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Choosing Breeds and Crossbreeding Systems by Computer

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Progress Report No. 2

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The first report dealing with this project appeared in the Cow-Calf Field Day bulletin, August, 1972. That report presented an example to demonstrate the utility of the program for the cow-calf man. The example was based on estimates of performance traits for specific breeds under a particular environment and management situation and on market conditions existing at that time. The management system basic to the program took the weaning calf to 700 pounds in a backgrounding phase and then through a 140-day feedlot phase which was split into a 50-day growing period and a 90-day finishing period. The purpose of this report is to investigate varying certain of the marketing conditions, specifically selling on a retail cut basis rather than a carcass weight basis, and, secondly, eliminating the carcass quality grade as a basis for pricing the carcass. The results should assist the producer in evaluating breeds and crossbreeding systems for the marketing system he thinks will be most commonly used in the future.

Procedure

All inputs into the program remain the same for this study as they were for the first study except that where carcasses were not graded the grade spread was entered as zero rather than the 4 cents per pound spread between average choice and average good used in the first study.

Four systems were compared. The first system was that of selling on a carcass weight and grade basis. This was the basis for the first report. The second system calculated the retail cuts for each breed and crossbred and these were sold on a carcass grade basis. Selling price per pound of retail cuts was increased 60% as compared to carcass beef price in order to reflect the increased value. This was standard for all breeds and all crossbreds. Total retail cuts were used in the program.

The price spread between average choice and average good was set at zero and the sale based on carcass weight in system 3. System 4 was based on retail cuts for sale weight and zero price spread relative to carcass quality grade.

Some justification for choosing these four systems may be in order. First, it has been apparent for some time that all carcasses of equal weight are not of equal value in terms of the edible product they yield. Indeed, the change that the beef industry has been going through in recent years was primarily generated by the large amount of waste fat that had to be trimmed from many of the carcasses marketed. This, of course, led to the yield grades which estimate the yield of retail cuts from the four primal cuts (cutability). It is generally accepted that a measure of retail cuts is a better measure of the salable meat

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in a carcass than is the carcass weight itself and some packers have recently been paying a premium for carcasses yielding a higher proportion of retail cuts.

The grading system seems to be perpetually under attack by some segment of the industry. At the present time there are rumblings within the industry to change the standards again. Because of this and because past research on carcass grading may not be well known to the average producer, some discussion of the grading system may be in order.

The carcass quality grade is primarily dependent upon three factors, marbling, maturity and conformation. Although it is generally agreed that conformation is a measure of quantity rather than quality, the carcass quality grade standards still include conformation as part of the grade. Within a maturity group, marbling is the most important factor in determining carcass grade. Many of the arguments about what is most important in determining carcass grade revolve around the range in age of the carcasses studied. If the carcasses come from animals ranging in age from 18 months to 5 years, the maturity factor will likely be most important, while, if the carcasses come from animals aged 18 to 24 months, marbling level will probably be the most important in determining carcass grade.

The critical issue is referred to above, that of meat quality versus carcass grade. This question has received a great deal of research attention in the past. A review of the literature which includes most but not all references starts with a study by Hostetler in 1936 which concluded that marbling was not an important factor in determining tenderness. In 1945 Ramsbottom and co-workers studying tenderness of beef concluded that there was no relationship between tenderness and the fat within a muscle (marbling). Cover et al. (1956) in Texas studied both juiciness and tenderness in their relationship to marbling and found that marbling was indicative of only 10 to 25% of the differences in both tenderness and juiciness and the remaining 75% of the differences were due to undetermined factors. In 1959 Palmer and co-workers concluded that a low relationship existed between marbling and tenderness as did Wellington and Stouffer in 1959. In addition, they found a low relationship to juiciness. During the 1960's there were a number of studies dealing with this general area of the relationship of marbling and maturity to palatability factors and overall acceptance. These references are provided in the bibliography for those who wish to read further on the subject. Summarizing these, there seems to be general agreement that carcass grade and/or marbling has a very low relationship to tenderness, whether measured by shear or by taste panel. Some 12 studies support this conclusion. There were seven reports indicating a low relationship to juiciness, five reports of a low relationship to flavor and six reports of a low relationship to overall acceptance.

