SELECTION FOR INCREASED WEANING OR YEARLING WEIGHT IN ANGUS CATTLE. II. EVALUATION OF RESPONSE

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Story in Brief

Three 50-cow, 4-sire lines of Angus cattle were selected for individual weaning weight, individual yearling weight or a combination of individual and progeny weaning weights as part of a long term selection project. Also, a contemporary Angus control line was maintained to monitor yearly environmental changes. The objective of this portion of this study was to evaluate direct and correlated responses, measured as deviations from the unselected control, after 14 years of selection for increased weaning or yearling weight.

Genetic responses, averaged over sexes, for weaning weight and yearling weight, respectively, were 3.61 and 4.89 lb/yr in the weaning weight line, 3.81 and 7.89 lb/yr in the yearling weight line and 4.81 and 8.33 lb/yr in the progeny test line. Positive correlated responses of .55, 1.03 and .67 lb/yr were observed for birth weight in the weaning weight, yearling weight and progeny test lines, respectively. Slight positive correlated responses were observed for conformation grades in all three lines. Realized heritabilities were .29 for weaning weight and .37 for yearling weight and the realized genetic correlation between weaning weight and yearling weight was .81. All genetic responses and realized heritabilities may have been slightly underestimated since a small amount of selection occurred for weaning weight and yearling weight in the control line.

(Key Words: Beef Cattle, Selection Response, Weaning Weight, Yearling Weight, Angus).

Introduction

Genetic change brought about by selection is often complicated to evaluate since the observed change in performance is the result of both genetic and environmental factors. Thus, separation of observed change into its component parts is a primary concern in the analysis of selection experiments. One way to eliminate environmental trend from the observed change is to use an unselected control population, maintained and reproduced in the same environment as the selection lines. Ideally, a control line has no selection pressure applied to any trait, thus the only fluctuations in average animal performance should be environmental or non-genetic in nature. Differences between the select and control lines should represent genetic response to selection.

Control populations have often been used in selection experiments involving laboratory animals; however, few such studies have been conducted with livestock. The objective of this portion of the study was to evaluate direct and correlated responses, measured as deviations

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from an unselected control, after 14 years of selection for increased weaning or yearling weight in Angus cattle.

Materials and Methods

Three selection lines and an unselected control line were established from a common base of Angus cattle in 1963 as part of a long-term selection project at the Oklahoma Agricultural Experiment Station. Selection criteria were heaviest individual 205-day weaning weight (WWL), heaviest individual 365-day (bulls) or 425-day (heifers) yearling weight (YWL) and a combination of heaviest individual and progeny 205-day weaning weights (PTL). Bulls and heifers in the control line (CL) were chosen to have as near zero selection differentials as possible for both weaning and yearling weight. First selections were made from the 1965 calf crop and continued through 1979 in all lines except the PTL which was terminated with the 1978 calf crop. Fifty cows were maintained in each line with two bulls and 10 heifers being selected on line criteria within each line each year. Selected bulls were used for two years.

Performance data through yearling age was collected on 694, 691, 666 and 698 calves in the WWL, PTL and CL, respectively. Performance traits analyzed were birth weight (BW), preweaning average daily gain (WDG), weaning weight (WW), weaning conformation grade (WG), weaning condition score (WC), weaning to yearling daily gain (YDG), yearling weight (YW), yearling conformation grade (YG) and yearling condition score (YC). Weaning weights were adjusted to a 205-day basis and then adjusted for age of dam. Yearling weights (365-day for bulls and 425-day for heifers) were calculated by multiplying YDG by 160 for bulls and 220 for heifers and adding 205-day age of dam adjusted WW.

More detailed descriptions of line formation and management were presented in the first article of this series.

Results and Discussion

Phenotypic Trends

Annual phenotypic trends for each line are presented in Figures 1-3 for BW, WW, and YW. Generally, the selection lines followed similar patterns of phenotypic response. A negative trend was observed for BW in all lines except YWL. Also, growth traits exhibited negative trends with the exception of YDG and YW in the selection lines. Phenotypic trends for conformation grades and condition scores were positive in all lines. To help clarify phenotypic time trends, regression coefficients of performance on year, averaged over sexes, are given in Table 1 for the nine traits evaluated in each line.

