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Introduction

Some genes may affect more than one trait. Therefore, the traits can be genetically correlated. Knowledge of genetic correlations among traits is useful for efficient selection of replacement bulls and heifers if the breeder considers more than one trait. In designed selection programs, emphasis to be placed on the various traits can depend, in part, on the genetic correlations among them. In addition, genetic correlations can be used to predict what is expected to happen to traits other than those used in selection as a result of that selection. This effect on traits other than those used in selection is referred to as correlated response.

The objective of this study was to estimate from experimental data the genetic correlations between reproductive and maternal traits of beef females and growth and carcass traits of paternal half-sib steers. A more detailed account of the methodology and results can be found in the Journal of Animal Science, volume 58, pages 1171 to 1180.

Procedure

This study includes data on calves born at MARC during 1970, 1971, and 1972. Straightbred Hereford and Angus cows were mated to either Hereford, Angus, Jersey, South Devon, Limousin, Charolais, or Simmental sires to calve from late February to early May. Bull calves were castrated at birth, and all calves had access to creep feed from mid-July until weaning in late October.

After weaning, heifers were fed *ad libitum* a diet of approximately 50 percent corn silage and 50 percent grass haylage with supplemental protein and minerals. Heifers were observed for estrous activity twice daily from approximately 250 to 510 days of age, except in 1971, when estrous detection ceased at about 480 days of age. A breeding season of approximately 65 days started when the average age of all heifers was 430 days. During the first two-thirds of the breeding season, all heifers were artificially inseminated with semen from either Hereford, Angus, Devon, Holstein, or Brahman bulls. In the latter one-third of the breeding season, natural service Hereford and Angus sires were used.

Postweaning management of steer calves differed from that of their half-sib heifers. After a 25- to 30-day adaptation period, steers were implanted with 36 mg diethylstilbestrol (DES) and assigned to feedlot pens with fence-line bunks. Steers were also fed *ad libitum,* but the dietary energy density increased periodically as they matured. Steers were slaughtered in one of three groups at about one-month intervals. The initial slaughter group was killed after 190 days on feed in 1971, 169 days in 1972, and 194 days in 1973. The right side of each carcass was transported to Kansas State University. Sides were cut into wholesale cuts and cuts fabricated into boneless (except for rib and short loin), closely trimmed (.3 in) retail product (steaks, roasts, and lean trim), fat trim, and bone.

Results

Estimated heritabilities for the traits studied are presented in Table 1. Heritability estimates for age and weight at first observed estrus, or puberty (61 pct and 70 pct, respectively), are somewhat higher than previously reported estimates. The 3 percent heritability for conceptions/service in this study is in agreement with previous estimates for fertility, whether measured as calving rate, conception/service, or services/conception. Gestation length and calf birth weight have been implicated in the incidence of dystocia and calf mortality. In this study, gestation length, calf birth weight, calving difficulty, and preweaning daily gain were treated as traits of the cow. Heritability estimates were 30 percent for gestation length, 37 percent for calf birth weight, and 22 percent for calving difficulty. The heritability estimate for preweaning gain of the calf, as a trait of the dam, was 9 percent. Previous studies suggest the heritability of preweaning gain, as a trait of the dam, lies in the range of 17 to 34 percent. The heritability of preweaning gain, as a trait of the calf, was also found to be low (7 pct) in these data.

The amount of feed eaten by a cow is related to her weight. Therefore, cow size may be important in the evaluation of alternative selection objectives. Mature weight has been one commonly used measure of size. The estimated heritability of the average of four weights taken at 7 years of age was 54 percent in this study.

Heritability estimates for daily gain (36 pct), carcass weight (44 pct), retail product weight (45 pct), and trimmed fat weight (50 pct) found in this study are comparable with other estimates in the literature. Selection to increase (or decrease) any of these traits measured on steers should be effective.

Also presented in Table 1 are estimated genetic correlations of traits expressed in males and females. Postweaning daily gain, carcass weight, and retail product weight at a constant age seem to have similar genetic associations with the complex of female reproductive and productivity traits studied.

Since retail product weight and carcass weight had essentially equal heritabilities, predicted correlated responses to selection for either trait are also similar. Predicted correlated responses to selection for either retail product weight or carcass weight are greater in magnitude than those for daily gain selection, due primarily to the higher heritabilities of the former traits. Selection for increased carcass weight or retail product weight of steers at a constant slaughter age should result in heifers that are older and heavier at puberty and have slightly improved fertility. The gestation length of these heifers and calf birth weight would increase slightly, although, maternally, calving would occur with less difficulty. The inconsistency of a larger calf and less calving difficulty is perhaps explained by the increased size of the heifer.

Selection for decreased fat recently has received considerable attention. While this course of action may result in more desirable carcasses, the genetic correlations found in this study may indicate possible problems. Females from sires selected for reduced fat trim of steer progeny would be expected to reach puberty later and at a heavier weight, have reduced fertility, and be larger at 7 years of age. These data also suggest a longer first gestation with the resultant calf born heavier and with greater difficulty.

These results document the existence of unfavorable genetic correlations between component traits of female productivity and progeny carcass value. Therefore, specialized sire and dam lines appear to merit consideration in beef production. Alternatively, selection indexes that incorporate both carcass value traits and maternal productivity traits provide logical selection objectives in general purpose populations. Genetic progress in a general purpose population would be slower than progress that could be made from crossing sire and dam lines selected for specialized roles.

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Table 1.—Estimated genetic correlations of reproductive and material traits with growth and carcass traits. In parentheses are the respective heritability estimates (h^2) and the number of heifers or steers (n)[a]

	Growth and carcass traits of steers			
Reproductive and maternal traits of females	Daily gain (h^2 = .36; n = 1,095)	Carcass wt (h^2 = .44; n = 1,071)	Fat trim wt (h^2 = .50; n = 1,071)	Retail product wt (h^2 = .45; n = 1,064)
Age at puberty (h^2 = .61; n = 813)	.16	.17	−.29	.30
Weight at puberty (h^2 = .70; n = 841)	.07	.07	−.31	.08
Conceptions/service (h^2 = .03; n = 771)	+[b]	.61	.21	.28
Gestation length (h^2 = .30; n = 580)	−.10	.03	−.07	.13
Calving difficulty (h^2 = .22; n = 590)	−.60	−.31	−.36	−.02
Birth weight (h^2 = .37; n = 581)	.34	.37	−.07	.30
Preweaning daily gain (h^2 = .09; n = 624)	−[b]	−[b]	−[b]	−.26
Mature weight (h^2 = .54; n = 639)	.07	.21	−.09	.25

[a]Genetic correlations have an expected range from −1.0 to +1.0. Estimates in the ranges .7 to .10 and −.7 to −1.0 indicate strong positive and negative genetic relationships between traits, respectively. Estimates from −.2 to .2 indicate weak genetic relationships between traits.

[b]The estimated genetic correlation was either greater than +1.0 or less than −1.0. Only the sign of the estimate has been reported.