Costello and Shafer working here at South Dakota State reported results at the 1968 beef cattle field day which gave an indication of the relationship of marbling and maturity in determining the actual quality factors of the meat. They studied the carcasses of 123 female bovine animals ranging in estimated live age from the first group of 10 to 18 months to aged cows beyond 5 years of age. Maturity groups A, B, C, D and E were represented and carcass grades choice through cutter were represented. When all females were studied together, carcass grade accounted for one-third to one-half of the differences in tenderness as measured by the shear or taste panel, respectively. When the youthful group, maturity scores A and B, were studied alone, this relationship dropped with only 7 to 30% of the differences in tenderness accounted for by carcass grade. In the older group, maturity scores C, D and E, carcass grade accounted for 4 to

19% of the differences in tenderness. In the overall study with all carcasses included, carcass grade accounted for approximately 50% of the differences in taste panel flavor. Comparable figures in the young and old groups were 25% and 20%, respectively.

Busch studied data collected from 289 Hereford steers produced on a number of South Dakota ranches and fed at South Dakota State University. These steers were slaughtered at 15 to 18 months of age. Differences in carcass grade accounted for .1% of the differences in tenderness.

These results are in agreement with results from other institutions which indicate that, within age groups, differences in carcass grade are not very meaningful in predicting actual meat quality. Ziegler et al. (1971) studied data from 402 carcasses and found that carcass grade accounted for .04% of the difference in tenderness measured by taste panel, .7% of the difference in flavor, 2.5% of the difference in juiciness and 1.2% of the difference in total acceptance. This means that 98% or more of the variability in quality factors was not predictable from carcass grade.

Some of the reasons for the low correlation between carcass grade and actual meat quality may be variation within an animal, environmental factors at the plant during the kill and chill periods and how the carcass is ribbed. For example, Blumer and co-workers in 1962 found a great deal of variation in marbling within an animal and even within a muscle. This ranged up to 2 2/3 marbling grades in one rib cut. They also found variation from one side to the other of the same carcass. The length of time the carcass is chilled is another important factor in determining the grade. Producers marketing on a grade and yield basis with less than a 24-hour chill may find carcasses grading low as compared to what they might have graded with a longer chill.

Since a large proportion of our slaughter beef is in the young maturity groups (all of it is in the program discussed here) and since future changes in the grading system cannot be forecast, the price differential between grades was omitted in systems 3 and 4 rather than to guess at some nonexistent change that might be made in the system. For these reasons the four systems indicated were utilized.

Results and Conclusions

The packer and industry returns for each of the four systems for the straightbred and three different crossbred groups are presented in table 1. System 1 was used to order these groups on industry return since it was the data reported in the first progress report and is thought to be reasonably typical of present industry marketing practice. Since there are a possible 28 two breed rotation crosses, 56 three breed rotation crosses and 168 specialized crosses, only the top ten breeding groups are reported for each of the crossbred systems. In the case of ties, more than ten are reported to include all that are equal in industry return. In each case, though, they are ranked on industry return of system 1.

It is apparent immediately that selling on a retail cut basis versus a carcass weight basis influences packer return and influences industry return. Not all breeds or crosses respond the same with higher yielding breeding groups such as Limousin and Charolais increasing and lowering yielding groups such as Jersey and Jersey crosses decreasing. In some cases, crosses in the top ten on system 1

do not appear in the top ten in system 2 where the only difference is yield of retail cuts. Generally over all groups, there is an increase in packer return which results in a general overall increase in industry return. There are few exceptions to this.