Genetic Trends

Phenotypic trends are the result of both genetic and environmental factors; however, phenotypic trend in the CL should be a reflection of environmental trend. Thus, genetic trends in the selection lines were calculated as deviations from the CL. Annual genetic trends for WW, averaged over sexes, for the three selection lines are depicted graphically in Figure 4. Generally, the lines progressed at similar rates over time, improving until the 1978 calf crop. Figures 5 and 6

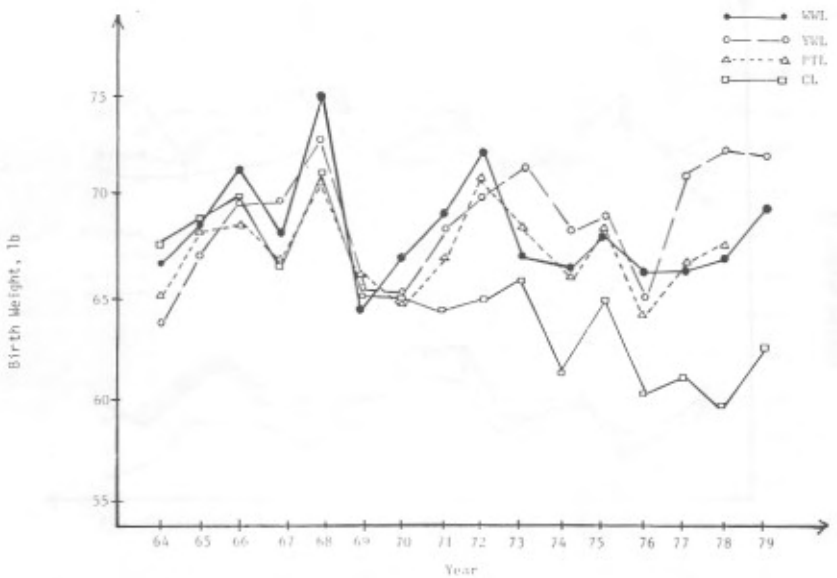

Figure 1. Annual phenotypic means for birth weight averaged over sex.

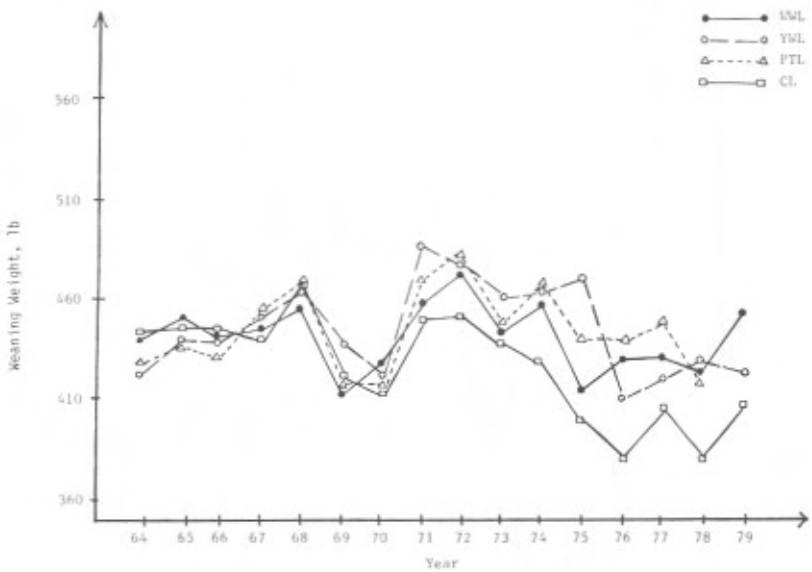

Figure 2. Annual phenotypic means for 205-day weaning weight averaged over sex.

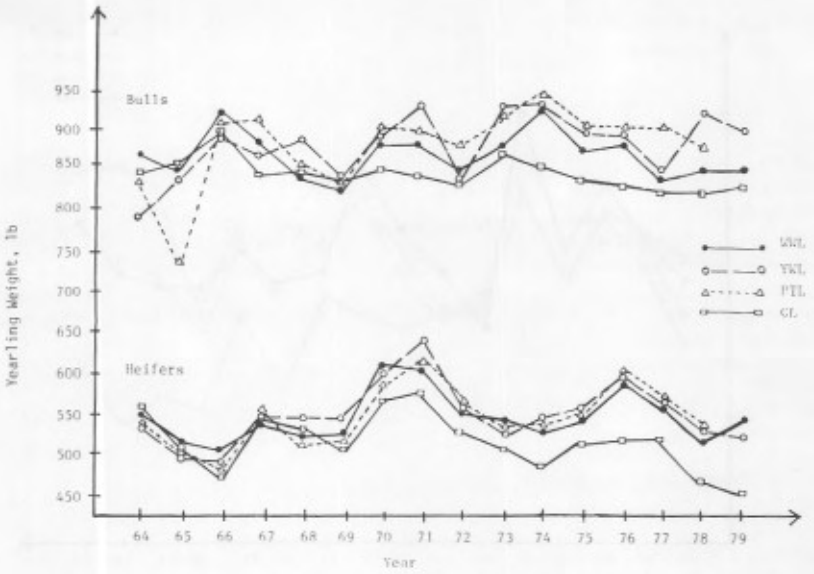

Figure 3. Annual phenotypic means for yearling weight for bulls (365-day) and heifers (425-day).

