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GENETIC ASPECTS OF FERTILITY, INTERVAL AND MILK TRAITS FOR THE FIRST THREE LACTATIONS IN BRAUNVIEH COWS

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SUMMARY

Six linear mixed models were used to study the fixed effects of non-genetic factors and the random effect of sire and the interactions of year and month of calving by region on fertility, interval and milk traits. Data were included 34447 records for the first three lactations of Braunvieh cows. Data of each parity were analyzed separately. Milk traits studied were milk yield (MY), fat yield (FY), protein yield (PY), fat percentage (F%) and protein percentage (P%). Interval traits were days in milk (DM) and preceding days dry (DD) and reproductive traits were days open (DO) and age at calving (AC).

Least-squares analysis of variance showed significant effects of month and age at calving on all traits, significant effect of year of calving on most traits. DO had a significant effect on all traits except DD.

Heritabilities were 0.65, 0.11, 0.10, 0.31, 0.58, 0.57, 0.60, 0.36 and 0.35 for AC, DO, DM, .DD, MY, FY, PY, F% and P%, respectively in the first lactation, while the corresponding values in the 2nd lactation were 0.81, 0.13, 0.05, 0.29, 0.55, 0.52, 0.59, 0.30 and 0.43, respectively. Except AC, the estimates were 0.14, 0.08, 0.28, 0.54, 0.49, 0.58, 0.27 and 0.37 for the 3rd lactation, respectively.

The all possible correlations (genetic, phenotypic and environmental) among interval, fertility and milk traits (yields and percentages) were calculated and tabulated.

Keywords: Braunvieh, milk, fertility and interval traits, genetic parameters

INTRODUCTION

Most of the disposals of dairy cows were due to reproductive failure. Infertility contributes to increased breeding and veterinary costs. About 30 % of all veterinary treatments were because of infertility, and on average 25 % of the cows in the health control program were treated for reproductive problems, while about 13 % of disposals were reported because of low production and cows culled due to fertility problems account for about 28 % in Western Europe (e.g. Philipsson, 1981).

Standards for AI bull evaluation for dairy and dual-purpose breeds have been proposed by an European working group (Gaillard et al., 1977) not only for production traits but also for reproduction and several management traits.

Numerous studies have estimated genetic and phenotypic parameters of fertility traits (e.g. Philipsson, 1981; Hansen et al., 1983a; Hansen et al., 1983b; Seykora and Mc Daniel, 1983; Hermas et al., 1987; Soliman and Khalil, 1991). Results of previous studies reported low heritability estimates of female fertility (less than 10 %). Thus the major part of variation in fertility results from environmental causes and non-additive genetic variation. The most important environmental factors were herd, year of calving, season of calving, AI unit, age and technicians. Heritability estimates for days dry ranged from 15 to 34 % (Schaeffer and Henderson, 1972; Soliman and Khalil, 1991). Because of the possible genetic component of days dry, adjustment of milk records for days dry has not been advocated.

Genetic improvement in dairy cattle in most countries has focused primarily on milk yield with less emphasis on components of milk. The economic incentive for protein content in milk has caused interest in genetically altering milk components. The positive value of protein is not just a short-term trend. The quota system place no restriction on protein percentage. Hence, the relative economic weight of protein is increased by it.

The purposes of the present study were to investigate: non-genetic factors affecting different interval-, reproductive- and milk traits (specially protein) in different parities of Austrian Braunvieh AI data, to estimate heritabilities of these traits, and to estimate phenotypic, environmental and genetic correlations among traits studied.

MATERIALS AND METHODS

The material was obtained from the Official Federation of Austrian Cattle Breeders (ZAR). The records used were those of cows calving over six consecutive calving years (1977 trough 1982). The records were from AI bulls. One daughter per sire per herd was chosen randomly (Karras and Schlote, 1982; Soliman, 1984). Usually daughters are tested in different herds. All records were 305-day or shorter completed lactations. Both fertility (interval traits) and milk trait data were used. Data were available on 13861, 11496 and 9090 paternal half-sisters from 838, 805 and 754 sires in the 1st, 2nd and 3rd lactations, respectively. Traits studied were: milk yield (MY), fat yield (FY), protein yield (PY), fat percentage (F%), protein percentage (P%) as milk traits, days in milk (DM) and preceding days dry (DD) as interval traits, and days open (DO) and age at calving (AC) as reproductive traits.

Cows were located in the province Tirol. Two data sets were obtained. The 1st set was for cows pastured on alpine grassland (alpage) denoted as (A), while the 2nd was for cows pastured in valleys denoted as (H). Details of the Breeding policy and management for Braunvieh cattle in Austria were described by Hartmann et al. (1992).

Data of each lactation were analyzed separately in each set by Harvey's (1990) mixed model computer program. Table 1 lists random and fixed effects included in the different models used to analyze traits of the first three parities. However, it was not possible to examine simultaneously all factors and interactions between them, which were likely to influence traits studied, because the equations for estimation would have involved a matrix too large to invert. The limited numbers of records or their absence in some subclasses, did not permit the inclusions of such interactions.

Estimates of effects of sires (σ^2_s) and remainder (σ^2_e) components of variances and covariances were computed according to Method III of Henderson. Paternal half-sib analysis of variances and covariances were utilized to obtain the estimates of heritability and correlations for each parity separately by Harvey's program (1990).

Table 1. Effects included in the different mixed models used to analyze milk-, fertility- and interval traits of the first three lactations in Austrian Braunvieh cows

Traits++	Model	Parity	Effects included in the models+							
			sire	year (Y)	month (M)	age	region (L)	days open	YxL	MxL
MY, FY, PY, DM, DD	1	1	x	x	x	x	x	x	x	x
MY, FY, PY, DM, DD	2	2	x	x	x	x	x	x	x	x
MY, FY, PY, DM, DD	3	3	x	x	x	-	x	x	x	x
MY, FY, PY, DM, DD, AC, DO	4	1	x	x	x	-	x	-	x	x
MY, FY, PY, DM, DD, AC, DO	5	2	x	x	x	-	x	-	x	x
MY, FY, PY, DM, DD, DO	6	3	x	x	x	-	x	-	x	x

\+ sire is a random effect, other effects are fixed.
++ MY, FY and PY= 305 day Milk-, fat- and protein yield, respectively, DM, DD and DO = Days in milk, days dry and days open, respectively, AC = Age at calving.

RESULTS AND DISCUSSION

Means and variations

Means, standard deviations and coefficients of variation (CV%) for milk-, interval- and reproductive traits in the first three lactations are given in Table 2. The general trends of means for interval and reproductive traits seem to be constant in the different parities, except age at calving which increased from the first to the second lactation by 39%. The coefficients of variations were similar in all parities. Yield traits increased up to the third parity. The greatest rise of the increase of yield traits was observed from the first to the second parity. Higher CV were found for DO and DD than for other traits.

Table 2. Means, standard deviations (SD) and coefficients of variation (CV) of fertility, interval and milk traits in the first three lactations of Braunvieh cattle

Traits	No. of records	Mean	SD	CV%+
1st Lactation	13861			
Age at calving (mo.)		33.40	4.30	11
Days open		97	72	59
Days in milk		320	42	12
Days dry		88	29	33
Milk yield (Kg)		3701	683	18
Fat yield (Kg)		148	30	20
Protein yield (Kg)		117	23	19
Fat %		3.99	0.31	7
Protein %		3.17	0.21	6
2nd Lactation	11496			
Age at calving (mo.)		46.40	4.60	9
Days open		99	70	56
Days in milk		318	43	13
Days dry		86	30	35
Milk yield (Kg)		4162	766	18
Fat yield (Kg)		167	35	21
Protein yield (Kg)		132	26	19
Fat %		4.01	0.32	8
Protein %		3.16	0.21	6
3rd Lactation	9090			
Days open		99	74	61
Days in milk		320	45	13
Days dry		90	30	34
Milk yield (Kg)		4378	793	18
Fat yield (Kg)		175	36	20
Protein yield (Kg)		137	27	19
Fat %		3.99	0.32	8
Protein %		3.13	0.21	6

+ Coefficients of variation computed from residual mean squares divided by the overall least-squares means of a given trait.

