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EVALUATION OF INDUSTRY BREEDING PROGRAMS FOR DAIRY CATTLE
MILK AND MEAT PRODUCTION

FRANZ PIRCHNER, WEST GERMANY
Department of Animal Science
Munich University of Technology
D-8050 Freising, FRG

SUMMARY

In most European dual purpose breeds beef merit is paid attention to by selection among performance tested bulls where comparison is made with performance tested bulls and relatively little weight to muscling and thus to carcass meat content. The genetic correlation between beef and dairy merit appears to be negative. This, in combination with large and effective selection pressure on milk leads to negating the effects of the little and relatively inaccurate selection for beef merit at the best. Field progeny testing for beef merit can be economical and will permit to neutralize or even improve the beef merit of dual purpose cattle without much reduction in genetic progress of dairy merit.

In dual purpose cattle breeds milk and meat are of roughly equal importance, i.e. the minor trait should not contribute less than some 20 - 25 % to the total income.

The selection objectives for dairy traits are clearly defined and there exists a close correspondence with selection criteria such as lactation or part lactation yield. The selection objectives in case of beef production is the quantity of lean meat or the efficiency of lean meat production. However, the selection criteria are numerous and they need to be included in fairly complex prediction equations. Frequently their commercial relevance is not obvious. Also, prospective feeder animals are usually marketed very early - frequently at an age of one week - where the fattening quality can be poorly appraised and no or little price differentiation is practiced.

INTRODUCTION

Organized breed improvement for dairy performance is well established. Progeny testing of bulls for milk yield became general after WW II. The selection schemes are all based on progeny testing and they are fairly standard in all major dairying areas.

In contrast testing of bulls for their genetic merit for beef production is comparatively new and less developed. The approach taken varies widely between and even within European countries. One reason for this discrepancy between testing for beef and dairy merit is the comparative ease with which size, and therefore growth, and muscling can be judged on the live animal. In contrast, dairy performance not only is sex-limited but even in females accurate appraisal requires measuring the milk yield. Therefore, objective and systematic milk recording has been instituted rather early while for meat performance one was satisfied with visual appraisal, in some cases right up to the present. Nevertheless, before the advent of progeny testing for milk the accuracy...
of estimating the genetic merit for milk and beef was not very different.

In all European countries some improvement schemes for beef production in dual purpose breeds are in operation. The improvement rests mostly on performance testing of young bulls. On a rather limited scale progeny testing is also practiced either in stations or on field records. Since station testing incurs rather large expenses it is reserved, in general, for performance testing. In the EC there are in excess of 5,000 places, in the Comecon countries (except the Soviet Union) some 6,000 places available for performance testing of young bulls for meat production. However, animals are often grouped and then no feed consumption records are collected. Also a large proportion of young bulls is still bought either in auctions or directly from breeders' herds.

Station progeny testing is carried out in some countries on a limited scale and slaughter data are available. In some countries the progeny testing for meat production is reserved for the selection of future bull sires (Pribyl et al., 1984). In Bavaria the progeny test capacity suffices for some 15% of the bulls (Averdunk, 1984) and in Denmark the best 30 of the 120 progeny tested (for milk) bulls are subjected to a progeny test for beef performance (Andersen, 1982).

**METHODOLOGICAL PROBLEMS**

Testing for beef performance involves several problems, some of which shall be briefly discussed. Most of these are relevant to testing for beef performance in general while the genetic connexion between meat growth and dairy performance is special and in some way central to dual purpose breeding.

As mentioned above performance testing frequently involves only measuring the growth rate and, possibly, appraisal of muscularity either by scoring or by ultrasonic measurement. A European working group (Andersen et al., 1981) has outlined how the feeding regime in the test period influences components of lean tissue growth (LTG). In the pertinent production areas concentrate feeding is restricted while roughage is offered ad libitum. However, the level of concentrate feeding is fairly high so that LTG and residual feed conversion efficiency should receive considerable selection pressure.

For termination of the testing period three alternatives are possible: 1) age constant termination 2) weight constant termination and 3) testing to constant finish. At Clay Center (Smith et al., 1976) the three methods were compared and methods 1) and 2) were shown to be biased in favor of large sized, late maturing cattle. When comparison was made at equal degree of fatness the bias was absent. Also marketing of cattle occurs at comparable degree of finish. Therefore method 3) should be favored in testing or the records should be corrected to equal finish.

