree of finish, grading systems and consumer preferences also vary within very wide limits from one country to another.

This very diversified picture makes it difficult to elaborate general selection schemes which are relevant to more than the specific situation for which they are designed. The present paper is intended to illustrate some general features in beef cattle breeding, which are unaffected by the diversities described above.

THE EFFECT OF BREED AND CROSSING POLICY

Although some characters are recorded and selected for on the female side, selection for beef is to a large extent equivalent to the assessment of the breeding value and subsequent selection among bulls. Three cases can be defined in view of the origin of the calves.
Case 1. Selection for beef within a dual-purpose breed parallel to selection for milk traits.

Case 2. Selection of terminal sires used either for crossing in dairy herds or as mates to crossbred females in a hybrid program.

Case 3. Selection of sires used for production of maternal lines in a hybrid program.

The aim of the breeding programme is of necessity different for the three cases, and is described more detailed below.

**Traits, genetic parameters and economic weights**

The present list of traits is limited to those which are of general interest. For this reason carcass merit and meat quality has been omitted. It is not possible to define any standard for these characters which can be regarded as relevant for more than one or a few countries.

**Growth rate.** In the literature growth rate is generally subdivided into pre- and post-weaning growth rate. This subdivision is mainly a reflection of how the character is recorded with more external disturbances pre- than post-weaning. Although the growth in early stages can to some extent be affected by genes different from those affecting the growth rate during the finish period, it is practical to regard growth rate from birth to finish as one trait. The heritability varies, according to the way it is recorded. In the very comprehensive book by PRESTON and WILLIS (1970) the heritabilities below are given and mainly relate to beef breeds:

<table>
<thead>
<tr>
<th>Trait</th>
<th>$h^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-weaning growth rate</td>
<td>≈0.3</td>
</tr>
<tr>
<td>Post-weaning growth rate</td>
<td>≈0.5</td>
</tr>
<tr>
<td>Final weight</td>
<td>≈0.65</td>
</tr>
</tbody>
</table>

In dairy breeds growth rate is mainly recorded from birth (or slightly after) to one year of age or slaughter age. The Danish figures (DISSING ANDERSEN et al., 1971) which are based on a larger number of observations and Finnish (LINDSTRÖM, 1972) indicate $h^2 \approx 0.6$ when growth is recorded in a controlled environment. When growth is recorded in the field under practical conditions lower heritabilities are recorded. LILJEDAL and LINDBE (1964) arrived at $h^2 = 0.29$ in a field progeny test scheme.

The phenotypic coefficient of variation varies according to the feeding regime. The more controlled the environment, the smaller is the variation. LINDBE (1968) estimated the genetic standard deviation for growth rate to be $≈ 5\%$ of the mean. An increased growth rate of the order of one per cent can be valued at 7 Sw.Cr. per beast produced (*). (HÖKAS personal communication). Of these 7 Cr., 4 are attributed to reduced costs for buildings and 3 for reduced labor costs. In most countries the benefit of increased growth rate is probably markedly less than in

(*) 1 US dollar = 4.35 Sw. Cr.
Sweden. It should be born in mind that the correlated reduction in feed per unit of gain is not included.

**Feed conversion efficiency.** As feed is one of the major costs in beef production (in Sweden 50 per cent of the total costs), feed conversion efficiency is a very important trait. In controlled environments covering the growth period from birth to slaughter, heritabilities close to $h^2 = 0.6$ have been recorded in a number of investigations (Dissing Andersen et al., 1971; Gravert, 1970). The phenotypic coefficient of variation can be estimated at about 6.5 per cent (Lindhe, 1968; Bech Andersen, 1972) and the genetic standard deviation at about 5 per cent. When feed conversion efficiency is recorded in a post-weaning growth test, heritability values are lower than those given above. Preston and Willis (1970) have given the values between 0.36 — 0.44 which is based on figures from the United States.

The economic value of a reduction of Mcal/Kg live weight gain by one per cent can be valued at 13 Sw.Cr. (Hökás personal communication).