Estimation of non-genetic effects

Effects of month and year of calving

For all traits studied in different parities, month of calving proved to be significant (P<0.001) as shown in Tables 3 & 4. In general, year of calving affected most traits studied (P<0.001) across parities. Similarly, most of the Austrian studies (e.g. Soliman, 1984; Soliman et al., 1989; Soliman and Khalil, 1989; 1991 & 1993) showed that month-and year of calving effects were of some importance in influencing yield and interval traits of different breeds of dairy cattle. Therefore, any model of analysis for such traits should include the effect of these factors for appropriate analysis.

Table 3. F-ratios for the effects of different factors on fertility and interval traits of Braunvieh cows in the first three lactations

Source of variation	1st lactation		2nd lactation		3rd lactation	
	d.f.	F-ratio	d.f.	F-ratio	d.f.	F-ratio
Age at calving (AC)						
Sire	837	4.2***	804	4.6***	-	-
Year of calving (Y)	5	138.6***	5	179.3***	-	-
Month of calving (M)	11	82.1***	11	13.8***	-	-
Grazing region (L)	1	9.2***	1	4.2***	-	-
Y x L	5	1.1ns	5	1.1ns	-	-
M x L	11	5.8***	11	3.3***	-	-
Remainder	12986	14.5a	10658	19.3a	-	-
Days open (DO)						
Sire	837	1.4***	804	1.5***	753	1.4***
Year of calving (Y)	5	25.5***	5	21.7***	5	18.7***
Month of calving (M)	11	36.7***	11	48.0***	11	21.6***
Grazing region (L)	1	1.2ns	1	0.8ns	1	0.3ns
Y x L	5	1.8ns	5	0.9ns	5	1.2ns
M x L	11	7.6***	11	5.5***	11	1.0ns
Remainder	12986	3765a	10658	4397a	830	5048a
Days in milk (DM)						
Sire	837	1.4***	804	1.2***	753	1.2***
Year of calving (Y)	5	9.3***	5	8.0***	5	8.6***
Month of calving (M)	11	35.9***	11	26.6***	11	25.1***
Age at calving	16	4.5***	16	4.3***	-	-
Days open	4	8.7***	4	7.3***	4	17.1***
Grazing region (L)	1	368.7***	1	240.0***	1	140.0***
Y x L	5	0.6ns	5	2.3*	5	1.0ns
M x L	11	7.8***	11	4.6***	11	2.9***
Remainder	12970	1597a	10638	1697a	8299	1850a
Days dry (DD)						
Sire	837	2.4***	804	2.1***	753	1.9***
Year of calving (Y)	5	102.4***	5	94.4***	5	74.7***
Month of calving (M)	11	3.6***	11	6.7***	11	5.1***
Age at calving	16	4.5***	16	4.7***	-	-
Days open	4	1.6ns	4	1.8ns	4	1.0ns
Grazing region (L)	1	23.5***	1	8.9***	1	4.8*
Y x L	5	6.7***	5	6.7***	5	5.6***
M x L	11	2.6***	11	2.6***	11	3.8***
Remainder	12970	5972a	10638	6981a	8299	8090a

a= Means squares

ns= Not significant, *= P<0.05, **= P<0.01, ***= P<0.001

Table 4. F-ratios for the effects of different factors on milk traits of Braunvieh cows in the first three lactations

Source of variation	1st lactation		2nd lactation		3rd lactation	
	d.f.	F-ratio	d.f.	F-ratio	d.f.	F-ratio
Milk yield (MY)						
Sire	837	3.4***	804	2.8***	753	2.4***
Year of calving (Y)	5	6.6***	5	2.7***	5	4.4***
Month of calving (M)	11	19.4***	11	8.6***	11	7.4***
Age at calving	16	5.4***	16	1.7***	-	-
Days open	4	25.9***	4	23.0***	4	16.5***
Grazing region (L)	1	252.9***	1	177.0***	1	139.4***
Y x L	5	0.6ns	5	2.0ns	5	0.5ns
M x L	11	7.9***	11	4.5***	11	2.3***
Remainder	12970	643374a	10638a	790274a	8299	865896a
Fat yield (FY)						
Sire	837	3.4***	804	2.7***	753	2.4***
Year of calving (Y)	5	4.8***	5	1.7ns	5	3.7***
Month of calving (M)	11	19.1***	11	9.2***	11	7.2***
Age at calving	16	6.3***	16	2.5***	-	-
Days open	4	22.9***	4	20.4***	4	13.8***
Grazing region (L)	1	201.0***	1	162.8***	1	149.6***
Y x L	5	0.7ns	5	1.7ns	5	0.4ns
M x L	11	6.7***	11	3.6***	11	2.3***
Remainder	12970	1224a	10638a	1540a	8299	1716a
Protein yield (PY)						
Sire	837	3.4***	804	2.9***	753	2.6***
Year of calving (Y)	5	6.5***	5	0.9ns	5	4.5***
Month of calving (M)	11	20.6***	11	9.7***	11	7.8***
Age at calving	16	4.5***	16	1.4ns	-	-
Days open	4	17.8***	4	14.3***	4	11.5***
Grazing region (L)	1	186.4***	1	149.2***	1	107.5***
Y x L	5	0.7ns	5	2.0ns	5	0.4ns
M x L	11	6.3***	11	4.1***	11	1.9*
Remainder	12970	748a	10638a	908a	8299	985a
Fat percentage (F %)						
Sire	837	2.7***	804	2.2***	753	1.9***
Year of calving (Y)	5	2.7*	5	1.3ns	5	2.0ns
Month of calving (M)	11	2.5**	11	2.5**	11	3.8***
Age at calving	16	1.7*	16	1.7*	-	-
Days open	4	2.1ns	4	2.0ns	4	1.8ns
Grazing region (L)	1	2.5ns	1	2.0ns	1	10.7***
Y x L	5	2.1ns	5	o.4ns	5	0.4ns
M x L	11	0.8ns	11	0.8ns	11	1.1ns
Remainder	12970	0.092a	10638a	0.100a	8299	0.102a
Protein percentage (P %)						
Sire	837	2.6***	804	2.6***	753	1.9***
Year of calving (Y)	5	9.2***	5	5.1***	5	2.2*
Month of calving (M)	11	3.6***	11	4.3***	11	3.9***
Age at calving	16	0.7ns	16	1.8*	-	-
Days open	4	7.4***	4	6.2***	4	1.7ns
Grazing region (L)	1	19.5***	1	0.9ns	1	15.0***
Y x L	5	1.0ns	5	1.5ns	5	0.1ns
M x L	11	1.0ns	11	1.5ns	11	1.4ns
Remainder	12970	0.043a	10638a	0.041a	8299	0.100a

a= Means squares

ns= Not significant, *= P<0.05, **= P<0.01, ***= P<0.001

Furthermore if year effects do exist, these could be eliminated if bull evaluation were carried out within season. (e.g. Janson, 1980a).

The highest frequencies of calvings were observed October through December, between 60 and 66 %. It is noticed that the dairymen in Austria concentrated their calving in autumn and early winter months. In general, heifers and cows calving during autumn months have the highest performance of yield traits, while those calving in winter months showed the lowest. These findings are in agreement with other Austrian studies (e.g. Soliman, 1984; Soliman et al., 1989; Soliman and Khalil, 1989; 1991 & 1993). Age at calving showed the same trend as yield traits, while DO and DD showed that heifers and cows calving in autumn months had the longest intervals. Heifers and cows calving in winter months had the shortest DM, while summer calvers showed the longest DM.