The correlation between size and muscularity on one hand and calving ease on the other is negative for direct and, somewhat less, for maternal effects (Fewson, 1985).

A problem general to all station testing concerns the possible interaction between environments and genotypes. Since testing of young bulls at stations is comparatively popular, care must be taken to avoid serious interactions. However, if progeny testing for beef traits carried out in the field should be of less importance, British heifer muscling scores are utilized. British genotypes (breeds and twines) are, however, the correlation is poor and the volume of data on the latter account of the departures, several studies were strains and crosses, such as (Reklewski, 1982). A number of dual purpose Friesian or were published (O’Ferral et al., 1973). In the production of Holstein gene composition and if public lean are corrected to the dairy performance of

**Table 1.**

<table>
<thead>
<tr>
<th>Genetic Connexion between Meat and Milk</th>
<th>Performance Differences (Averdunk et al., 1984)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat/Bone Ratio</td>
<td>Meat/Carcass</td>
</tr>
<tr>
<td>Meat/Carcass</td>
<td>Meat/Bone Ratio in Hindquarters</td>
</tr>
<tr>
<td>Meat Gain</td>
<td>% 4-legs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Meat/Bone Ratio</th>
<th>Milk Yield, kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTB, g/d</td>
<td></td>
</tr>
<tr>
<td>Milch Yield, kg</td>
<td></td>
</tr>
</tbody>
</table>

1) computed from results of Stolzman et al. (1978) and references in % carcass fat.

Another possible correlation between meat and milk yield is considered as correlated performances of Friesian and Brown Swiss and White, Braunvieh). The correlation is estimated. Again it turns to be between -0.3 and -0.6, due to genetic parameters which auxiliary criteria are correlated muscle content and again
milk and beef was not very
some improvement schemes for
eds are in operation. The im-
pending testing of young bulls. Or-
station testing incurs rather
general, for performance tests
00 places, in the Comecon co-
000 places available for
for meat production. However, to
feed consumption records for young bulls is still done in some
breeders' herds. This may also be practiced in some stations,
station testing incurs ra-
ger, for performance testing in
places available. In some
production is reserved for the
elite young bulls. 4) Young bulls are available. In some
roduction is reserved for the
for some 15% of the bulls
30 of the 120 progeny test available. In some
beef traits is still carried out in some coun-
data available. In some coun-
production is reserved for the

PROBLEMS
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c sexes, frequently involve the ex-
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mance testing frequently in-
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ultrasonic measurement. A number of authors have outlined how
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e is offered ad libitum. How-
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ency should receive consider-
ting period three alternative na-
ion 2) weight constant termi-
ish. At Clay Center (Smith
mpared and methods 1) and 2)
large sized, late maturing
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hould be favored in testing to equal finish.
ize and muscularity on one ha-
gative for direct and, somewhat
1985).
station testing concerns the
ments and genotypes. Since
comparatively popular, car-
ctions. However, if progeny

testing for beef traits should become more popular, it would be
cluded in the field and genotype environment interactions
should be of less importance unless female (heifer) or calf pro-
geny is utilized. British experience (Anon., 1983) indicates that
muscling scores are good predictors of carcass conformation
of bulls. In contrast El-Hakim (1982) reports interactions between
genotypes (breeds and twins) and veal or beef traits.
The correlation between dairy performance and LTG or its
feed efficiency is of direct relevance to dual purpose breeding.
The correlation is poorly known mainly because a sufficiently large
volume of data on the lean meat content of carcasses is not avail-
able on account of the difficulty and cost of measurements. How-
ever, several studies were concerned with the comparison of breeds,
stations and genotypes, such as the Polish FAO Friesian comparison
(Reklewski, 1982). A number other comparisons mostly of European
dual purpose Friesian or Red and White cattle with US-Holsteins
were published (O'Ferrall, 1982). There is consensus that intro-
duction of Holstein genes or of Brown Swiss genes impairs carcass
composition and if published data on meat-%, meat growth and car-
cass lean are corrected to equal fatness, their correlations with the
dairy performance of the genotypes is negative (Table 1).