Theoretically, feed conversion efficiency can be improved very considerably. Lindhe and Henningsson (1968) found that about one third of deposited energy in an animal was deposited as fatty tissue in the body cavities. This was true for steers and bulls of Swedish dairy breeds, slaughtered when the amount of fatty tissue in the carcass amounted to 15 per cent. It was also found that crosses with beef bulls had a lower share of total deposited energy situated in the body cavities. These crosses had also converted feed more efficiently. These results have been verified in later investigations (Henningsson, 1969).

As all fat deposited in the thoracic and abdominal cavity can be regarded as waste fat, the commercial value of which is much lower than the costs for its production, one goal for the future may be to select animals with a minimum of fatty tissue in the body cavities. As yet unanswered questions are the genetic relations between different fat depots and the relations with other production characters, such as milk yield.

There is general agreement that feed consumed per unit of weight gain is negatively related to gain. Bech Andersen et al. (1971) concluded that growth rate and feed conversion efficiency are so closely related that almost the whole variation in feed conversion is covered if the growth rate is recorded. Preston and Willis (1970), however, claim that the relationship between gain and feed conversion is not so high as to obviate the need to select for this latter trait.

Apparently, higher relations between gain and feed efficiency are found when the test period covers the whole rearing period from birth to slaughter than in post-weaning test periods. In the very comprehensive Danish experiments, which cover the whole growth period, the genetic correlation between gain and feed units per Kg live weight gain is of the order $r_e = -0.9$. (Dissing Andersen et al., 1971). In Germany, Trappmann (1972) has given the figure $r_e = -0.86$, while Dieter (1969) and Langholz and Jongeling (1972) have found somewhat lower values. The values given by Preston and Willis (1970) are of a lower order ($-0.32$ to $-0.79$).

If feed conversion per se should be recorded when the breeding value for growth rate is assessed cannot be generally answered. The cost of the operation and the test procedure are factors which have to be considered when making decisions.
Carcass weight at desired level of fatness. Prices of calves suited for beef production have risen sharply in Europe during recent years. In certain countries, bull calves cost more than 1,000 Sw. Cr. per piece. This stresses the importance of late maturing animals in order to reduce the calf cost per Kg meat produced.

According to Dissing Andersen et al. (1971), the genetic correlation between growth rate and per cent fat in carcass amounts to -0.76 when bulls are slaughtered at a constant weight. The correlation between growth rate and per cent lean in carcass amounts to +0.74. The phenotypic standard deviation for per cent lean at a constant slaughter weight amounts to less than 2 per cent. The heritability for the character was higher for the RDM breed ($h^2 = 0.68$) than for the SDM breed ($h^2 = 0.18$).

Apparently selection for increased growth rate appears to delay the deposition of fat in the carcass, which means that selection for growth rate is accompanied by higher carcass weights if a certain level of fatness is particularly desired. If per cent lean should also be selected for directly, is dependent on many factors such as the price of the calves, the preference of the consumers, the actual level of per cent lean in the breed under consideration etc.

Calving performance. A fourth character which is of specific importance in the selection of bulls for beef is calving performance, expressed as number of surviving calves per completed pregnancy. The report by van Dieten (1963) focused attention on the economic importance of perinatal mortality. Gilmore and Fechheimer (1969) concluded that although deaths may occur at any time during gestation or calfhood, there appears to be two peaks of susceptibility. The first peak is during the first trimester of embryonic life; the second peak is about the time of parturition.

In table 1 the calf losses around parturition subdivided into different causes are given for four Swedish dairy breeds.

It is obvious that stillbirth and postnatal mortality constitute the majority of all calf losses, even in breeds with relatively low figures for stillbirth.