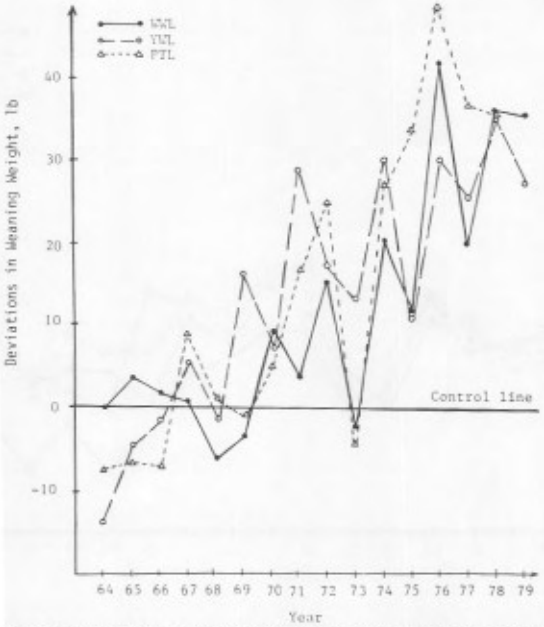

Figure 4. Annual genetic trend for 205-day weaning weight averaged over sex as deviations from control.

Table 1. Coefficients of regression of performance on year averaged over sex.

Trait	Line[a]			
	WWL	YWL	PTL	CL
Birth weight (lb/yr)	-.195	.285	-.080	-.749
Preweaning daily gain (lb/day/yr)	-.003	-.008	.005	-.017
Weaning weight (lb/yr)	-.712	-.517	.481	-4.326
Weaning conformation grade[b]	.074	.064	.076	.050
Weaning condition score[c]	.097	.068	.087	-.065
Weaning to yearling daily gain(lb/day/yr)	.005	.022	.021	-.003
Yearling weight (lb/yr)	.0003	2.992	3.431	-4.894
Yearling conformation grade[b]	.082	.091	.072	.059
Yearling condition score[c]	.064	.065	.066	.066

[a]WWL=weaning weight line, YWL=yearling weight line, PTL=progeny test line, CL=control line.
[b]Conformation grade on a 17 point scale with 13=average choice.
[c]Condition score on a 9 point scale with 1=thin to 9=very fat.

represent genetic trends for YW of bulls and heifers, respectively. Again, the annual genetic trends for the selection lines followed similar patterns; however, YW means for bulls were more eratic than for heifers.

Annual genetic trends in each line are presented in Table 2 by sex and averaged over sexes. In general, genetic trends followed a similar pattern for both sexes with genetic response tending to be larger for bulls. However, genetic responses for conformation grades and condition scores were higher for heifers.

Genetic responses, averaged over sexes, for WW and YW, respectively, were 3.61 and 4.89 lb/yr in the WWL and 3.81 and 7.89 lb/yr in the YWL. Thus, the correlated response in WW from selection for YW was greater than the response obtained by directly selecting for WW. Conversely, the correlated response in YW from selection for WW was only 62 percent as effective as direct selection for YW. Unfortunately, positive correlated responses of .55 and 1.03 lb/yr were observed for BW in the WWL and YWL, respectively. In both lines, slight positive correlated responses were observed for WG, WC and YG with very little change observed for YC.