Table 1
Genetic Correlation between Dairy and Beef

<table>
<thead>
<tr>
<th>Correlation of Dairy Performance with</th>
<th>Meat/Bone Ratio</th>
<th>Meat/Carcass</th>
<th>Meat/Bone Ratio in Hindquarter</th>
<th>Meat Gain</th>
<th>% 4-legs</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTG, g/d</td>
<td>-0.31</td>
<td>-0.40</td>
<td>-0.40 Mason et al.</td>
<td>-0.38</td>
<td>0.40</td>
</tr>
<tr>
<td>Milk Yield, kg</td>
<td>-0.36</td>
<td>-0.40</td>
<td>-0.36</td>
<td>-0.38</td>
<td>0.40</td>
</tr>
<tr>
<td>Performance Differences of Dairy (D) and Dual Purpose (DP) Breeds</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
<tr>
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<td>-0.40</td>
<td>-0.36</td>
<td>-0.38</td>
<td>0.40</td>
</tr>
<tr>
<td>Performance Differences of Dairy (D) and Dual Purpose (DP) Breeds</td>
<td>2)</td>
<td>3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
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<td>-0.38</td>
<td>0.40</td>
</tr>
</tbody>
</table>

1) computed from results given by Roklewski et al. (1978) and
2) Stolzman et al. (1978) after correction of beef traits for dif-
3) fferences in % carcass fat. 2) D - DP = 3/4 Brown Swiss - Braunvieh,
Kögel et al. 1978. 3) D - DP = Holstein-Friesian - Dutch Friesian,
de Boer et al. 1967.

Another possibility of estimating the genetic correlation
between meat and milk yield is provided by the comparison of the
respective performances of the American dairy breeds Holstein-
Friesian and Brown Swiss with their European parent breeds (Black-
and-White, Braunvieh). The changes in carcass composition can be
considered as a correlated response to nearly exclusive selection for
milkyield in America. Therefore a realized genetic correlation may
be estimated. Again it turns out to be strongly negative, somewhere
between -0.3 and -0.6, depending on the assumptions about the other
parameters which are necessary for the estimation. Several
auxiliary criteria are correlated rather closely with the carcass
content and again they all are negatively correlated with
dairy performance (Table 1). In contrast to the near consensus of most published estimates of meat–milk correlations there is considerable variability among the published correlations between growth rate and dairy performance. However, they are small, either slightly negative or slightly positive. Some of the differences could be due to the different ways of determining growth rate – to fixed age, weight or finish, with ad lib or under restricted feeding. However, no investigation of the consequences to the correlation of measures taken in different ways, is available.

EUROPEAN IMPROVEMENT SCHEMES

In most European countries testing for beef merit of dual purpose bulls consists of performance testing for growth rate and sometimes muscle and only rarely is this information supplemented with progeny tests and if so these are not infrequently based on heifer progeny. The first selection involves culling of roughly one half of young bulls on the basis of the performance test or of an index combining the dairy performance of dam and half-sisters with growth rate and in some cases muscularity of the tested bulls themselves. In Table 2 the relative contribution of Table 2

| Relative Contribution of Breeding Values of Various Traits to the Aggregate Genotype |
|---------------------------------------------|-------------|-------------|-------------|-------------|
| Denmark                                    | Finland     | Germany 1) | Norway      | Sweden 2)  |
| Milk                                       | 32          | 52          | 47          | 61          |
| Beef                                       | 23          | 8           | 42          | 28          |
| Milkability                                | 3+          | 11          | 11          | 10          |
| Conformation                               | 37          | 5           | 11          | 10          |
| Fertility                                  | 7           | 16          | 10          | 0.3         |
| Calving Ease                               | 6           | 3           | 7           | 0.3         |
| Disease                                    | 13          |             |             |             |
| Temperament                                | 4           | 6           | 2           |             |


1) for young bull selection only, 2) for secondary traits subjective weights are used. Source: Pimland and Gravir, 1984; Gjol-Christensen, 1984; Lederer, 1984; Mäntysaari et al., 1984; Philipsson, 1984.

1) Fleckvieh, HF German Friesians.

Various traits to the index is given. The contributions were computed by multiplying the published weights times the genetic standard deviation or the standard deviation of the indices. In most instances the indices refer to the selection of progeny tested bulls which obviously had been selected in a first stage on their own performance. The German indices are destined to select young bulls which in a second stage are selected according to their progenies' dairy performance. However, when young bulls have been through a performance test and the remainder ranked the same selection intensity: (Wismans, 1984). In Denmark 1/3 of the performance test (Zelfel, 1984). In Table 3 the culling rates of 80% or more are given. In most testing schemes for which traits, similar to those used in genetic and phenotypic correla and milk fat yield and muscle scores and milk fever.