Considering graded versus nongraded, again there is a general increase in packer return and a resulting increase in industry return brought about by the fact that carcasses grading good now sell for the same price as choice in this system. The response from the different breeding groups is variable and dependent upon the percentage expected to grade choice which is part of the input to the program. The additional cost for the U.S.D.A. quality grading service was not included. Including this cost would further favor systems 3 and 4.

At this point, it is important to understand that the returns for systems 2, 3 and 4 probably do not have the distribution to the producing segments that they would have if carcasses were actually marketed under those conditions. The manner in which marketing has been handled in the computer provides the packing phase with all of the increased return from systems 2, 3 and 4. In actual practice, this would likely be distributed back to the other three phases. Since there appeared to be little basis for predicting this distribution, it was left entirely in the packer phase. Tables 2 and 5 present the return to labor for the four phases and the total for industry for each of the four systems used in this study. These tables allow an evaluation of the straightbreds and the top ten of the crosses for each of the systems subject to the conditions of the breed estimates, costs and marketing conditions specified in the computer input (see Report No. 1).

It seems apparent that in the distribution of the increased return the cow-calf phase of the industry will have to receive major consideration, since it appears that this segment would be the least well paid in relation to system 1 or the present marketing system. This could be said in another way. That is, if retail cuts and/or the ungraded basis become an important part of our marketing system, then the breeds and crosses that rate high in yield of retail cuts, irrespective of their grading ability under the present system, should command a higher price per pound at weaning to repay the producer for his costs in producing these cattle. Some breeds that exhibit a high yield of edible product have a higher cow maintenance requirement due to either large size or higher milk production levels.

Because of the variability of the various breeds in yield of retail cuts and in percent choice, it is difficult to draw a general conclusion relative to the two main factors studied. There can be little question that marketing on the basis of retail cuts free of the waste trim is a more desirable procedure. This is reflected in the computer estimates presented in tables 3 and 5 when they are compared to tables 2 and 4.

The ungraded carcass basis in system 3 obviously helps those breeds that were estimated to have a low percent choice but a high dressing percent. The ungraded system in combination with retail cuts, system 4, naturally helps those breeds most that were low in percent choice and high in yield of retail cuts. There appears to be an increase perhaps of the order of $10 to $15 in industry return associated with retail cut sales and a like amount with the ungraded system.

Because of the large number of crosses in tables 3, 4 and 5, no attempt will be made to evaluate all of them. Instead, consideration of each crossbreeding

system in table 5 will be used to demonstrate how evaluation of crosses under this marketing system can be compared to the results of the first report (table 2). The producer can then apply this method to his choice of marketing system.

For the two breed rotation in the first report, the Angus-Hereford cross was highest in industry return and also in weaning return. In table 5 the Charolais-Limousin cross is highest in industry return and exceeds the Angus-Hereford cross by $20. If all of the $20 increase is passed back to the cow-calf producer, this would give a weaning comparison of $33 versus $43 for the Angus-Hereford. If this is done, then the packer return must be reduced by $20. It appears that the packer return could be reduced still another $10 to $30, bringing the Charolais-Limousin equal to the Angus-Hereford in weaning return and still returning the packer $16 more than the Angus-Hereford cross. In addition, the feeder would enjoy a $6 advantage. The second two breed rotation, the Hereford-Limousin, has a $14 advantage which if applied to the cow-calf phase would result in equal return at weaning, a $3 advantage to the Hereford-Limousin in the backgrounding, a $1 advantage in the feedlot for the Angus-Hereford and a $13 advantage at the packer phase for the Hereford-Limousin.

Applying the same technique to the three breed rotation, we see that the Charolais-Simmental-Limousin cross has a $24 advantage over the Angus-Hereford-Red Poll which when applied to the weaning phase brings that return to $40 as compared to $46 for the Angus-Hereford-Red Poll. There is a $3 advantage to the Charolais-Simmental-Limousin at backgrounding, a $7 advantage in the feedlot and a $19 advantage to the packer. The Hereford-Charolais-Limousin cross is equal in industry return to the Charolais-Simmental-Limousin in table 5 and, if the $24 advantage over the Angus-Hereford-Red Poll in industry return is applied to the weaning phase, the return at weaning is $50 or a $4 advantage for the Hereford-Charolais-Limousin, a $3 disadvantage at backgrounding, a $2 advantage in the feedlot and a $6 advantage in the packing phase. Several of the remaining three breed rotation crosses compare favorably, also.