Least square means of year of calving showed that there was an upward trend in all traits studied over the years, except for DM and DD where stable and downward trends were observed, respectively. The upward trend is probably due in part to genetic improvement and partly to improved feeding and management. In recent years, dairy cattle breeders in Austria succeeded to improve the reproductive performance of their cows by reducing the calving interval through fixing DM and decreasing DD.

The least squares means for month of calving are illustrated in Figures (1 up to 3). In the first two lactations, August - October were consistently the months with the highest yield traits, while in the third lactation the highest production pronounced in September - November. On the other hand, cows freshening in May, April and June had the lowest performance in the first, second and third lactation, respectively. In general, the highest percentage of fat and protein occurred during the periods of highest yields, while the lowest values were recorded during the peroids of lowest yields, except in the first lactation which the highest fat percentage was recorded during the period of lowest yields.

Fig. 1. Effect of month of calving on milk yield in the first three lactations

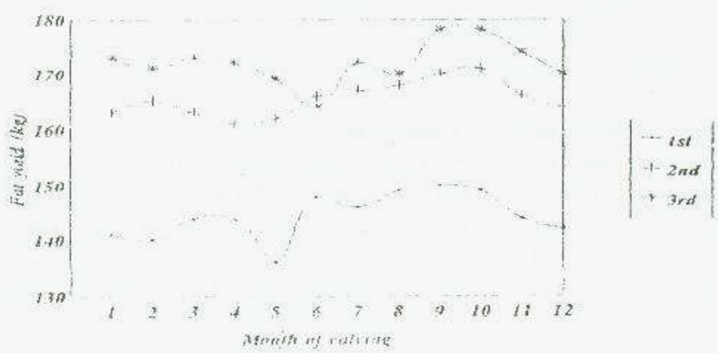

Fig. 2. Effect of month of calving on fat yield in the first three lactations

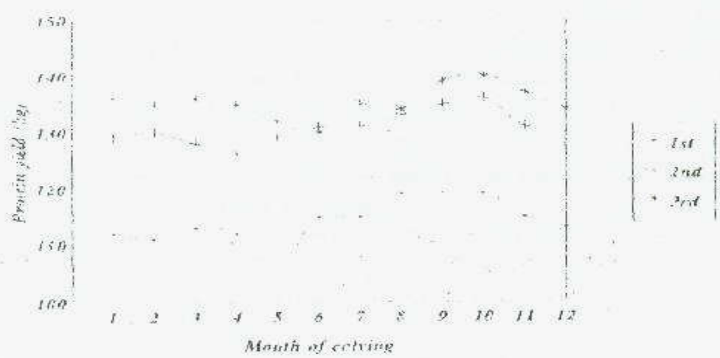

Fig. 3. Effect of month of calving on protein yield in the first three lactations

Effect of age at calving

Age effects on different traits of primiparous and multiparous cows were significant (P<0.001), except on PY in the 2nd lactation. Age could be expected to be a source of variation if the heifers were first inseminated so early in life that some of them had not reached sexual maturity. In practice, however, heifers are not inseminated until they show estrus regularly. Sexual maturity and onset of first estrus occur at a certain weight rather than a certain age. However, since freshening of cows in early lactation are not desired on mountain-pastured, farmers tend to have heifers calfe in autumn. Thus the relatively late age at 1st calving has to be regarded under this restrriction. The significant effect of age at calving on yield traits was reported by many investigators (e.g. Hansen et al., 1983; Pape et al., 1983; Romberg et al., 1983; Alps et al., 1984; Soliman 1984; Soliman et al., 1989; Soliman and Khalil, 1991 and 1993).

The most frequent classes of age at calving are 33.4 and 46.6 months in the 1st and 2nd lactation, resp. The highest frequency of calvings (62%) was observed at 32-36 mo. in the 1st lactation, while 59 % of calvings was at 45 - 49 mo. of age in the second lactation. For all traits studied there is a tendency for improvement which may by be due to the fact that older cows are more selected. In general, traits studied steadily increases with the advanced of parity from first through third lactation. These results are in agreement with previous investigations (e.g. Karras and Schlote, 1982; Pape et al., 1983; Romberg et al., 1983; Soliman, 1984; Soliman et al. 1989; Soliman and Khalil, 1989; 1991 & 1993).

Relationships between yield traits and age at calving were illustrated in figures (4 up to 6) by using least squares means. These curves pronounced that yield traits within each lactation were affected by age at calving in similar manner, i.e the same trend for milk, fat and protein was observed. Curves of the first lactation showed that cows freshening at 40 month or more had the highest yield traits, while the lowest production was recorded for cows calved at 24 month or less. In general, cows freshening at 33 up to 36 month were produced relatively the highest yield traits. Curves of yield traits in the second lactation pronounced that cows attained the highest yield traits when they ages

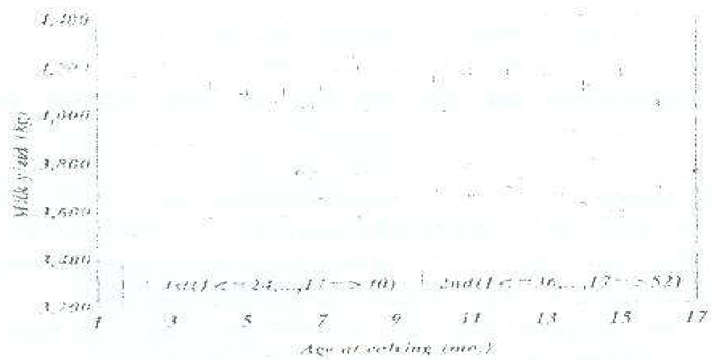

Fig. 4. Effect of age at calving on milk yield in the first two lactations

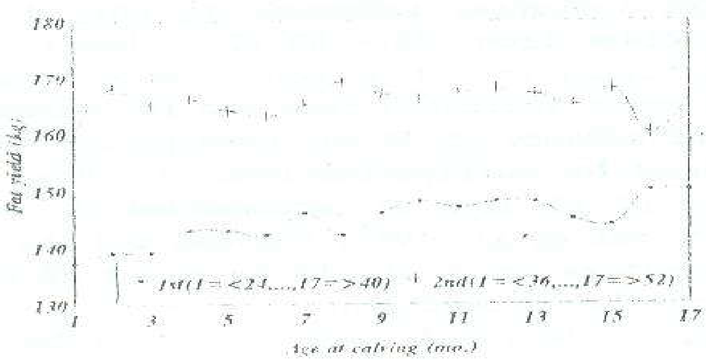

Fig. 5. Effect of age at calving on fat yield in the first two lactations

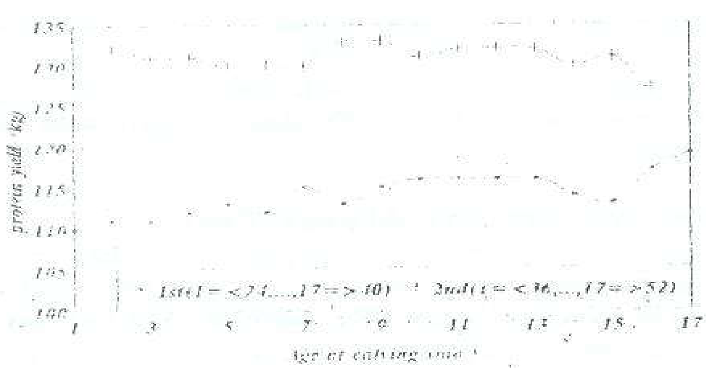

Fig. 6. Effect of age at calving on protein yield in the first two lactations

were 43 month, while cows calved at early (36 mo.) and later age (51 mo.) had the lowest yield traits. In general, cows freshening at 45 up to 48 month recorded relatively the highest performance.