Table 3

<table>
<thead>
<tr>
<th>Culling Rates in CSSR Breed</th>
<th>Performa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight gain</td>
<td>25</td>
</tr>
<tr>
<td>Conformation</td>
<td>12</td>
</tr>
<tr>
<td>Health</td>
<td>13</td>
</tr>
<tr>
<td>Milk Yield</td>
<td></td>
</tr>
<tr>
<td>Fat %</td>
<td></td>
</tr>
<tr>
<td>Fertility</td>
<td></td>
</tr>
<tr>
<td>Milkability</td>
<td></td>
</tr>
<tr>
<td>Udder</td>
<td></td>
</tr>
</tbody>
</table>

1) including semen quality, Source: Pribyl et al. 1984

The various in i.e. information on milk index and vice versa. The methods are compared in testing schemes for which traits, similar to those used in genetic and phenotypic correla and milk fat yield and muscle scores and milk fever. The index of the Bavarian merit is not very high. The index of the Bavarian 1
contrast to the near consensus, there is considerable variance in the established correlations between growth rate, milk yield, and meat quality traits. However, they are small, and the benefits of determining growth rates and milk or under restricted conditions may not offset the consequences to the consumer in the same way, is available.

**ROVEMENT SCHEMES**

Several testing for beef merit purposes, the performance testing for growth rate and milk yield is most frequently. The testing involves culling on the basis of the performance of dam and sire traits in some cases muscularity of the dam is considered. The relative contribution of the various traits to the total index is usually computed independently, i.e., information on milk is disregarded when computing the beef index and vice versa. The efficiency of the various selection methods are compared in table 4 on hand of four partly abstracted schemes for which traits, genetic parameters and economic weights similar to those used in Germany were utilized. However, the genetic and phenotypic correlations between growth rate on one hand and milk fat yield and muscle scores on the other, were assumed to be zero and 0.2, respectively, while the genetic correlation between muscle scores and milk yield is taken to be -0.3. The selection schemes are a three stage selection (A), selection according to an empirical index as used for German Fleckvieh (B), an optimal index (C) and no selection for beef traits (D). The variants B, C and D are two-stage selection schemes where stage one involves index selection of young bulls and stage two selection based on progeny tests for dairy performance, respectively. In scheme A stage 1 is selection of young bulls for dairy merit, stage 2 involves independent culling for beef performance and stage 3 finally progeny test selection for milk yield. For all schemes it is assumed that 10% of young bulls are retained on account of estimated dairy merit and beef performance. Of course, selection intensity can be greater but additional traits probably need to be taken into account. After the progeny test 20% of the bulls are retained for AI. As is evident from the figures given in the table selection for dairy performance impaires muscling.

Separate selection for muscling as in scheme A but also with an optimal index cannot neutralize this indirect genetic change, not even in young bulls where accuracy of estimating dairy merit is not very high. The exception is scheme B patterned after the index of the Bavarian Fleckvieh. In all cases progeny test through a performance test on a station about 40 to 50% are culled and the remainder ranked by index. In the Netherlands about the same selection intensity is applied to performance in stations (Wismans, 1984). In Denmark about 20% and in East Germany about 1/3 of the performance tested bulls enter AI service as test bulls (Felfel, 1984). In table 3 the culling rates which are applied in the CSSR are given. In model calculations Fewson (1985) found culling rates of 80% or more optimal.

<table>
<thead>
<tr>
<th>Performance Test</th>
<th>Proven Bulls</th>
<th>Bull Sires</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight gain</td>
<td>29</td>
<td>10</td>
</tr>
<tr>
<td>Conformation</td>
<td>12.5</td>
<td>10</td>
</tr>
<tr>
<td>Health</td>
<td>13.4</td>
<td>10</td>
</tr>
<tr>
<td>Milk Yield</td>
<td>65</td>
<td>&gt;70</td>
</tr>
<tr>
<td>Fat %</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Fertility</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Milkability</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Udder</td>
<td>5</td>
<td>10</td>
</tr>
</tbody>
</table>

1) Including semen quality, 2) Carcass gain of progeny.