The Limousin by Angus-Hereford specialized cross was tied with the Red Poll by Angus-Hereford cross in the first report. In order to simplify the discussion, comparison will be made only to the Limousin by Angus-Hereford cross. In both systems, there is little variation among the top eleven or twelve specialized crosses. Where ties occur, they are listed in alphabetical order. The Charolais by Hereford-Limousin specialized cross in table 5 has a $26 advantage in industry return. Applying this to the weaning phase results in a $55 return at weaning which is $16 greater than the Limousin by Angus-Hereford in table 2. The Charolais by Hereford-Limousin has a $1 disadvantage in the background but a $1 advantage in the feedlot. In addition, it has a $9 advantage in the packer phase. All of the top twelve specialized crosses in table 5 would compare favorably with the top two specialized crosses in table 2.

Another way of looking at the differences between the marketing systems for the producing phase of the industry is presented in table 6. This table assumes that the packer can afford to just break even on the carcass sale and contains then the price per hundredweight and the price per head that he can pay the feeder for each of the straightbreds and for the first listed crossbreds under marketing systems 1 and 4. This table emphasizes the differences in marketing on a retail cut and ungraded basis and, in addition, emphasizes the importance of the weight of product sold as well as the price per hundredweight. For example, the price per hundredweight under system 3 for the straightbred Limousin and

the straightbred Charolais is $34.10. The difference in weight of product is enough to give the Charolais a $19 advantage in return per head. Under system 4 the Charolais sells for a lower price per hundredweight but actually returns $14 more per head. With regard to the crosses listed, it should be emphasized that there are several crosses in nearly every case that are essentially equal to those listed (see tables 2 and 5).

To further demonstrate the effect of returning the bulk of the increased return to the cow-calf man, table 7 presents the net return per head at weaning for the straightbreds and for the top listed crosses in systems 1 and 5, assuming again that the packer just breaks even on the carcasses and makes his profit from the offal sales. This table emphasizes the cost to the cow-calf man for maintaining larger cows or cows with higher milk production. It does indicate, however, that these cattle can be competitive if carcasses are marketed on either a retail cut basis, an ungraded basis or on a system including both. In fact, they would be the breeds of choice under the latter situation and especially so when the remaining phases of the industry are concerned.

It should be emphasized that how the increased return to industry would be partitioned to the two phases if marketing practices were changed cannot be determined. Applying a large proportion to the weaning phase appears necessary and reasonable since the crosses that return the highest industry return are those that have higher production costs at weaning.

Summary

The purpose of progress report no. 2 was to investigate variations in marketing procedures and how these affect choice of breeds and crossbreeding systems. The variations considered were sales of carcasses based on yield of retail cuts rather than sales on carcass weight and consideration of grading versus ungraded carcasses.

In choosing crossbreeding programs, specific crosses rather than generalizations about breeds or crossbreeding systems are most important. In the case of this report, producers should evaluate the market conditions under which their cattle might be sold and evaluate each specific system in terms of its expectation and his own management and environmental situation. Forms for accomplishing this were provided along with report no. 1.