Effect of days open

Days open affected significantly (P<0.001) yield traits and DM, while no significant effects were observed on DD (Table 4). Significant effects of DO on yield traits was reported in Austria and other Europe countries (e.g. Pape et al., 1983; Romberg et al., 1983; Alps et al., 1984; Soliman, 1984; Soliman et al., 1989; Soliman and Khalil, 1989 & 1993). Yield traits and LP increased linearly with the increase of Do (P<0.001). Milk yield, for instance, increased by only 4- 6% for increasing DO class from 30 - 59 (1st class) to 150 - 179 days (5th class) over four months across parities. Least squares means indicated that the increases of the yields with the advance of DO for primiparous cows were higher than those for multiparous cows. In this respect, an open period of 60 days is recommended for economic production (Soliman et al. 1989; Soliman and Khalil 1989 and 1993). Therefore, cows should be mated as early as possible for maximum production.

The delaying of days open may be caused by several factors, e.g. the heat detection routine which have been considered to be the major management procedure affecting fertility traits, farmer's decision and breeding policy. Accordingly, the farmers were to inseminate high-yielding cows later than moderate or low producing cows. In general, 55 - 57 % of cows in different parities had days open periods of up to 89 days. The modal value of 60 - 89 days open are observed for all parities.

Grazing regions (Valley vs. Alpage Pasture)

Least squares analysis of variance (Tables 3 & 4) revealed highly significant effects (P<0.001) of grazing regions on yield traits and DM; while different trends for such effects were observed on AC and DD (P<0.05 or P<0.01), and not significant (P>0.05) on DO. Significant effects of grazing regions on yield traits was reported in Austria by many investigators (e. g. Soliman, 1984; Soliman et al., 1989; Soliman and Khalil, 1989). Yield traits of valley pastured cows were higher than those cows of mountain pastured (alpage) across parities by 4.1-4.4% for milk, 3.7-5.1% for fat and 3.5-4.0% for protein, the differences in advanced parities were higher than those in the first one. The difference between valley-pastured and mountain-pastured cows for age at calving and interval parameters were almost constant (1-2%) across parities. These findings are similar to those obtained by Soliman (1984).

Effect of interactions

The effect of interaction between month of calving and grazing region on traits studies across parities were in most cases significant (P<0.001), while interaction between year of calving and grazing region on all traits of different parities were not significant, except it was significant on DD (P<0.001).

Variance components

The sire effect was significant (P<0.001) for all traits studied (Table 5). The sire component of variance differed slightly between parities (Table 5). The sire contribution ranged from 12.3 to 14.9 % for yield traits, while the corresponding estimates for percentage traits were in general between 6.8 and 10.4 %. Obviously there was no marked reduction in the additive genetic variance due to selection (across parities) especially for yield traits. Estimates for DM, DD, DO and AC were between 1.2 and 2.4 ; 7.1 and 7.7; 2.8 and 3.6; 16.3 and 20.2, respectively. Here the sire component of variance for interval traits were generally small. In general, the percent of sire component of yield and percentage traits and DD for first lactation was higher than that of the subsequent lactations. No consistent pattern for DM was observed, while for DO and AC it increased with the advance of lactations. The percentage of error variance component of all traits increased steadily across parities, except for P% value increased and then decreased. Most of these findings are similar to those obtained from other Austrian studies (e.g. Soliman, 1984, Soliman et al., 1990; Soliman and Khalil, 1989; 1991 & 1993).

Table 5. Variance component estimates (σ^2) and proportions of variation (V %) due to random effects and heritability estimates (h^2) and their standard errors (SE) for interval traits in the first three lactations of Fleckvieh cattle

Traits	Sire+ σ^2	Sire+ V %	Remainder σ^2	Remainder V %	h^2	SE
1st Lactation						
Age at calving	2.83	16.3	14.53	83.7	0.65	0.036
Days open	107.0	2.8	3765.0	97.2	0.11	0.023
Days in milk	39.0	2.4	1597.0	97.6	0.10	0.016
Days dry	69.0	7.7	828.0	92.3	0.31	0.025
Milk yield	76458.0	14.6	448818.0	85.4	0.58	0.034
Fat yield	146.0	14.1	887.0	85.9	0.57	0.033
Protein yield	92.0	14.9	526.0	85.1	0.60	0.034
Fat %	0.0093	9.0	0.0940	91.0	0.36	0.027
Protein %	0.0043	9.0	0.0437	91.0	0.35	0.026
2nd Lactation						
Age at calving	4.88	20.2	19.34	79.8	0.81	0.042
Days open	150.0	3.3	4397.0	96.7	0.13	0.020
Days in milk	21.0	1.2	1697.0	98.8	0.05	0.017
Days dry	64.0	7.1	835.0	92.0	0.29	0.026
Milk yield	91725.0	13.8	571159.0	86.2	0.55	0.035
Fat yield	172.0	12.9	1162.0	87.1	0.52	0.034
Protein yield	115.0	14.9	657.0	85.1	0.59	0.037
Fat %	0.0084	7.6	0.1024	92.4	0.30	0.027
Protein %	0.0048	10.4	0.0414	89.6	0.42	0.031
3rd Lactation						
Days open	187.0	3.6	5048.0	96.4	0.14	0.024
Days in milk	37.0	2.0	1850.0	98.0	0.08	0.021
Days dry	64.0	7.1	840.0	92.9	0.28	0.030
Milk yield	95546.0	13.4	616608.0	86.6	0.54	0.038
Fat yield	179.0	12.3	1276.0	87.7	0.49	0.037
Protein yield	118.0	14.4	703.0	85.6	0.58	0.040
Fat %	0.0075	6.8	0.1022	93.2	0.27	0.029
Protein %	0.0043	9.4	0.0417	90.6	0.37	0.033

+ Contribution of sire to variance of all traits studied was significant ($P<0.001$) in different lactations.

Heritability estimates

Heritability estimates of 305-day milk traits with their standard errors are in Table 5. In general, most of the estimates for yield traits were higher than other published estimates. This could be due to the model. It did not account for the effect in a crossbred population of Brown Swiss X Austrian Braunvieh. Most of the Braunvieh cows in Austria are backcrosses with Brown Swiss cattle, hence the possibility of crosses and more additive genetic variance. The model used considered additive genetic effects. Ignoring non-additive effects might bias variance components. It could be, also, due to some effects that were not included in the model (e.g. some sire progeny-groups lightly differed in age) or may be partially confounded with the sire (in a few cases, a sire was used in just one year and season), and consequently, some upward bias in sire components of variance were obtained, or because the data spanned 6 years, genetic trend could have a slight effect on the estimates. The heritability (h^2) estimates of milk traits of the first lactation record are higher than that for other parities, except for P%. These results are in agreement with other studies (e.g. Karras and Schlote, 1982; Pape et al., 1983; Romberg et al., 1983; Alps et al, 1984; Schneeberger and Hagger, 1986; Soliman, 1984; Soliman et al., 1990; Soliman and Khalil, 1993), but was larger than other estimates (e.g. de Jager and Kennedy, 1987; Wilmink, 1987; Meinert et al. 1989). Estimates of h^2 for yield traits in the first three lactations ranged from 0.54 to 0.58 for MY; 0.49 to 0.57 for FY and 0.58 to 0.60 for PY, while h^2 estimates of fat and protein percentage ranged from 0.27 to 0.36 for F% and 0.35 to 0.42 for P%. These results were in agreement with those of some researchers (e.g. Schneeberger and Hagger, 1986; Dommerholt and Wilmink, 1986; de Jager and Kennedy, 1987; Soliman and Khalil, 1989) but was less than those found by others (e.g. Wilmink, 1987; Meinert et al., 1989). Our estimates of h^2 for yield traits are among the highest in literature. As in yield traits, h^2 estimates of DM and DD also appear to be decreasing steadily with the advance of parities, while an inverse trend was observed for DO and AC. Heritability estimates of DM for the first three lactations (0.05 to 0.10) were lower than the estimates of DO (0.11 to 0.14) and DD (0.28 to 0.31). Heritability estimates of DO found to be larger than that of other studies (e.g. Schneeberger and Hagger, 1986; Hermas et al., 1987; Soliman and Khalil, 1991). Estimates of h^2 for DD were larger than usually found in the literature (e.g. Soliman and Khalil, 1991). Heritability of DD is commonly found to be larger than that of DM and DO. Thus, it may be that usual estimates of heritability of DM and DO are biased downward because of selection on calving interval (e.g. shortening interval between subsequent lactations) and on milk productions. However, h^2 estimates of interval traits are within the range reported in different studies (e.g. Hansen, 1979; Janson and Andreasson, 1980; Seykora and McDaniel, 1983; Strandberg and Danell, 1988; Soliman and Khalil, 1991). It should be emphasized have that the difference in h^2 between parities in interval traits as in yield traits were generally small. Interval traits of first calvers (e.g. DM and DD) were slightly more heritable than that of older calvers.