Annual genetic responses, averaged over sexes, were also evaluated in the PTL. Direct response for WW was 4.81 lb/yr and correlated response for YW was 8.33 lb/yr. Both values are larger than the

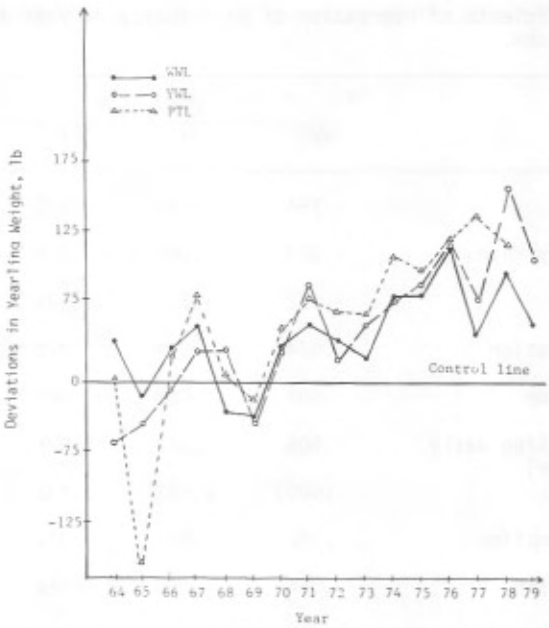

Figure 5. Annual genetic trend for 365-day yearling weight of bulls as deviations from control.

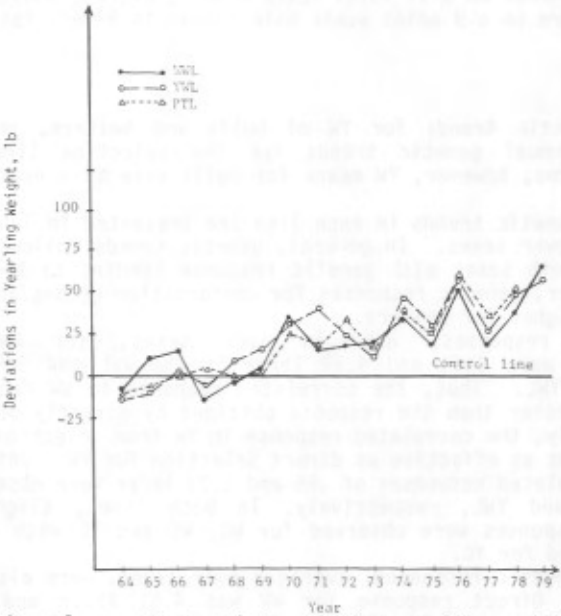

Figure 6. Annual genetic trend for 425-day yearling weight for heifers as deviations from control.

Table 2. Estimates of genetic trend per year from differences between selection and control lines.

	Line[a]								
	WWL			YWL			PTL		
Trait	Bulls	Heifers	Avg.	Bulls	Heifers	Avg.	Bulls	Heifers	Avg.
Birth weight (lb)	.55	.56	.55	1.15	.91	1.03	.75	.59	.67
Preweaning gain (lb/day)	.01	.01	.01	.01	.01	.01	.02	.02	.02
Weaning weight (lb)	4.24	2.99	3.61	4.81	2.82	3.81	5.28	4.34	4.81
Weaning conf. grade[b]	.01	.01	.03	.01	.01	.01	.02	.03	.03
Weaning cond. score[c]	.02	.05	.03	.00	.01	.00	.02	.03	.02
Weaning-to yearling gain(lb/day)	.01	.01	.01	.04	.01	.03	.03	.01	.02
Yearling weight (lb)	5.64	4.14	4.89	10.85	4.92	7.89	10.01	6.64	8.33
Yearling conf. grade[b]	.02	.03	.03	.03	.03	.03	.00	.03	.02
Yearling cond. score[c]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[a]WWL=weaning weight line, YWL=yearling weight line, PTL=progeny test line.
[b]Conformation grade on a 17 point scale with 13=average choice.
[c]Condition score on a 9 point scale with 1=thin to 9=very fat.

respective genetic responses observed in the WWL and YWL. Birth weight showed a positive genetic response intermediate to that observed in the WWL and YWL while responses in conformation grades and condition scores were similar in all lines.

Realized heritabilities based on genetic response and mean cumulative selection differentials were .29 for WW and .37 for YW. These realized heritabilities may have been slightly underestimated since a small amount of selection occurred for WW and YW in the early years of the study. The realized genetic correlation between WW and YW was .81.

Conclusions

Results obtained from this study indicate that selection for WW or YW should result in improved growth rate in beef cattle. Selection for YW appears to be the most effective for increasing both WW and YW; however, larger increases in BW result as well. Although selection for WW based on a combination of individual and progeny test information resulted in larger responses in WW and YW per year, the added expense of progeny testing may limit its practicality. The high genetic correlation between WW and YW (.81) will allow breeders to use WW as an effective early culling procedure even if the primary selection objective is to increase YW. In selection programs designed to increase growth rate some attention should be given to minimizing the correlated response of increased BW.