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Table 1. Return to Labor for Packer and Industry for Each of the Four Systems

	System 1 Carcass graded		System 2 Retail cuts graded		System 3 Carcass not graded		System 4 Retail cuts not graded	
	Packer	Industry	Packer	Industry	Packer	Industry	Packer	Industry
Straightbred								
Angus	-17	80	-20	77	-15	82	-18	79
Hereford	-17	80	-14	83	-10	87	- 7	90
Limousin	-18	61	14	93	1	80	35	114
Charolais	-16	56	11	84	1	74	30	103
Red Poll	0	56	14	69	11	66	25	80
Simmental	-11	45	10	67	6	63	29	85
Holstein	3	32	23	52	17	46	38	67
Jersey	5	23	3	21	19	37	16	34
Top Ten Two Breed Rotation								
Ang-Her	-17	92	-17	92	-13	97	-13	97
Ang-Lim	-18	81	- 3	96	- 7	92	8	108
Ang-Pol	- 9	81	- 3	87	- 2	88	4	94[a]
Her-Lim	-18	79	0	97	- 5	93	14	111
Her-Pol	- 8	79	0	88	1	88	10	97
Ang-Cha	-17	78	- 5	90	- 7	88	5	100
Her-Cha	-17	76	- 2	91	- 5	88	11	104
Lim-Pol	- 9	69	14	92	6	84	30	108
Her-Jer	- 6	65	- 6	65[a]	5	76[a]	5	76[a]
Ang-Jer	- 6	63	- 9	60[a]	3	72[a]	0	69[a]

Table 1 Continued

	System 1 Carcass graded		System 2 Retail cuts graded		System 3 Carcass not graded		System 4 Retail cuts not graded	
	Packer	Industry	Packer	Industry	Packer	Industry	Packer	Industry
Top Ten Three Breed Rotation								
Ang-Her-Pol	-11	89	- 7	94	- 5	95	0	100[a]
Ang-Her-Lim	-18	88	- 7	99	- 8	98	3	109
Ang-Her-Cha	-17	84	- 8	93	- 8	93	1	103[a]
Ang-Lim-Pol	-12	81	3	96	- 1	92	14	107
Her-Lim-Pol	-12	80	5	96	1	92	18	109
Ang-Her-Sim	-15	79	- 8	87[a]	- 6	88	1	96[a]
Ang-Cha-Lim	-18	77	1	96	- 4	91	15	110
Ang-Cha-Pol	-11	77	2	90[a]	- 1	87	12	101[a]
Ang-Her-Jer	-10	76	-10	75[a]	- 1	84[a]	- 2	83[a]
Her-Cha-Lim	-18	76	4	97	- 3	91	19	113
Top Eleven Specialized Crosses								
Lim x Ang-Her	-19	87	- 9	97	-10	96	0	106[a]
Pol x Ang-Her	-12	87	- 7	92[a]	- 5	94	- 1	98[a]
Her x Ang-Lim	-19	85	- 8	96	- 9	95	2	106[a]
Ang x Her-Lim	-17	84	- 5	96	- 6	94	6	106[a]
Ang x Her-Pol	-11	84	- 5	89[a]	- 4	91	2	96[a]
Ang x Her-Cha	-15	83	- 5	93[a]	- 5	93	5	103[a]
Cha x Ang-Her	-21	83	-13	92[a]	-12	92	-4	100[a]
Her x Ang-Pol	-13	83	- 8	88[a]	- 7	90[a]	-2	95[a]
Hol x Ang-Her	-15	83	- 8	90[a]	- 7	91	-1	97[a]
Jer x Ang-Her	- 6	83	- 7	82[a]	2	91	1	90[a]
Sim x Ang-Her	-19	83	-13	89[a]	-11	91	-4	98[a]

[a]Not in top ten for this system.