In reports on the performance of the Charolais breed (Aurio1 et al., 1959) and Charolais crosses (Milk Marketing Board, 1966; Lindhe, 1968) it has been shown that perinatal mortality is higher among Charolais-sired calves than among for instance purebred Ayrshires or Swedish Red and Whites. Later investigations (Sagebiel et al., 1969; Philipsson, 1970 and Laster, 1972) have confirmed that calves sired by Charolais and other breeds which are interesting as a sire breed for crossing such as Simmental, Limousin and South Devon have a perinatal mortality which calls for consideration. Table 2 gives figures on perinatal mortality of different Swedish beef breeds and crosses.

As all investigations have shown, it is mainly in connection with primiparous calvings that the breed differences arise, since the breed differences of later calvings are almost negligible. The figures of perinatal mortality with heifers as dams are well above 10 per cent for both purebred Charolais and Charolais crosses in Sweden.

The process of parturition per se involves danger for the life of the foetus [cf. Bane (1964)]. A stillbirth is often the effect of a disproportion between the dimensions of the foetus and the maternal pelvis. Calculated heritabilities are
<table>
<thead>
<tr>
<th>Breed</th>
<th>No. of recorded pregnancies</th>
<th>Observed abortions %</th>
<th>Stillbirth or dead within 24 h. of birth %</th>
<th>Calves dead within two weeks %</th>
<th>Congenital abnormalities %</th>
<th>Total losses %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sw. Red &amp; White</td>
<td>664,159</td>
<td>0.98</td>
<td>2.60</td>
<td>0.57</td>
<td>0.07</td>
<td>4.22</td>
</tr>
<tr>
<td>Sw. Friesian</td>
<td>232,365</td>
<td>1.38</td>
<td>3.40</td>
<td>0.46</td>
<td>0.08</td>
<td>5.32</td>
</tr>
<tr>
<td>Sw. Polled</td>
<td>20,371</td>
<td>0.79</td>
<td>4.31</td>
<td>0.40</td>
<td>0.07</td>
<td>5.57</td>
</tr>
<tr>
<td>Sw. Jersey</td>
<td>11,129</td>
<td>1.62</td>
<td>2.46</td>
<td>1.05</td>
<td>0.11</td>
<td>5.24</td>
</tr>
<tr>
<td>Weighted mean</td>
<td>928,024</td>
<td>1.08</td>
<td>2.84</td>
<td>0.55</td>
<td>0.07</td>
<td>4.54</td>
</tr>
<tr>
<td>Per cent of all losses</td>
<td></td>
<td>23.8</td>
<td>62.6</td>
<td>12.1</td>
<td>1.5</td>
<td>100</td>
</tr>
</tbody>
</table>
TABLE 2

PERINATAL MORTALITY OF DIFFERENT BEEF BREEDS AND CROSSES IN SWEDEN

<table>
<thead>
<tr>
<th>Breed or cross</th>
<th>No. of observations</th>
<th>Source of information</th>
<th>Per cent still-born calves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charolais</td>
<td>980</td>
<td>Beef recording</td>
<td>8.80</td>
</tr>
<tr>
<td>Hereford</td>
<td>2,126</td>
<td>Beef recording</td>
<td>6.40</td>
</tr>
<tr>
<td>Aberdeen Angus</td>
<td>219</td>
<td>Beef recording</td>
<td>5.60</td>
</tr>
<tr>
<td>Charolais x dairy</td>
<td>680</td>
<td>Special investigations</td>
<td>5.27</td>
</tr>
</tbody>
</table>

often subdivided into heritability of stillbirths as a property of the calf \( (h_1^2) \) and as a property of the dam \( (h_2^2) \). In table 3 calculated heritabilities according to different authors are summarized.

It is obvious from the figures given that the heritability of stillbirths is of the order of 2-3 per cent both for the calf and the dam trait.

The deciding factor as to whether selection is worth-while or not is not \( h^2 \) per se but \( r_G \) which is the correlation between the genotype of the individual and the observed phenotype(s). If the genotype of a bull is estimated by means of progeny-testing, \( r_G \) is equal to

\[
r_{G} = \frac{0.25 \cdot h^2 n}{1 + (n-1) 0.25 h^2}
\]

(Robertson and Rendel, 1950).