Conclusions based on studies of reproductive genetics have been diverse and not always directly related to results obtained. Some authors have concluded that due to low heritability, there has generally been little emphasis in selection for these traits, despite the economic importance of fertility in dairy cattle (e.g. Everett et al., 1966 and Hansen et al., 1983b); others have concluded that despite low heritability, AI sires should be evaluated for reproductive efficiency and that some selection should be based on such evaluations to inhibit the decline in fertility resulting from correlated response due to selection for higher production (e.g. Janson, 1980a; Philipsson, 1981; Hermas et al., 1987; Soliman et al., 1990; Soliman and Khalil, 1991). Estimates of h^2 for age at first and second calving (0.65 and 0.80, respectively) were higher than estimates of other measures of fertility and interval traits studied, indicated that selection would results in genetic response. Age at calving may be considered at least in part as measures of maturity as well as measures of fertility. Genetic differences in rate of maturity might have contributed to the higher estimates of heritability. Age at calving seems to be more efficient as a selection criterion than other traits studied.

Genetic, phenotypic and environmental correlations
Correlations between interval and fertility traits

Genetic (r_G), phenotypic (r_P) and environmental (r_E) correlations between interval and fertility traits in the first three lactations are presented in Table 6. Genetic correlations between AC and DO were mostly favourable (0.60 -.0.79), the general level of AC seems to be regulated by the same physiological factors. However, r_P's and r_E's generally were lower than r_G's. No consistent trend was observed for the genetic relationship between AC and DM, which small negative estimate was obtained in the first lactation, while moderate positive estimate was found in the second lactation, however, estimates of r_P and r_E were very small (.04 -.09). The same trend was observed for the relationship between AC and DD.

Table 6. Estimates of genetic correlations with standard errors (below diagonal), phenotypic and environmental+ correlations (above diagonal line) between fertility and interval traits of Braunvieh cattle

Traits	AC	DO	DM	DD
Age at calving (AC)				
1st lactation		0.32 (0.22)	0.04 (0.09)	0.09 (-0.12)
2nd lactation		0.38 (0.29)	0.08 (0.06)	0.08 (-0.11)
Days Open (DO)				
1st lactation			0.06 (0.06)	-
2nd lactation	0.79+0.05		0.08 (0.04)	0.01 (-0.07)
3rd lactation			0.09 (0.06)	0.01 (-0.01)
Days in milk (DM)				
1st lactation	-0.06+0.08	0.57+0.08		-
2nd lactation	0.25+0.10	0.52+0.15		-0.02 (-0.02)
3rd lactation		0.36+0.15		0.01 (-0.03)
Days Dry (DD)				
1st lactation	0.32+0.08	-	-	
2nd lactation	0.25+0.05	0.11+0.09	0.33+0.14	
3rd lactation	-	0.09+0.10	0.21+0.12	

\+ Environmental correlations are given in parentheses adjacent to the phenotypic correlations.

Genetic correlations between DO and DM generally were moderate (0.36 -0.57), but the r_P and r_E were very low. Therefore, selection for shorter DO will lead to shorter DM. The low r_P and high r_G between DO and DM combined with low heritabilities of the two traits (.05 -.10 for DM and 0.11 - 0.14 for DO) show that the environmental conditions under which they are recorded differ considerably. Days open had low correlations (r_G, r_P and r_E) with DD, while moderate r_G's were obtained between DD and DM (0.21 - 0.33), therefore, selection for longer DM will therefore lead to longer DD. In general, r_G's between DO, DM and DD decreased with the advance of parities, while r_P's and r_E's almost constant across parities. However, r_G's and r_P's between AC and both DO and DM increased distinctly with the advance of lactations, while reverse trend was observed between AC and DD. Animal first inseminated as heifers and later as cows constitute a selected group of animals, which may cause a slight bias in the estimate of genetic correlations. Animals culled for fertility disturbances as heifers, were of course not be considered. This selection will reduce genetic variation a little and consequently the estimates of r_G could be assumed to be reduced. The results found in this study, indicate a close genetic relationship between AC and both DO and DD, and also between DM and both DO and DD.

Consequently with the present breeding structure it is possible to evaluate AI bulls for female fertility, but large number of progenies per group are needed to achieve reasonably accurate estimate of breeding value.

In relation heritability for age at calving and different interval traits, AC seem to be more efficient as a selection criterion than the other traits. This trait and also DO have the advantage over the other interval traits, as they can be used for both heifers and cows.

Correlations between milk traits and both fertility and interval traits

Estimates of genetic (r_G), phenotypic (r_P) and environmental (r_E) correlations are given in Table 7. Across parities moderate by negative r_G estimates were observed between AC and yield traits (-0.45 to -0.56), while lower estimates were obtained between AC and percentage traits (-.08 to -0.32). These estimates were in a favourable direction, indicating that selection for increased milk traits would be expected to decrease age at calving. Similarly, most of the reviewed studies showed favourable r_G between AC and milk traits (e.g. Hansen et al., 1983; Seykora and McDaniel, 1983; Hermas et al., 1987; Soliman and Khalil, 1991). These results are important, because AC had significant additive variance (i.e. h^2 for age at first and second calving were .65 and .81, respectively) and so is an obvious target for selection. The phenotypic correlations involving AC and milk traits were of similar direction but lower than r_G's and ranged between -0.02 and -0.07 for yield traits, and between 0.02 to -0.10 for percentage traits. Estimates of r_E between AC and milk traits were positive and higher than the corresponding estimates of r_G and r_P, and ranged between 0.79 and 0.99 for r_E's between AC and yield traits and ranged from 0.12 to 0.27 with percentage traits. In general, correlations between age at first calving and milk traits were higher than the corresponding estimates of age at second calving with milk traits. Increased milk traits may be favourably related to improved AC, since genetic correlations of AC with milk traits in the first two lactations tended to be negative.

Estimates of r_G indicate moderate negative (desirable) relationship between DO and milk traits, and those estimates increased generally with the advance of lactation in the order of -0.15 to -0.41. These favourable estimates are desirable for selection for higher milk traits and shorter DO. Van Arendonk et al. (1987); Strandberg and Danell (1988) and Soliman and Khalil (1991) found higher positive r_G's between DO and yield traits in 1st and 2nd lactations. These r_G's may to some extent be inflated if farmers tend to begin inseminating high producers later than low producers, allowing them to have longer calving intervals. Days open is function of days from calving to the first insemination and nonreturn rate of cows, which both have negative correlation with milk traits; thus, a high antagonistic relationship between DO and milk traits might reflect the increased accuracy of that measure of the general level of fertility.