Table 2. Return to Labor for Each Breeding Group Per Unit at Each Phase and Total for Industry for System 1. (Carcass - Graded)

Breed	Weaning	Background	Feedlot	Packer	Industry
		Straightbred			
Angus	24	10	62	-17	80
Hereford	30	14	54	-17	80
Limousin	4	16	59	-18	61
Charolais	- 1	5	68	-16	56
Red Poll	19	-10	47	0	56
Simmental	- 2	2	56	-11	45
Holstein	- 8	-20	57	3	32
Jersey	- 5	-17	40	5	23
		Top Ten Two Breed Rotation			
Ang-Her	43	7	60	-17	92
Ang-Lim	28	8	63	-18	81
Ang-Pol	38	- 5	56	- 9	81
Her-Lim	29	10	59	-18	79
Her-Pol	40	- 4	52	- 8	79
Ang-Cha	24	3	68	-17	78
Her-Cha	26	3	64	-17	76
Lim-Pol	25	- 2	54	- 9	69
Her-Jer	29	- 5	46	- 6	65
Ang-Jer	24	- 6	51	- 6	63
		Top Ten Three Breed Rotation			
Ang-Her-Pol	46	- 2	57	-11	89
Ang-Her-Lim	38	7	61	-18	88
Ang-Her-Cha	34	2	65	-17	84
Ang-Lim-Pol	35	- 1	58	-12	81
Her-Lim-Pol	36	- 0	56	-12	80
Ang-Her-Sim	33	1	61	-15	79
Ang-Cha-Lim	25	4	66	-18	77
Ang-Cha-Pol	31	- 5	62	-11	77
Ang-Her-Jer	35	- 2	53	-10	76
Her-Cha-Lim	26	4	63	-18	76
		Top Eleven Specialized Crosses			
Lim x Ang-Her	39	7	60	-19	87
Pol x Ang-Her	40	1	58	-12	87
Her x Ang-Lim	39	5	61	-19	85
Ang x Her-Lim	29	10	62	-17	84
Ang x Her-Pol	39	- 1	57	-11	84
Ang x Her-Cha	27	5	66	-15	83
Cha x Ang-Her	39	3	62	-21	83
Her x Ang-Pol	47	- 6	56	-13	83
Hol x Ang-Her	41	- 2	59	-15	83
Jer x Ang-Her	30	3	56	- 6	83
Sim x Ang-Her	40	3	59	-19	83

Table 3. Return to Labor for Each Breeding Group Per Unit at Each Phase and Total for Industry for System 2 (Retail Cuts - Graded)

Breed	Weaning	Background	Feedlot	Packer	Industry
		Straightbred			
Limousin	4	16	59	14	93
Charolais	- 1	5	68	11	84
Hereford	30	14	54	-14	83
Angus	24	10	62	-20	77
Red Poll	19	-10	47	14	69
Simmental	- 2	2	56	10	67
Holstein	- 8	-20	57	23	52
Jersey	- 5	-17	40	3	21
		Top Ten Two Breed Rotation			
Cha-Lim	13	6	66	13	97
Her-Lim	29	10	59	0	97
Ang-Lim	28	8	63	- 3	96
Ang-Her	43	7	60	-17	92
Lim-Pol	25	- 2	54	14	92
Her-Cha	26	3	64	- 2	91
Ang-Cha	24	3	68	- 5	90
Her-Pol	40	- 4	52	0	88
Ang-Pol	38	- 5	56	- 3	87
Sim-Lim	11	4	60	12	87
		Top Ten Three Breed Rotation			
Ang-Her-Lim	38	7	61	- 7	99
Her-Cha-Lim	26	4	63	4	97
Ang-Cha-Lim	25	4	66	1	96
Ang-Lim-Pol	35	- 1	58	3	96
Her-Lim-Pol	36	- 0	56	5	96
Ang-Her-Pol	46	- 2	57	- 7	94
Cha-Lim-Pol	23	- 3	60	13	94
Ang-Her-Cha	34	2	65	- 8	93
Cha-Sim-Lim	16	1	64	12	93
Her-Cha-Pol	32	- 4	59	4	91
		Top Twelve Specialized Crosses			
Cha x Her-Lim	29	6	61	0	97
Lim x Ang-Her	39	7	60	- 9	97
Ang x Her-Lim	29	10	62	- 5	96
Her x Ang-Lim	39	5	61	- 8	96
Ang x Cha-Lim	15	6	68	5	95
Her x Cha-Lim	22	3	64	5	95
Lim x Her-Cha	23	5	64	4	95
Sim x Her-Lim	30	6	58	0	95
Cha x Ang-Lim	29	4	64	- 3	94
Lim x Ang-Cha	25	3	66	1	94
Pol x Ang-Lim	30	2	59	2	94
Pol x Her-Lim	28	4	57	6	94

