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Choosing Breeds and Crossbreeding Systems by Computer

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Choosing Breeds and Crossbreeding Systems by Computer

A Progress Report

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A computer program called "Simumate" has been developed that will allow a producer to evaluate crossbreeding systems for his particular nutrition and management situation using the breeds of his choice. This program, based on a method suggested by Dearborn (1970), takes into account energy requirements for maintenance of the cow, for milk production and for gain required during the gestation period (Neville and McCullough, 1969). It also takes into account the reproductive rate, growth rate, selling prices at several stages and the costs of production both feed and fixed in arriving at a net return for all straightbreds, all possible two breed rotation, three breed rotation and specialized crosses. In order to acquaint the producer with the program, the following example has been calculated. This example is intended only to acquaint the producer with what the program can do for him and should not be used for planning a program. The cost situation should be tailored to the individual ranch unit and the breed estimates will vary with the nutrition and management levels of different operations.

SAMPLE PROBLEM

Table 1 contains breed estimates, cost estimates, price estimates and base figures for weaning weight and feed requirement used in the example. It should be emphasized that all results obtained from this program are a result of the input contained in this table. Thus, the results presented later should not be interpreted as being definite breed differences but should be considered as breed or crossbred performance, assuming that the breeds would perform in the herd according to the information in table 1.

Some of the information required in table 1 is not readily available and some assumptions have to be made. For example, female fertility for the exotic breeds and for the dairy breeds handled as beef breeds in this country are not available. For the exotics, several of the other items are not available. These estimates may not fit a particular herd, but, as indicated above, the example is given only for demonstration and not for use in planning programs. For example, male fertility used for the exotic breeds is lower than for the other breeds. This is because on the average the Charolais breed in natural service has had some male fertility problems. There are Charolais herds that do not have male fertility problems, and a producer with access to bulls from these herds would want to enter a higher male fertility figure than is used here. All other exotic breeds are presently used in artificial service. While some producers have mastered the A.I. technique and can achieve a higher male fertility than that indicated in table 1, for a general example a lower figure seems more reasonable. This particular trait emphasizes the need to tailor this program to a particular situation. Another example of this is the effect of a large breed or the effect of a breed producing a large amount of milk. Either of these kinds of breeds will require a larger energy source if they are to reproduce regularly as beef cows should. Thus, a heavy milking

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Table 1. Price, Cost, and Breed Estimates and Weaning Weight and Feed Requirement Bases

Card 1

Name I. M. Rancher Address Highmore, S. D. Zip code 57345

Card 2

N	Cost/100 cows									Wng Wt. Base			Feed Cost Cents per Pound									Fixed Cost Cents per Day						Base Feed Requirement						Carc Price		Grade Spread		
	Fixed					Variable							Backgrnd			Growth			Finish			Bkgnd		Grow		Fin		Bkgnd		Grow		Fin					
1	2	3	4	5		6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
8	7	5	0	0		5	0	0	0	4	0	0	0	1	8	0	2	1	0	2	3	1	0	1	0	1	0	9	0	8	2	7	5	5	5	0	4	0

Card 3

Breed			Cow Size				Annual Milk Production				Male Fert		Female Fert		Calf Livability		Ind. Growth			Maternal Ability			Wean. Price	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
A	N	G	1	0	5	0	2	4	0	0	9	2	9	6	9	6	0	0	8	0	0	5	4	0
H	E	R	1	1	2	5	2	0	0	0	9	8	9	6	9	2	0	1	4	—	0	5	4	2
C	H	A	1	2	5	0	2	8	0	0	9	0	9	2	9	0	0	2	2	0	0	7	3	8
H	O	L	1	3	0	0	4	5	0	0	9	4	9	0	9	0	0	1	8	0	1	2	3	7
J	E	R		9	0	0	3	6	0	0	9	4	9	6	9	4	—	0	9	0	1	0	3	4
S	I	M	1	3	0	0	4	0	0	0	9	2	9	1	9	0	0	2	2	0	1	1	3	8
L	I	M	1	1	6	0	2	2	0	0	9	2	9	4	9	2	0	1	2	0	0	0	3	8
P	O	L	1	0	5	0	3	0	0	0	9	4	9	5	9	6	0	0	8	0	0	8	3	8

Card 3 (Continued)

Daily Gain									Breed-Feed Efficiency			Selling Price				Dress. Percent		Cut-ability		Percent Choice		
Background			Growing			Finishing						Background		Feedlot								
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	
2	0	0	2	7	0	2	7	0	0	0	3	3	5	3	6	6	3	6	2	9	0	
2	1	0	3	0	0	3	0	0	0	0	0	3	6	3	5	6	2	6	3	7	5	
2	3	0	3	4	0	3	4	0	—	0	3	3	4	3	4	6	2	6	7	4	0	
2	2	5	3	3	0	3	3	0	0	0	0	3	0	3	1	5	9	6	6	5	0	
1	7	0	2	0	0	2	0	0	0	0	6	2	7	3	0	5	8	6	2	4	0	
2	3	0	3	4	0	3	4	0	—	0	3	3	4	3	3	6	1	6	6	4	0	
2	1	0	3	0	0	3	0	0	—	0	3	3	4	3	4	6	2	6	8	3	0	
2	0	0	2	7	0	2	7	0	0	0	3	3	1	3	2	6	0	6	5	6	0	

breed or a large breed might have a higher female fertility under conditions of a high plane of nutrition, but the same breed under a low plane of nutrition might have a lower female fertility.