If a large number of progenies are observed, characters with a low heritability can be selected successfully. Lindhe (1967) found that selection for reduced stillbirth among bulls with at least 400 progenies could be compared with selection for a trait observed on the bull itself with a heritability of \( h^2 = 0.43 \) provided that the generation interval is equal in the two cases.

Recently the author calculated the coefficient of correlation between the first and the second 500 calvings of heifers and the first and the second 1,000 calvings on cows (2nd and later calvings) with bulls as fathers and maternal grandfathers of calves (previously unpublished data). The results are given in table 4.

As is illustrated in table 4 the correlation between two groups of 500 observations is fairly high for characters where the heritability for the probability of the character to appear, is as low as 2 per cent or lower. It is reasonable to assume higher correlations and heritabilities for breeds with a high incidence of stillbirths.

The economic value of 1 per cent reduced calf mortality is equal to 1 per cent of the value of a new born calf plus the cost of reduced calving difficulties which accompanies a reduced incidence of stillbirth. The influence on the fertility and milk yield of the dam should also be included. Philipsson (personal communication) estimated the economic value of 1 per cent reduced stillbirth at 7 Sw. Cr. if the price of the calf amounted to 400 Sw. Cr. As higher calf prices can be expected in the future, a gain of 8-10 Sw. Cr. per each per cent unit should be expected.
<table>
<thead>
<tr>
<th></th>
<th>Stillbirths</th>
<th>Difficult calvings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Heifers as dams</td>
<td>Cow as dams</td>
</tr>
<tr>
<td></td>
<td>$h^2_c$</td>
<td>$h^2_d$</td>
</tr>
<tr>
<td><strong>Bar-Anan, 1972.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct est.</td>
<td>3.41</td>
<td>1.31</td>
</tr>
<tr>
<td>Indirect est.</td>
<td>4.06</td>
<td>2.17</td>
</tr>
<tr>
<td><strong>Belic &amp; Menissier, 1968</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cloppenburg, 1966</td>
<td>2.8</td>
<td>0.6</td>
</tr>
<tr>
<td>Brinks et al, 1973</td>
<td>6.9</td>
<td>13.4</td>
</tr>
<tr>
<td><strong>Gaillard, 1969.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simmental</td>
<td>2.8</td>
<td>0.6</td>
</tr>
<tr>
<td>Braunvich</td>
<td>2.7</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Philipsson, 1970</strong></td>
<td>1.3</td>
<td>2.7</td>
</tr>
<tr>
<td>Auran, 1972</td>
<td>1.6</td>
<td>0.5</td>
</tr>
</tbody>
</table>
TABLE 4

COEFFICIENTS OF CORRELATION BETWEEN THE FIRST AND SECOND 500 CALVINGS (HEIFERS AS DAMS) AND THE FIRST AND SECOND 1,000 CALVINGS (2ND AND LATER CALVINGS) OF BULL AS FATHERS AND GRANDFATHERS OF THE CALVES BORN

<table>
<thead>
<tr>
<th>Breed</th>
<th>Bull as fathers</th>
<th>Bull as grandf.</th>
<th>Bull as fathers</th>
<th>Bull as grandf.</th>
<th>Estimated heritabilities %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r between first and second 500 calvings (heifers as dams)</td>
<td>r between first and second 1,000 calvings (cows as dams)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No. of bulls</td>
<td>r</td>
<td>No. of bulls</td>
<td>r</td>
<td>No. of bulls</td>
</tr>
<tr>
<td>SRB¹</td>
<td>22</td>
<td>0.50</td>
<td>25</td>
<td>0.68</td>
<td>51</td>
</tr>
<tr>
<td>SLB²</td>
<td>11</td>
<td>0.80</td>
<td>7</td>
<td>0.78</td>
<td>20</td>
</tr>
</tbody>
</table>

¹ = Swedish Red and White cattle.
² = Swedish Friesian.
In short, the traits selected here are selected as being of specific interest for sires selected in the three cases mentioned above. Carcass traits are omitted because of the very great differences in economic value of these traits between countries. Traits of general interest in cattle breeding as reproductive performance, milk yield, etc, have also been omitted.