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Table 4
Breeding Values of Bulls

<table>
<thead>
<tr>
<th>A</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Σ</th>
<th>1*</th>
<th>2*</th>
<th>Σ</th>
<th>1**</th>
<th>2**</th>
<th>Σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk Fat (F), kg</td>
<td>9.7</td>
<td>-7</td>
<td>12.9</td>
<td>21.9</td>
<td>7.7</td>
<td>12.9</td>
<td>20.6</td>
<td>8.2</td>
<td>12.9</td>
<td>21.1</td>
</tr>
<tr>
<td>Growth Rate (GR), kg/d</td>
<td>0.046</td>
<td>0.046</td>
<td>0.060</td>
<td>0.060</td>
<td>0.067</td>
<td>0.067</td>
<td>0.067</td>
<td>0.067</td>
<td>0.067</td>
<td>0.067</td>
</tr>
<tr>
<td>Muscling Scores (MS)</td>
<td>-0.18</td>
<td>0.18</td>
<td>-0.22</td>
<td>-0.22</td>
<td>-0.11</td>
<td>-0.11</td>
<td>-0.04</td>
<td>-0.26</td>
<td>-0.23</td>
<td>-0.22</td>
</tr>
<tr>
<td>Σ</td>
<td>65.8</td>
<td>68.5</td>
<td>70.2</td>
<td>55.4</td>
<td>82.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A 3-stage selection, stage 1, i=1.4 based on dam's (3 lactations) and half-sisters' dairy performance (n=50), stage 2 beef performance test, i=1. Selection stage 3 progeny test for dairy performance, i=1.4. B Selection for index for German Fleckvieh, i=1.75, 2* as 3, i=1.4. C 1* Optimal young bull index, i=1.75, 2* as 3. D Selection for dairy performance only, 1* as 1 but i=1.75, 2* as 3. E 1** as 1*, 2** optimal progeny test index, i=1.4.

Table 5
Accumulated Profits (DM) from Beef Testing

<table>
<thead>
<tr>
<th>Dairy Merit (D)</th>
<th>Selection</th>
<th>Dairy Merit and Beef Merit in Performance Test (C)</th>
<th>Dairy Merit and Beef Merit in Progeny (E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>stage</td>
<td>c</td>
<td>b</td>
<td>2*</td>
</tr>
<tr>
<td>Milk Fat</td>
<td>60.4</td>
<td>526</td>
<td>125.0</td>
</tr>
<tr>
<td>Growth Rate</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Muscle Scores</td>
<td>-5.7</td>
<td>-49</td>
<td>-11.2</td>
</tr>
<tr>
<td></td>
<td>476</td>
<td>991</td>
<td>742</td>
</tr>
</tbody>
</table>

D, C, E as in table 4, c accumulated, discounted profit per cow, in DM, d accumulated, discounted profit of 20,000 inseminations, 8,700 lactations, 8,700 slaughter animals, 1,000 DM. Realizations of dairy and beef expressions over 12 years.
In contrast improvement of growth rate of the young bulls is carried through all stages of selection which is of cause a consequence of the zero correlation assumed. However, comparison of scheme D, where no performance test selection is considered with the other schemes makes it obvious that young bull selection for growth rate and muscling reduces the impairment of muscling score to about half as much as is suffered by exclusive selection for dairy merit, and leads to a noticeable improvement in growth rate. If the traits are weighted by the relative economic values used in German Fleckvieh the total improvements of the four schemes are 65.8, 68.5, 70.2 and 55.4 units, respectively.

All three dual purpose schemes are superior to the single trait scheme by nearly 20% because the improvement in growth rate and the reduction in impairment of muscling outweigh the value of the reduction of genetic gain in milk fat yield. The use of the optimal index C leads to the largest benefit but the empirical Fleckvieh index is not very much inferior.

If dual purpose selection uses, in addition to dairy traits, growth rate as the sole beef trait, the deterioration of muscling is expected to be considerably larger than if this has a separate weight, even under our comparatively favorable assumptions about the correlation matrix. Danish experience (Andersen, 1982) is that selection for growth rate impairs dressing-% and muscling.