Producers utilizing this program are encouraged to carefully consider their fixed and variable costs associated with production. The actual calculation of these costs according to the form in the appendix may be helpful in increasing the efficiency of production.

Return to Cow-Calf Enterprise

Straightbred Evaluation

The capacity of the computer limits the number of breeds that may be compared at any one time to eight. Therefore, the choice for this example was limited to the two British breeds which are most numerous in our state, Hereford and Angus, and the two most widely used, recently introduced breeds, Simmental and Limousin. The Charolais was included because of its recent popularity and for comparison with the recently introduced breeds. Two dairy breeds common to this country were included, one large-Holstein and one small-Jersey. A dual purpose breed, Red Poll, was also selected to broaden the application of the example.

The computer utilizes the cow size and milk production data to calculate the TDN (energy) required to maintain 100 cows a year producing the amount of milk indicated and allowing for a 10 percent gain in body weight during gestation. The first breed entered in table 1 is set at 100 cows and all breeds and crossbreds computed thereafter are in relation to the first named breed. For example, in table 2 the straightbred performance indicates that where 100 Angus cows could be carried under the conditions of this herd, 96 Hereford cows could be carried, 75 Holstein and 105 Jersey cows. Unit refers to an adjusted cow unit. In this example it refers to one Angus cow or the fraction of a cow of another breed that would have the same annual feed requirement as one Angus cow. The computer uses the first named breed as the reference breed, so a producer will generally want to enter first the breed of his present cow herd. It is important to understand that differences in carrying capacity are not important to producers who are not already utilizing all feed resources. If the size of the cow herd is limited by either available labor or capital rather than feed, a larger, heavier milking cow may be more profitable. However, if all of the pasture and available forage are being utilized, then consideration should be given to how many cows can be carried.

Male fertility, female fertility and calf livability are used to calculate the percent calf crop at weaning which is listed for the straightbreds in table 2. The percent calf crop weaned is the lowest in this example for Charolais and the two large heavy milking breeds, Simmental and Holstein. Herefords had the highest average, although they were followed very closely by Red Poll, Angus and Jersey.

The individual growth capability and the maternal ability of each breed are utilized along with the weaning weight base to calculate the average weaning weight for each breed (table 2). Thus, in the example (table 1) it can be seen that the Hereford has an advantage over the Angus in individual growth but has a disadvantage in maternal or milking ability. The weaning weights for the two breeds listed in table 2 are in nearly the same proportion as noted in a recent analysis of the South Dakota Production Records Association data. In order to arrive at individual growth and maternal ability estimates that rank the breeds in the desired order, the user can calculate straightbred weaning weight by multiplying the weaning

Table 2. Predicted Performance of Straightbreds at Weaning

Breed	Carrying capacity	Calf crop weaned	Weaning weight	Weaning return[a]
Hereford	96	0.87	436	30
Angus	100	0.85	452	24
Red Poll	97	0.86	464	19
Limousin	93	0.80	448	4
Charolais	84	0.75	516	0
Simmental	77	0.75	532	-2
Jersey	105	0.85	404	-5
Holstein	75	0.76	520	-8

[a]Return to labor and management per unit.

weight base by each of the estimates and adding the three terms together. In the example the Angus breed was given a plus 8 percent for individual growth and a plus 5 percent for maternal ability. With a 400 pound weaning weight base, this gives a 452 pound weaning weight for straightbred Angus--400 + (.08 x 400) + (.05 x 400) = 400 + 32 + 20 = 452.

The last column, Weaning Return, indicates the dollar return to labor and management per unit. This takes into account carrying capacity, percent calf crop at weaning, weaning weight, costs, both fixed and variable, and selling price and is calculated by dividing 100 into the total net return from the 100 cow equivalent unit. In this example the Herefords returned $30 per calf, highest of the straightbreds. With all factors considered, the Holstein lost $8 per calf under the conditions of this herd. Return is relative to return obtained from the first breed listed in table 1 (in this case, Angus). Differences smaller than $5 in return should not be given much weight since the accuracy of estimation is probably not that good for some of the items. Selling prices are hard to establish especially for crossbreds. Perhaps it can be improved in the future, but at the present time selling prices are simply an average of the breeds entering a cross. Price at weaning is adjusted for weaning weight. Each 50 pound change from the base weaning weight changes the price one cent per pound with heavier calves selling for less and lighter calves selling for more per pound. There is no specific combining ability in these results as only average heterosis values have been used in the calculation of crossbred performance (table 3). That is, if the Angus crosses better with one breed than another, this is not taken into account but all crosses of one kind (e.g., two breed rotation) are given equal heterosis for each trait.