METHODS FOR ASSESSING THE BREEDING VALUE OF THE BULL

Case 1

Selection for growth rate and feed conversion efficiency in breeds chiefly kept for milk production, is practised mainly in Scandinavia. Bull calves are performance tested and selected for growth rate prior to progeny testing for dairy traits in order to reduce the costs for the total selection operation, applied among future AI bulls. Lindhè (1968) and Petersen et al. (1972) have calculated optimum selection intensity after performance testing in selection of bulls in an AI-breeding scheme according to the general lines for such a scheme drawn up by Skjervold (1965). Haring (1972) found that selection of young bulls subsequent to performance testing was not economically justified under German conditions. The practice of testing and selection in different Scandinavian countries has been described by Lindhè and Christensen (1968), Persson and Christensen (1969), Lindström and Maijala (1970), Bech Andersen (1972) and Fimland (1972). The genetic gain for growth rate possible to achieve within reasonable economic frames is of the order of 0.2-0.3 per cent per year.

Progeny testing for stillbirths (performance of progeny and daughters) regularly takes place parallel to the progeny test for milk.

If carcass traits are to be considered, two alternatives are possible. One is to assess the carcass merits of the bull itself, when the appropriate number of doses have been deepfrozen. In Sweden, where 30,000 doses are collected and stored, the bulls are about 36 months of age at slaughter. The other alternative is to progeny test the bulls for carcass merit parallel to other types of progeny testing.

It should be born in mind, however, that there is very little room for selection for carcass merit in a breed, kept mainly for dairy production. The accumulated cost of each bull at 36 months of age is about 40,000 Sw. Cr. if the costs for culled mates after the performance test and for the deep-frozen semen are included. When the performance of the daughters is available the selection for dairy traits takes place. These traits include yield, reproductive performance, possibly milk composition and/or resistance against mastitis and other diseases. With regard to economic considerations, the room for selection for carcass merit in dual purpose breeds is very limited if existent at all. Before measures are taken to record carcass merit, a cost-benefit analysis is worth-while.

Case 2

In a way selection of terminal sires is simpler, since all characters connected with female reproductive performance can be omitted. Generally performance
recording of the merits of the bulls should be adopted for all characters which can be recorded in live animals, in order to eliminate, or at least limit the number of (= the costs of) progeny tested bulls. The Swedish method of selection of beef bulls for cross-breeding purposes in dairy herds is one model by means of which genetic change can be achieved at limited costs.

In the purebred beef populations in Sweden about 1,000 Hereford and about 500 Charolais bull calves are born annually. Ten per cent of these bull calves are selected on the farms for subsequent performance testing at two stations during the age interval 150-365 days of age. This first stage of selection which so far has been up to the breeder, can be more efficient in the future by means of a preliminary index based on early weaning performance of the calf, on the merits of the dam and the sibs and on the merits of the sire.

A second selection, again in the order of ten per cent selected, takes place after conclusion of the performance test which is based on the test performance of the bulls, Lindh (1971). Those selected are tested for semen quality after which the appropriate number of doses are deep-frozen. The owner receives the bull back to his herd within a year of the end of the performance test.