Selection for muscling and for growth rate will impede calving ease. In several countries attempts are made to control undesirable developments in the calving process by restricting changes in gestation length which serves as proxy for calf birth weight (Wismans, 1984, Andersen, 1982). For our examples we have assumed genetic correlations of -0.3 and -0.1 between muscling score and growth rate on one hand and calving ease on the other, this being considered as maternal trait. The correlations with the direct effect would be similar if not more undesirable. However, direct effects could be controlled largely by mating heifers to specially selected bulls. Changes in growth rate and muscling brought about by selection schemes A, B, C should change calving ease by 0.034, 0.019 and -0.015 points on a scale with σ = 3 and h² = 0.1. The small changes, in case of three stage selection and of the optimal index selection positive, in case of the Fleckvieh index negative, are a consequence of the impairment of muscling scores which in turn derives from the rather large and effective selection pressure on dairy performance.

PROGENY TESTING

It is evident and corroborated by experience (Wismans, 1984, Andersen, 1982) that selection for dairy performance and crossing to dairy strains will impair the carcass muscle content. Selection of young bulls on estimates of their own muscle content is insufficient to counteract the very effective selection pressure for milk. In practically all improvement schemes both pressure and accuracy of selection for dairy traits is much less than for milk yield (culling rates ca. 50 %, r_Mg ≈ 0.6, respectively, for beef traits vs. 10 to 20 % and r_Mg > 0.8 for progeny performance of milk yield, respectively). Obviously nearly all testing resources are allocated to milk recording and progeny testing for dairy traits.
and few means are reserved for testing meat traits. Now progress in the traits will depend very much on the extent and quality of recording and evaluation of collected information and only partially on the economic value of the traits. The reason for the lack of more attention to beef traits is historical to some extent but mainly it is caused by the experience and opinion of breeders that returns from dairy improvement are greater than from beef improvement, which of course gets the question back to the economics.

The efficiency of progeny testing for beef performance is indicated in col. E of table 4. It is assumed that beef performance was tested on 30 progeny in the field which has, as consequence, a lower heritability of growth rate ($h^2 = 0.16$) than station testing. However, the heritability of muscling scores was assumed to be equal to that of station test ($h^2 = 0.4$). Selection according to an optimal index comprising progeny averages for milk fat yield, growth rate and muscling scores is assumed. The variances and covariances are corrected for previous selection. As is evident, the genetic merit for muscling score of the bulls is improved a little in spite of the negative genetic connexion with milk fat yield, growth rate and muscling scores is assumed. The variances and covariances are corrected for previous selection. However, they lead to rather large reductions in overall genetic gains if the accuracy of ascertaining the trait to be restricted is comparatively small.

EFFICIENCY OF TESTING

The feasibility of testing for beef merit is not infrequently questioned. For example Wisman (1984) quotes a benefit/cost ratio of only 8.4 for beef improvement of Dutch cattle in contrast to such a ratio of 180 for dairy improvement. However Cunningham and Moioli (1982) find much more favorable ratios under Irish conditions. They quote benefit/cost ratios of 21 and 12 for performance test and subsequent progeny test for beef merit and 27 for dairy progeny test. If beef merit is improved only by performance test the benefit/cost ratio is 33 compared to 28 for dairy progeny test. Glaser et al. (1985) find that beef performance testing causes less than 10% of costs but contributes between 1/4 and more than 1/3 of the genetic gain in breeding programs. Inclusion of beef progeny testing adds between about 1/10 and 1/6 of costs of breeding programs without attention to beef merit but its contribution to genetic gain can be between 40 and almost 50%.

In table 5 the benefits accruing from some of the improvement programs for beef merit outlined in table 4 are indicated. The genetic improvements calculated in this are utilized and the following returns over feed costs are assumed: 1 kg butterfat 5 DM, 1 g daily gain 0.679 DM and one point of muscling score 24.70 DM. These values were derived from the relative importance attributed to the traits in the German Fleckvieh index. The returns are computed for 20,000 inseminations of one bull. It is assumed that 56% of the inseminations result in productive offspring and that for each birth 0.1% of the animals accrue in the course of the birth. This results in 8,700 discards per 1,200 DM for performance testing normal for progeny testing in the field.

The benefit/cost ratio of progeny testing relative to no breeding programs is 150 DM for performance testing and the benefit/cost ratio is about 2 if the better/cost ratio of only 8.4 for beef improvement of Dutch cattle in Ireland is used. Therefore one may question why considerable efforts have been devoted to the beef component of the index.