Table 4. Return to Labor for Each Breeding Group Per Unit at Each Phase and Total for Industry for System 3 (Carcass - Not Graded)

Breed	Weaning	Background	Feedlot	Packer	Industry
		Straightbred			
Hereford	30	14	54	-10	87
Angus	24	10	62	-15	82
Limousin	4	16	59	1	80
Charolais	- 1	5	68	1	74
Red Poll	19	-10	47	11	66
Simmental	- 2	2	56	6	63
Holstein	- 8	-20	57	17	46
Jersey	- 5	-17	40	19	37
		Top Eleven Two Breed Rotation			
Ang-Her	43	7	60	-13	97
Her-Lim	29	10	59	- 5	93
Ang-Lim	28	8	63	- 7	92
Ang-Cha	24	3	68	- 7	88
Ang-Pol	38	- 5	56	- 2	88
Her-Cha	26	3	64	- 5	88
Her-Pol	40	- 4	52	1	88
Cha-Lim	13	6	66	1	85
Lim-Pol	25	- 2	54	6	84
Ang-Sim	22	1	62	- 5	81
Her-Sim	24	2	58	- 2	81
		Top Ten Three Breed Rotation			
Ang-Her-Lim	38	7	61	- 8	98
Ang-Her-Pol	46	- 2	57	- 5	95
Ang-Her-Cha	34	2	65	- 8	93
Ang-Lim-Pol	35	- 1	58	- 1	92
Her-Lim-Pol	36	- 0	56	1	92
Ang-Cha-Lim	25	4	66	- 4	91
Her-Cha-Lim	26	4	63	- 3	91
Ang-Her-Sim	33	1	61	- 6	88
Ang-Cha-Pol	31	- 5	62	- 1	87
Her-Cha-Pol	32	- 4	59	1	87
		Top Eleven Specialized Crosses			
Lim x Ang-Her	39	7	60	-10	96
Her x Ang-Lim	39	5	61	- 9	95
Ang x Her-Lim	29	10	62	- 6	94
Pol x Ang-Her	40	1	58	- 5	94
Ang x Her-Cha	27	5	66	- 5	93
Cha x Ang-Her	39	3	62	-12	92
Ang x Her-Pol	39	- 1	57	- 4	91
Cha x Her-Lim	29	6	61	- 6	91
Hol x Ang-Her	41	- 2	59	- 7	91
Jer x Ang-Her	30	3	56	2	91
Sim x Ang-Her	40	3	59	-11	91

Table 5. Return to Labor for Each Breeding Group Per Unit at Each Phase and Total for Industry for System 4 (Retail Cuts - Not Graded)