The first 1,000 doses are used directly to test of calving difficulties. Following this only the semen of bulls whose progeny can be delivered without difficulties is used. The sires ultimately selected are also used in purebred beef herds in order to produce sons for the next generation. In the last year the selected bulls had an average growth rate 17% above that of the other bulls tested. If the selection within herds is disregarded an approximate estimation can be made of achievable genetic gain for growth rate.

\[
\begin{align*}
\text{Path of gene transmission} & \quad \text{Sel. differential in } \sigma \text{-units } \cdot i \quad \sigma_i = \sqrt{h^2} \quad \sigma_x \quad i \cdot h \cdot \sigma_x \quad L \\
\text{Sire-son} & \quad \ldots \quad \ldots \quad 3.4 \quad 0.77 \quad 5 \quad 13.09 \quad 4 \\
\text{Sire-daughter} & \quad \ldots \quad \ldots \quad 1 \quad 0.77 \quad 5 \quad 3.85 \quad 7 \\
\text{Dam-son} & \quad \ldots \quad \ldots \quad 8 \quad 0.77 \quad 5 \quad 3.85 \quad 8 \\
\text{Dam-daughter} & \quad \ldots \quad \ldots \\
\end{align*}
\]

\[
\Delta G = \frac{16.94}{27} = 0.63
\]

A genetic gain of 0.6 per cent per year is thus within easy reach in a moderate-sized beef population such as that of Sweden.

Over the years the average final weights have increased as a consequence of more deliberate selection by the breeders of bulls for testing. Environmental trends are difficult to avoid, although the feeding regime has been the same the whole time. However, the bulls selected in 1973 were 118 Kg heavier at 400 days of age than average bulls 5 years earlier. The selection differential during the last year is 74 Kg and the change in average weights that has taken place during the 5 year period 44 Kg.
The test for difficult calvings recently produced the first results. The results of the best and the worse bull in each breed are given in table 5.

### TABLE 5
THE RESULTS OF TESTING FOR DIFFICULT CALVINGS OF SELECTED BEEF BULLS CROSSED WITH DAIRY COWS

<table>
<thead>
<tr>
<th>Breed</th>
<th>Best bull</th>
<th>Worse bull</th>
<th>No. of recorded deliveries</th>
<th>Growth index</th>
<th>Per cent difficult calvings</th>
<th>% stillbirths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charolais</td>
<td>109</td>
<td>168</td>
<td>105</td>
<td>104</td>
<td>9.0</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25.6</td>
<td>11.0</td>
</tr>
<tr>
<td>Hereford</td>
<td>173</td>
<td>180</td>
<td>105</td>
<td>102</td>
<td>4.3</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10.6</td>
<td>5.4</td>
</tr>
</tbody>
</table>

The figures in table 5 illustrate that selection for easy calvings are compatible with selection for increased growth rate.

Carcass merit can be included at reasonable costs in the selection program for terminal sires. The cheapest method should be indirect measurements of live bulls. Research into suitable methods for this is urgent.

Progeny testing for carcass merit on a limited scale of bulls selected for growth rate and calving difficulties is within reasonable economic reach. Disadvantages are the cost of the operation and the prolongation of the generation interval along the paths sire-son and sire-dam. The genetic gain for growth rate will be negatively affected to some degree.

In short, the annual genetic gain for growth rate and feed conversion efficiency in a terminal sire breed can be more than twice as efficient as that achievable in a dual-purpose breed, even if the beef breed is assumed to be small (2,400 females) and the dual purpose breed is assumed to be large (400,000 females). In addition, carcass merit can be considered to a measurable extent in the beef breed. The possibility of this in a dual-purpose breed is almost negligible.

**CASE 3**

Only some general considerations can be presented here. CUNNINGHAM (1973) has found that some dairy crosses are suitable as dams in a hybrid suckler cow program. The program may have a design as follows:
The selection in the terminal sire line is described above. The traits in a selection index for line B should include female reproductive performance, which prolongs the generation interval. Milk yield is not necessarily important because of the combination with a dairy breed. Generally a low mature weight is aimed at in order to reduce the maintenance of the crossbred female. This desire is counter-balanced by the negative correlation between mature size and growth rate which may effect the growth rate of the end product in an adverse way. One of the aims of future research in beef breeding should be to devise the most economical combinations in a commercial hybrid suckler cow program.

SUMMARY

Four traits of particular importance in a beef breeding program have been dealt with viz:
1. Growth rate
2. Feed conversion efficiency
3. Carcass weight at desired level of fatness
4. Calving performance

Available genetic parameters and economic values are given. Carcass traits have been omitted because of the very great differences in the economic value of these traits between countries.