Another possibility would be the application of restricted indexes (Kempthorne and Nordskog, 1959, Niebel and Van Vleck, 1983) or of a desired gain index (Pesek and Baker, 1969). Therefore one may question why cows were selected for the beef component.

One problem is inherent in the system where the potential benefit is as is common in Bavarian Fleckvieh is more favorable (Schild et al., 1982). However, there are exceptions. For example, the genetic correlation of nearly 0.4 between one week old calves and carcass live weight. When calves are sold 6 months after weaning as is common in Bavarian Fleckvieh at 50% of the variance of butterfat yield the potential benefit is as is common in Bavarian Fleckvieh at 50% of the variance of butterfat yield. It has been shown that concentrates are relatively high and dual purpose cattle are economically feasible and beef cattle for supplying milk and meat. Therefore one may question why cows were selected for the beef component.

Another reason for the objection to testing for beef merit is the correlation of differences in it with those in overall merit. For example, that genetic variance of beef merit is nearly 10% of the variance of breeding merit and Philipsson (1984) finds that genetic variance of beef merit is less than 2% of the variance of breeding merit and Philipsson (1984) finds that genetic variance of beef merit is less than 2% of the variance of breeding merit. Therefore one may wonder why cows were selected for the beef component.

Another problem is the instability of muscling scores which is due to the relative low weight gain and the significant influences of unknown factors.
testing meat traits. Now progress on the extent and quality of information and only partially.

The reason for the lack of practical evaluation is to some extent buttressed by the experience of breeders, that beef improvement back to the economics of meat output for beef. The reason is that the index (Pesek and Baker, 1969) is 33 compared to 40 for dual purpose testing. For example Wismans (1984) points out that genetic variance of beef merit is 50% of the variance of dairy merit and Philipsson (1984) estimates that in Swedish Fleckvieh index and only 6,8 and 19% are caused by variation of the subindices for meat, fertility and other functional traits, respectively. On the other hand, Glaser et al. (1985) find that up to nearly 50% of the genetic progress in total genetic merit is contributed by beef improvement and the model calculations in table 5 as well as the figures given by Cunningham and Moioli (1982) also point to rather larger influence of the beef component on total genetic merit.

The discrepancy between these conclusions are partly explained by the inadequacies of marketing which as discussed above reflect only little of differences in beef merit but they are also due to the relative low weight given to carcass conformation and therefore to lean content in the calculations.

Our knowledge of the genetic correlation between dairy and beef merit is clearly wanting and data should be collected...
which permit good estimates. The rather large volume of completely dissected carcasses at meat research institutes frequently lacks pedigree information and is not suitable for such investigations. It is urgent that in future such work should be performed on material which permits genetic analysis.

Further studies on the optimal organization of testing for beef merit where proper attention is given to carcass value are needed. However, improvement of methods and/or organization of marketing which permit recognition of quality differences of dairy breed calves are necessary to ensure proper attention by farmers to the beef component of dual purpose cattle.

REFERENCES


ther large volume of complete table for such investigations. The optimal organization of test methods and/or organization of quality differences of different cattle should be performed on the carcass value of carcass variations of meat and milk production in British Friesian cattle. Annu. Prod. 14, 135.


Theoretical and practical ways to improve production traits by selection within local Bos indicus composite populations, upgrading of beef cattle through different crossbreeding programs, and summarizing the data from previous works on successful crossbreeding programs exist. Only few publications (Acharya and Roberts, 1984) exist on successful hybrid programs. Few reports are based on small numbers of observations over a short period. Main challenge is to develop programs which combine success in harsh environments, the production of larger heterosis effects characteristics. The problem of the appropriate inheritance in tropical cattle populations is of concern. The main conclusion is that Bos taurus breeds should be used as a base to 75%. In other words, the existence of different Bos taurus breeds for crossbreeding is generally accepted. There is no consensus on the appropriate breeds to be crossed with local Bos indicus breeds to be crossed with local zebu breeds. The application of new techniques like nuclear transfer and eventually transgenic animals opens new possibilities for consultants and consultants. For consultants, the choice of the appropriate breeding alternatives in the tropics, more than in temperate countries, is not just a business, but rather a complex situation. The large number of consultants and consultants are analyzed in retrospect (Acharya and Morris, 1984).