Antagonistic genetic moderate relationships were obtained for DD with yield traits and P% (-0.14 to -0.33), while positive estimates were found between DD and F%. Those estimates in the third lactation were higher than that of the second one. Similarly, a slight but favourable r_P's between DD and milk traits were found (-.0.06 to -0.09). These trends support Soliman and Khalil (1991), who also found evidence favourable genetic and phenotypic relationships between DD and milk traits. In general, estimates of r_E are small and inconsistent across parities and those estimates were lower than that of r_G and r_P.

Table 7. Estimates of genetic correlations with standard errors (on first line), phenotypic and environmental[+] correlations (on second line) between milk traits and both fertility and interval traits of Braunvieh cattle

Traits	AC	DO	DM	DD
Milk yield (MY)				
1st lactation	-0.55+0.04	-0.15+0.05	0.39+0.07	-
	-0.03(0.79)	0.09(0.29)	0.26(0.28)	-
2nd lactation	-0.45+0.04	-0.29+0.07	0.22+0.11	-0.20+0.06
	-0.04(0.89)	0.07(0.24)	0.25(0.36)	-0.08(0.00)
3rd lactation	-	-0.34+0.08	-0.03+0.11	-0.33+0.07
	-	0.03(0.19)	0.21(0.33)	-0.08(0.09)
Fat yield (FY)				
1st lactation	-0.53+0.04	-0.22+0.05	0.34+0.07	-
	-0.02(0.75)	0.09(0.25)	0.23(0.23)	-
2nd lactation	-0.48+0.04	-0.35+0.07	0.16+0.11	-0.14+0.06
	-0.05(0.86)	0.06(0.23)	0.21(0.27)	-0.07(-0.02)
3rd lactation	-	-0.36+0.08	-0.01+0.11	-0.27+0.07
	-	0.03(0.19)	0.19(0.28)	-0.07(0.06)
Protein yield (PY)				
1st lactation	-0.56+0.04	-0.24+0.05	0.34+0.07	-
	-0.04(0.82)	0.08(0.27)	0.23(0.24)	-
2nd lactation	-0.48+0.04	-0.35+0.07	0.08+0.11	-0.23+0.06
	-0.07(0.99)	0.04(0.24)	0.22(0.32)	-0.09(0.00)
3rd lactation	-	-0.41+0.08	-0.05+0.10	-0.33+0.06
	-	0.01(0.21)	0.18(0.30)	-0.09(0.08)
Fat percentage (F %)				
1st lactation	-0.08+0.05	-0.18+0.05	-0.02+0.08	-
	0.02(0.12)	-0.02(0.08)	-0.03(-0.03)	-
2nd lactation	-0.20+0.05	-0.27+0.09	-0.17+0.13	0.17+0.07
	-0.03(0.19)	-0.01(0.05)	-0.03(-0.01)	0.01(-0.06)
3rd lactation	-	-0.15+0.10	0.04+0.13	0.15+0.08
	-	0.01(0.04)	0.01(0.01)	0.01(-0.04)
Protein percentage (P %)				
1st lactation	-0.24+0.05	-0.22+0.05	-0.07+0.08	-
	-0.04(0.17)	-0.04(-0.02)	-0.04(-0.04)	-
2nd lactation	-0.32+0.05	-0.33+0.08	-0.43+0.13	-0.19+0.06
	-0.10(0.27)	-0.08(-0.01)	-0.04(-0.03)	-0.06(0.02)
3rd lactation	-	-0.40+0.09	-0.10+0.12	-0.15+0.07
	-	-0.06(0.05)	-0.05(-0.05)	-0.06(-0.01)

+ Environmental correlations are given in parentheses adjacent to the phenotypic correlations.

Days in milk had moderate positive r_G's, r_P's and r_E's with yield traits across parities, except r_G's of the third lactation which negative small estimates (-0.01 to -.08) were obtained. Estimates of r_G's of the first lactation were in the order of 0.34 to 0.39 and higher than the corresponding estimates of the second lactation (0.08 to 0.22). Across parities estimates of r_P (0.18 to

0.26) were smaller than those of r_E (0.23 to 0.36). This trend supports other findings (e.g. Hermas et al., 1987; Soliman and Khalil, 1991). Most estimates of r_G, r_P and r_E between DM and percentage traits in all lactations were negative but not different from zero, except r_G's in the second parity. However, the r_G's between DM and yield traits seems to be unfavourable in all lactations. Selection for higher yield traits leads to increasing DM and the interval between calvings.

Correlation between milk traits

Consistently high and positive estimates of r_G, r_P and r_E between yield traits were found across parities and ranged between 0.88 and 0.97 (Table 8). Estimates of r_G were higher than both r_P's and r_E's and most of estimates agreed with other investigators (e.g. Maijala and Hanna, 1974; Karras and Scholte, 1982; Pape et al., 1983; Alps et al. 1984; Soliman, 1984; Wilmink, 1986; de Jager and Kennedy, 1987; Meinert et al., 1989; Soliman and Khalil, 1989 and 1993; Soliman et al., 1990). Consequently, selection for high milk yield will be associated with genetic improvement in both fat and protein yields.

Estimates of r_G and r_P between yield and percentage traits were positive. Estimates of r_G's between milk yield and protein percentage were higher than those estimates of the relationship between milk yield and fat percentage (0.20 - 0.30 vs. 0.10 - 0.13, respectively). The r_G's between protein yield and protein percentage (0.44 - 0.53) increased with the advance of parities and were higher than those r_G's between fat percentage and fat yield (0.38 - 0.41), which the first lactation showed higher values than others. Estimates of r_G of fat yield with protein percentage were higher than the corresponding estimates of protein yield with fat percentage (0.36 - 0.42 vs. 0.23 -0.27, respectively). Phenotypic correlations were provide the same trend. These trends were reported by many investigators (e.g. Hargrove et al.,1981; de Jager and Kennedy, 1987 and Dommerholt and Wilmink, 1986). Positive relationships (r_G, r_P and r_E) between fat and protein percentage were obtained (0.47 - 0.56, for r_G's). Estimates of r_P and r_E are lower than the corresponding estimates of r_G. These results are in agreement with those estimates of Alps et al. (1984); Soliman (1984); de Jager and Kennedy (1987); Soliman and Khalil (1989); Soliman et al. (1990).

Table 8. Estimates of genetic correlations with standard errors (below diagonal) phenotypic and environmental+ correlations (above diagonal) among milk traits of Braunvieh cattle

Traits	MY	FY	PY	F %	P %
Milk yield (MY)					
1st lactation	-	0.93(0.89)	0.95(0.91)	0.06(0.01)	0.06(-0.07)
2nd lactation	-	0.93(0.88)	0.95(0.92)	0.07(0.05)	0.05(-0.14)
3rd lactation	-	0.92(0.88)	0.95(0.92)	0.09(0.09)	0.05(-0.15)
Fat yield (FY)					
1st lactation	0.96+0.01	-	0.95(0.84)	0.43(0.46)	0.17(0.02)
2nd lactation	0.96+0.01	-	0.91(0.85)	0.44(0.50)	0.16(-0.03)
3rd lactation	0.96+0.01	-	0.90(0.84)	0.47(0.53)	0.15(-0.06)
Protein yield (PY)					
1st lactation	0.97+0.01	0.97+0.01	-	0.16(0.08)	0.37(0.34)
2nd lactation	0.97+0.01	0.97+0.01	-	0.16(0.12)	0.36(0.24)
3rd lactation	0.97+0.01	0.96+0.01	-	0.18(0.15)	0.37(0.25)
Fat percentage (F %)					
1st lactation	0.13+0.05	0.41+0.01	0.27+0.05	-	0.33(0.21)
2nd lactation	0.10+0.06	0.38+0.05	0.23+0.06	-	0.30(0.21)
3rd lactation	0.12+0.07	0.39+0.06	0.24+0.06	-	0.27(0.17)
Protein percentage (P %)					
1st lactation	0.20+0.05	0.36+0.01	0.44+0.04	0.56+0.04	-
2nd lactation	0.25+0.05	0.38+0.05	0.49+0.04	0.47+0.05	-
3rd lactation	0.30+0.06	0.42+0.06	0.53+0.05	0.50+0.06	-

+ Environmental correlations are given in parentheses adjacent to the phenotypic correlations.