Models of selection have been outlined for three cases.
Case 1. Selection for beef in a dual-purpose breed parallel to selection for milk yield.
Case 2. Selection of terminal sires either for crossing in dairy herds or to mate crossbred females in a hybrid program.
Case 3. Selection of sires used for reproduction of maternal lines in a hybrid program.

In case 1 the genetic gain for growth rate can amount to 0.2-0.3 per cent a year. Selection for carcass merit is almost impossible within reasonable costs in a dual-purpose selection program.

In case 2 the genetic gain for growth rate of the order of 0.6 per cent a year is within easy reach even in a small beef population (2,000 females). If it is economically justified, carcass merit can be included in case 2 at reasonable costs.

So far, only general statements can be made regarding the selection in case 3.

RESUME

On a traité de quatre aspects ayant une importance particulière dans un programe d'élevage de bétail bovin:
1. Rythme de croissance.
2. Indice de conversion.
3. Poids de la carcasse au niveau souhaité d'engraissement.
4. Numéro d'accouchements (conduite rapportée à l'accouchement?)

On y mentionne les paramètres génétiques et les valeurs économiques dispo-
nibles. Les traits rapportés à la carcasse ont été omis à cause de différences considérables entre les valeurs économiques de ceux-ci dans les divers pays.

On signale trois modèles de sélection pour trois cas:

1er cas. Sélection de viande dans une race à double utilité, parallèle à une sélection pour la production de lait.

2ème cas. Sélection d’étalons terminaux pour les croiser avec le bétail laitier, ou pour procréer femelles hybrides dans un programme hybride.

3ème cas. Sélection d’étalons utilisés pour la reproduction de lignées maternelles dans un programme hybride.

Dans le premier cas, le profit génétique du rythme de croissance peut arriver à 0,2-0,3% pendant une année. Dans un programme à double utilité, la sélection pour améliorer la carcasse est presque impossible à coût raisonnable.

Dans le deuxième cas, on peut arriver facilement à un profit génétique dans le rythme de croissance de l’ordre de 0,6% annuel, inclus dans des populations réduites (2000 femelles). Dans ce cas, et s’il y existe une justification économique, on y pourrait inclure l’amélioration de la carcasse à prix raisonnable.

Jusqu’à ce moment-ci, et en rapport avec le troisième cas, on n’a pas pu faire que quelques affirmations générales.

RESUMEN

Se han tratado cuatro aspectos de particular importancia en un programa de crianza de vacuno, a saber:

1. Ritmo de crecimiento.
2. Índice de conversión.
3. Peso de la canal al nivel deseado de engorde.
4. Número de partos (¿comportamiento con relación al parto?).

Se hace mención de los parámetros genéticos y valores económicos disponibles. Los rasgos referentes a la canal han sido omitidos debido a las considerables diferencias entre los valores económicos de los mismos en los diversos países.

Se señalan tres modelos de selección para tres casos:

Caso 1. Selección de carne en una raza de doble utilidad, paralela a una selección para la producción de leche.

Caso 2. Selección de sementales terminales para cruzarlos con ganado lechero o para procrear hembras híbridas en un programa híbrido.

Caso 3. Selección de sementales utilizados para la reproducción de líneas maternas en un programa híbrido.

En el caso 1, la ganancia genética en el ritmo de crecimiento puede llegar a 0,2-0,3% al año. En un programa de selección de doble utilidad la selección para mejora de la canal es casi imposible a un coste razonable.
En el caso 2 se puede alcanzar fácilmente una ganancia genética en el ritmo de crecimiento del orden del 0,6 % anual incluso en poblaciones pequeñas (2.000 hembras). En este caso, y si existe una justificación económica, se puede incluir la mejora de la canal a un precio razonable.

Hasta ahora, y en relación al caso 3, sólo se pueden hacer afirmaciones generales.

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