Breed	Weaning	Background	Feedlot	Packer	Industry
		Straightbred			
Limousin	4	16	59	35	114
Charolais	- 1	5	68	30	103
Hereford	30	14	54	- 7	90
Simmental	- 2	2	56	29	85
Red Poll	19	-10	47	25	80
Angus	24	10	62	-18	79
Holstein	- 8	-20	57	38	67
Jersey	- 5	-17	40	16	34
		Top Twelve Two Breed Rotation			
Cha-Lim	13	6	66	33	117
Her-Lim	29	10	59	14	111
Ang-Lim	28	8	63	8	108
Lim-Pol	25	- 2	54	30	108
Sim-Lim	11	4	60	32	107
Her-Cha	26	3	64	11	104
Cha-Pol	21	- 7	59	28	101
Cha-Sim	8	- 2	65	30	101
Ang-Cha	24	3	68	5	100
Ang-Her	43	7	60	-13	97
Her-Pol	40	- 4	52	10	97
Hol-Lim	7	- 7	60	37	97
		Top Eleven Three Breed Rotation			
Cha-Sim-Lim	16	1	64	32	113
Her-Cha-Lim	26	4	63	19	113
Cha-Lim-Pol	23	- 3	60	30	111
Ang-Cha-Lim	25	4	66	15	110
Ang-Her-Lim	38	7	61	3	109
Her-Lim-Pol	36	- 0	56	18	109
Ang-Lim-Pol	35	- 1	58	14	107
Cha-Hol-Lim	13	- 6	64	35	106
Her-Sim-Lim	24	3	60	19	106
Ang-Sim-Lim	23	3	62	15	104
Sim-Lim-Pol	21	- 4	57	30	104
		Top Twelve Specialized Crosses			
Cha x Her-Lim	29	6	61	16	113
Sim x Cha-Lim	16	3	64	30	113
Her x Cha-Lim	22	3	64	21	111
Lim x Her-Cha	23	5	64	19	111
Pol x Cha-Lim	14	1	63	33	111
Hol x Cha-Lim	15	- 3	64	33	110
Sim x Her-Lim	30	6	58	15	110
Ang x Cha-Lim	15	6	68	20	109
Lim x Cha-Sim	10	0	66	33	109
Cha x Sim-Lim	13	1	63	30	108
Lim x Ang-Cha	25	3	66	14	108
Lim x Cha-Pol	22	- 4	60	30	108

Table 6. Estimated Price Per Cwt. and Per Head Packer Can Pay Feeder in Order to Break Even on Carcass Sale[a]

	System 1		System 2		System 3		System 4	
	Cwt.	Head	Cwt.	Head	Cwt.	Head	Cwt.	Head
Angus	$34.40	$371	$34.15	$368	$34.60	$373	$34.35	$370
Hereford	33.50	375	33.75	378	34.10	382	34.35	385
Limousin	32.40	363	35.25	395	34.10	382	37.10	416
Charolais	32.65	384	34.95	411	34.10	401	36.55	430
Red Poll	32.00	345	33.30	359	33.00	356	34.30	370
Simmental	32.05	377	33.85	398	33.50	394	35.45	417
Holstein	31.25	363	32.95	383	32.45	379	34.25	398
Jersey	30.50	299	30.30	297	31.95	313	31.65	310
First Listed Crosses Under System 1								
Ang-Her	$33.95	$378	$33.95	$378	$34.35	$382	$34.35	$382
Ang-Her-Pol	32.30	358	32.65	362	32.80	364	33.25	369
Lim x Ang-Her	31.60	355	32.50	365	32.40	364	33.30	374
First Listed Crosses Under System 4								
Cha-Lim	$32.45	$377	$35.10	$408	$34.10	$397	$36.85	$429
Cha-Sim-Lim	31.10	366	33.40	393	32.60	384	35.10	413
Cha x Her-Lim	30.85	357	32.60	377	32.10	371	34.00	393

[a]Subject to market conditions specified in computer input.

Table 7. Estimated Net Return Per Head at Weaning Assuming the Packer Just Breaks Even on Carcass Sale and Increase in Return Passes on to Weaning Phase

	System 1	System 2	System 3	System 4
Angus	$ 7	$ 4	$ 9	$ 6
Hereford	13	16	20	23
Limousin	-14	10	5	39
Charolais	-17	10	0	29
Red Poll	19	33	30	44
Simmental	-13	8	4	27
Holstein	- 5	15	9	30
Jersey	0	- 2	14	11
	First Listed Crosses Under System 1			
Ang-Her	26	26	30	30
Ang-Her-Pol	35	39	41	46
Lim x Ang-Her	20	30	29	39
	First Listed Crosses Under System 4			
Cha-Lim	- 5	26	14	46
Cha-Sim-Lim	1	28	19	48
Cha x Her-Lim	9	29	23	45