Implications to Breeding Programs

Heritabilities of 305-day milk traits were larger than most other estimates found in literature. Increasing percentage traits through selective breeding will be somewhat slower than for yield traits.

There were no large systematic changes in estimates of h^2, r_G, r_P and r_E across parities. However, heritabilities for milk traits, DM and DD were higher in first lactation than in later lactations, while genetic variances, however, did tend to increase with parity but the increase in phenotypic variance was generally dominating. As a results of low h^2 of DO and DM genetic improvement or maintenance of fertility has to be based on progeny testing of AI sires. Crucial for successful selection is that the trait evaluated be as closely correlated as possible to the breeding objective. Heritability of selection criterion should be as high as possible, with a large phenotypic variance. Evaluations of the trait should be available early in the life of the animal, preferably before production records are available. In addition, evaluation of the trait should be unbiased by selection or involuntary culling.

Age at calving had the highest h^2 estimates of all fertility and interval traits studied, it is available also for animals without two calvings, and is fairly robust against selection on culling.

Advantage of DO as selection criterion is that DO is directly related to the most important reproductive traits and calving interval. In this study h^2 estimates of DO were to be low, 0.11 - 0.14, although higher than in most studies. If DO is predicted from the last insemination day, it is available rather early in an animal's life, before first parity production information.

In many sire evaluation programs production records are corrected with respect to DO. The goal is to adjust milk traits for the effect of the stress caused by pregnancy. In practice DO would be an ideal trait to use in evaluation of reproductive performance as it is a by-product from sire evaluations for milk traits. Dong and Van Vleck (1989) found that the expected genetic change in calving interval for change in milk yield due to selection on milk yield was 2.1 d for a genetic increase of 450 kg of milk, therefore the economic value of the increased milk yield greatly exceeds the economic value of the decreased fertility as measured by increased calving interval or days open.

Heritabilities of AC and DD were high and moderate, while favourable r_G's of both AC and DD with milk traits were found. Therefore, selection for these traits would result in genetic response without impairing milk traits.

Heifer and cow fertility seem to be closely related, genetically (Janson, 1980b). Therefore, evaluation of bulls for female fertility can be based the fertility performance of heifer. Such a procedure will reduce the selection problem to a minimum. Breeding values of bulls for daughter fertility can be calculated before the result for milk traits and other traits which are considered in bull evaluation become available. From this point of view it is even possible to use the fertility results from first calvers and by adding these to heifer results, accuracy in bull evaluation can be enhanced, provided that biases do not occur due to selection. The fact that r_G's of fertility and intervals traits with milk traits is larger than the r_P's may complicated physiological studies. Even if, in general, high production is associated with problems in reproduction, the phenotypic variation among animals will make the observed relationship small and difficult to detect in experiments.

All r_G's and r_P's of AC, DO and DD with milk traits were favourable suggests that selection for milk traits would cause improvement in general of AC, DO and DD. It has been allowing farmers to have early age at calving and short calving interval, and both factors influenced positively the farmer's income.

Shorting the DO should not be a goal in itself, however. The ultimate goal in selection for better fertility should be to shorten the calving interval parallel with an improvement in conception rate. A major drawback with the interval traits as a selection criterion is that selection for any one of the intervals requires at least one calving, which may cause biases in the breeding values due to selection and also delay bull evaluation.

If the r_G's between milk traits and reproductive performance are negative, as found in this study, heritabilities as low as 0.1 for reproductive traits can lead to troublesome deterioration in reproduction when selection is for milk traits. For this reason, reproductive traits should be considered in dairy selection programs. Artificial breeding organizations should be encouraged to put some emphasis or reproductive performance when choosing cows to produce sons to be progeny tested. Progeny testing of artificial insemination sires for reproductive traits should be considered seriously.

Heritability estimates of protein yield were higher than other yield traits, and h^2 estimates of P% were also higher than for F% . Estimates of r_G's of protein yield and percentage with milk yield were higher than the corresponding estimates of fat yield and percentage with milk yield. Among yield traits r_G's were all strongly positive, therefore selection for any of the yield traits, especially protein yield, will result in substantial positive correlated changes in the other yield traits. On the other hand, single·trait selection to increase any of the percentage traits will attempting to improve yield traits. If payment for milk incorporated protein percentage or protein yield in the price formulae, a selection program could be developed that would increase protein yield, protein percentage and milk yield. As suggested previously, selection for protein yield would be worthy of consideration.

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REFERENCES

Alps, H., Z. Reklewski and G. Averdunk, 1984. Genetische Parameter für die Merkmale der Milchleistung unter besonderer Beruecksichtigung des Eiweisses beim Fleckvieh in Bayern. I. Mitteilung: Einzelmerkmale, Züchtungskunde 56: 88-98.

de Jager, D. and B.W. Kennedy, 1987. Genetic parameters of milk yield and composition and their relationships with alternative breeding goals. J. Dairy Sci. 70:1258.

Dommerholt, J. and J.B.M. Wilmink, 1986. Optimal selection responses under varying milk prices and margins for milk production. Livest. Prod. Sci. 14: 109-121.

Dong, M.C. and L.D. Van Vleck, 1989. Correlations Among First and Second Lactation Milk Yield and Calving Interval. J. Dairy Sci. 72: 1933-1936.

Everett, R.W., D.V. Armstrong and L.J. Boyd, 1966. Genetic relationship between production and breeding efficiency. Journal of Dairy Science 49: 879-886.

Gaillard, C., J. Dommerhold, E. Fimland, L. Gjol-Christensen, J. Lederer, A.E. McClintock, J.C. Mocquot and J. Philipsson, 1977. AI bull evaluation standards for dairy and dual purpose breeds. Livest. Prod. Sci. 4, 115-128.

Hansen, M., 1979. Genetic investigations on male and female fertility. Livestock Prod. Sci. 6: 325-334.

Hansen, L.B., A.E. Freeman and P.J. Berger, 1983. Variances, repeatabilities and age adjustment of yield and fertility in dairy cattle. J. Dairy Sci. 66: 281-292.

Hansen, L.B., A.E. Freeman and P.J. Berger, 1983a. Yield and fertility relationships in dairy cattle. J. Dairy Sci. 66: 293.

Hansen, L.B., A.E. Freemann and P.J. Berger, 1983b. Association of heifer fertility with cow fertility and yield in dairy cattle. J. Dairy Sci. 66: 306.

Hargrove, G.L., D.A. Mbah and J.L. Rosenberger, 1981. Genetic and environmental influences on milk component production. J. Dairy Sci. 64: 1593-1597.

Hartmann, O.; N. Ratheiser and H. Eder, 1992. Cattle Breeding in Austria. Zentrale Arebeitsgemeinschaft Österreichischer Rinderzüchter, 1060 Wien, Austria.

Harvey, W.R., 1990. User's Guide for LSMLWM. Mixed model least-squares and maximum likelihood computer program. PC-Version 2. Ohio State University, Columbus, (Mimeograph).

Hermas, S.A., C.M. Young and J.W. Rust, 1987. Genetic relationship and additive genetic variation of productive and reproductive traits in Guernsey dairy cattle. J. Dairy Sci. 70: 1252.

Janson, L., 1980a. Studies on fertility traits in Swedish dairy cattle. II. Genetic parameters. Acta Agricultural Scandinavica 30: 427-436.

Janson, L., 1980b. Studies on fertility traits in Swedish dairy cattle. III. Evaluation of bulls for daughter fertility. Acta Agricultural Scandinavica 31: 299-312.

Janson, L. and B. Andreasson, 1980. Studies on fertility traits in Swedish dairy cattle. IV. Genetic and phenotypic correlations between milk yield and fertility. Acta Agricultural Scadinavica 39: 313-322.

Karras, K. and W. Schlote, 1982. Ergebnisse von Populationsanalysen für die Milchleistung in verschiedenen Laktationen beim Fleckvieh. Züchtungskunde, 54: 165-172.

Kragelund, K., J. Hillel and D. Kalay, 1979. Genetic and phenotypic relationship between reproduction and milk production. Journal of Dairy Science 62: 468-474.

Maijala, K. and M. Hanna, 1974. Reliable phenotypic and genetic parameters in dairy cattle. 1st. World Congr. Genet. Appl. Livest. Prod. Madrid, Spain, 1: 541.

Meinert, T.R., S. Korver and J.A.M. Van Arendonk, 1989. Parameter estimation of milk yield and composition for 305 days and peak production. J. Dairy Sci.72: 1534-1539.

Pape, H. Chr., J. Claus and E. Kalm, 1983. Schätzung genetischer Parameter in aufeinanderfolgenden Laktationen beim Angler Rind in Schleswig-Holstein. I. Mitteilung: Schätzung von Hertibilitäten. Züchtungskunde 55: 14-23.

Philipsson, J., 1981. Genetic aspects of female fertility in dairy cattle. Livest. Prod. Sci. 8:307.

Romberg, F. J., Schulte-Coerne and D.L. Simon, 1983. Genetische und phänotypische Parameter für die ersten drei Laktationen rotbunter und schwarzbunter Kühe. Züchtungskunde 55: 163-176.

Schaeffer, L.R. and C.R. Henderson, 1972. Effects of days dry and days open on Holstein milk production. J. Dairy Sci. 55: 107.

Schneeberger, M. and C. Hagger, 1986. Relationship of fertility parameters with lactation yield in cows of various crossbreeding levels. 3rd World Congress on Genetic Applied to Livestock Production Vol. 6, pp. 107 - 112.

Seykora, A.J. and B.T. McDaniel, 1983. Heritabilities and correlations of lactation yields and fertility for Holsteins. J. Dairy Sci. 66: 1486-1493.

Soliman, A.M., 1984. Schätzung von Populationsparametern für die Milchleistung des Rindes in Österreich. Dissertation Doktorgrades, Universität für Bodenkultur, Wien (Austria).

Soliman, A.M. and M.H. Khalil, 1989. Milk protein as a breeding objective in Braunvieh cattle breeding. The third Egyptian-British Conference on Animal, Fish and Poultry Production, 7-10 October , 301-316, Alexandria, Egypt.

Soliman, A. M., A.A. Ashmawy, M.H. Khalil and A. Essl, 1989. Analysis of milk production traits of

Pinzgauer cattle in Austria. 1-Non-genetic factors. Journal of Animal Breeding and Genetics 106: 423-432.

Soliman, A.M., M.H.Khalil, A.A. Ashmawy and A. Essl, 1990. Analysis of milk production traits of Pinzgauer cattle in Austria. II-Genetic Parameters. J. Anim. Breed. Genet. 107: 43-51.

Soliman, A.M and M.H. Khalil, 1991. Genetic and phenotypic associations of milk traits with age at calving and with length of open period, dry period and lactation. Egypt. J. Anim. Prod. 28: 131-146.

Soliman, A.M. and M.H. Khalil, 1993. Estimation of genetic parameters for single and composite milk traits in Fleckvieh cattle and their uses in programmes of early selection. Egypt. J. Anim. Prod. 30: 21-37.

Strandberg, E. and B. danell, 1988. Genetic and phenotypic parameters for production and days open period in the first three lactations of Swedish dairy cattle. VI. World Conference on Animal Production, Helsinki, June 27-July 1st August, 1988.

Van Arendonk, J., R. Hovenier and W. De Boer, 1987. Phenotypic and genetic association between fertility and production in dairy cows. 38th Annual Meeting of European Association for Animal Production, Lisbon, Portugal.

Wilmink, J.B.M., 1986. The selection for milk constituents in the Netherlands. Annual conference on dairy cattle genetics on 18 October, 1986, Modena, Italy.

Wilmink, J.B.M., 1987. Efficiency of selection for different cumulative milk, fat and protein yields in first lactation. Ph. D. Thesis, Agric. Univ., Wageningen, Neth.

السمات الوراثية لصفات إنتاج اللبن، والصفات التناسلية والصفات البينية في المواسم الثلاثة الأولى في أبقار البراونقيه

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أستعملت فى هذه الدراسة ستة نماذج خطية مختلطة لدراسة التأثيرات الثابتة للعوامل غير الوراثية والتأثير العشوائى لكل من الأب وتأثير التداخل بين كل من شهر وسنة الولادة مع المنطقة على صفات إنتاج اللبن والصفات التناسلية والصفات البينية. وأستخدمت طريقة الحد الأدنى للمربعات لتحليل التباين لبيانات الدراسة.

وأستخدمت الدراسة عدد ٣٤٤٤٧ سجل للمواسم الثلاثة الأولى لأبقار البراونقيه النمساوية وتم إجراء التحليل لبيانات كل موسم على حده.

والصفات التى درست هى محصول كل من اللبن والدهن والبروتين وكذلك نسبة الدهن والبروتين فى اللبن، والصفات البينيه وهى أيام الحليب وأيام الجفاف، والصفات التناسلية أشتملت على الأيام المتوحة والعمر عند الولادة.

<u>وتلخصت النتائج فيما يلى:</u>

١- تأثير كل من شهر الولادة والعمر عند الولادة كان معنويا على كل الصفات المدروسة.

٢- كان تأثير سنة الولادة معنويا على معظم الصفات.

٣- كان تأثير الأيام المتوحة معنويا على كل الصفات المدروسة بإستثناء أيام الجفاف حيث كان التأثير عليها غير معنوى.

٤- قيم المعامل الوراثى (و^{2}) كانت ٠,٦٥، ٠,١١، ٠,١٠، ٠,٣٥، ٠,٥٨، ٠,٥٧، ٠,٦٠، ٠,٣٦، ٠,٣٥ لكل من العمر عند الولادة والأيام المفتوحة وأيام الحليب وأيام الجفاف ومحصول اللبن والدهن والبروتين ونسبة الدهن ونسبة البروتين فى اللبن فى الموسم الأول.

٥- قيم المعامل الوراثى (و٢) لهذه الصفات فـى الموسم الثانى هى ٠,٨١، ٠,١٣، ٠,٠٥، ٠,٢٩، ٠,٥٥، ٠,٥٢، ٠,٥٩، ٠,٣٠، ٠,٤٣ على الترتيب.

٦- بإستثناء العمر عند الولادة كانت قيم المعامل الوراثى (و٢) المقابلة فى الوسم الثالث هى ٠,١٤، ٠,٠٨، ٠,٢٨، ٠,٥٤، ٠,٤٩، ٠,٥٨، ٠,٢٧، ٠,٣٧ على الترتيب.

٧- كانت معاملات الإرتباط الوراثى والمظهرى والبيئى عالية وموجبة بين صفات محصول اللبن والدهن والبروتين فى كل من المواسم الثلاثة الأولى، وبلغت قيم معامل الأرتباط الوراثى ٠,٩٧ وتراوحت قيم المعامل المظهرى بين ٠,٩٠ – ٠,٩٥ وقيم المعامل البيئى بين ٠,٨٤ – ٠,٩٢ .