The postweaning phases of production have been divided into a backgrounding phase and a feedlot phase. In table 1 there is opportunity for providing breed estimates for daily gain during the backgrounding, growing and finishing periods. In addition, there are opportunities for separate feed costs, fixed costs and base feed requirements for these phases. The backgrounding phase takes the animals from weaning to 700 pounds and the 140 day feedlot phase allows division into a 50-day growing stage and a 90-day finishing phase. Utilizing this information along with the estimates of breed feed efficiency and the selling prices from the background and feedlot phases, costs and return to labor can be estimated for each phase.

For the backgrounding phase, days to 700 pounds are determined and the feed and fixed costs associated with this gain are calculated. Utilizing the selling prices and the costs, the returns on an individual animal basis are estimated.

Table 3. Heterosis Assumptions (Percent)

Trait	Potential	Two breed rotation (67)[a]	Three breed rotation (87)[b]
Cow size	3.0	2.0	2.6
Female fertility	5.0	3.4	4.4
Calf livability	5.0	3.4	4.4
Individual growth	5.0	3.4	4.4
Maternal ability	5.0	3.4	4.4
Milk production	12.0	8.0	10.4
All others	0.0	0.0	0.0

[a] It is estimated that individual and maternal heterosis will finally stabilize at 67 percent of the potential which is present in the first cross.
[b] Individual and maternal heterosis should finally stabilize at approximately 87 percent of the potential which is present in the first cross.

The growing and finishing phases of the 140-day feedlot period are similarly calculated except that the number of days is now held constant rather than the weight. In both the backgrounding and feedlot phases feed requirement for a breed or a breed cross is calculated by adjusting the base feed requirement up or down according to whether the breed feed efficiency is positive or negative. In the example, the base requirement in the backgrounding phase is assumed to be 9 pounds of feed per pound of gain and the Angus breed is assumed to require 3 percent more than this and the Charolais 3 percent less. Producers completing table 1 should keep in mind that the breed feed efficiency is relative to the base requirement that they enter.

The calculated slaughter weight and feedlot selling price are used to calculate the feedlot income. The gains, feed requirements and feed costs are calculated. Fixed costs are on a per day basis so that the number of days in the feedlot multiplied by the estimated fixed costs provided in the input represent total fixed costs. The fixed and feed costs then are subtracted from the feedlot income to arrive at an individual return to labor.

The packer phase of the program utilizes average carcass price and grade spread (the difference between average choice and average good grade in the carcass) along with the breed estimates for dressing percent, cutability and percent choice. Cutability is the percent yield of retail cuts from the carcass and percent choice is the proportion of steers expected to grade choice after a program of backgrounding to 700 pounds and 140 days in the feedlot. Packer return is based on the difference between the packer income from the dressed carcass only (carcass weight times carcass price adjusted for differences in grade) and the cost of buying the animal (slaughter weight times feedlot selling price). No credit is given to the packer for the offal, by-product and hide sales.

Although it is not indicated in the tables, producers utilizing the program will find in the computer print out a column headed retail cuts and two columns for market value. One of these is labeled carcass market value and the other

actual value. Carcass market value equals weight times selling price adjusted for differences in quality grade. Actual value does not include an adjustment in selling price for grade. Since quality grade forms the basis for pricing on today's market in the Northern Great Plains, packer returns given in the tables and in the computer output are based on the carcass market values which are influenced by grade differences. The actual value given in the computer print out is based on weight of total retail cuts rather than carcass weight and is therefore free of the trimmed waste fat and bone. Since this value is calculated without regard to carcass quality grade differences, it may have more meaning for producers that assume further alteration in the grade standards or dropping of all grade standards, or for feeders in certain areas like Los Angeles where only a small percent of the total slaughter beef is graded for quality.

Total industry return for the individual steer is calculated by totaling the returns at weaning, backgrounding, feeding and packing stages. This is probably the most meaningful column. Returns to each phase may be affected greatly by an error in pricing. However, since the selling price to one phase is the purchase price to the following phase, any pricing errors should have compensating effects relative to the total industry.

Two Breed Rotation

The performance of the top ten of the 28 possible two breed rotation crosses at weaning is given in table 4. Carrying capacities for two breed crosses ranged from 74 for the Holstein-Simmental to 100 for the Angus-Jersey. This carrying capacity is relative to 100 Angus cows. Percent calf crop varied from 80 for the Charolais-Simmental to 92 for the Hereford-Jersey, Hereford-Red Poll and the Angus-Hereford. Weaning weights ranged from 448 pounds for the Hereford-Jersey to 555 pounds for the Charolais-Simmental. Return is extremely variable, ranging from $3 for the Holstein-Simmental to $43 for the Angus-Hereford. In both the straightbred (table 2) and two breed rotation (table 4), the Angus and Hereford breeds have some advantage for the conditions of this herd. This is due to the higher levels of fertility and selling price entered and also to the intermediate size and milking ability. The Red Poll appears to combine well with these breeds for the conditions of this herd and the crosses with Hereford and Angus have a substantial advantage at weaning over the remaining two breed crosses. The next seven crosses (table 4) may not be different from each other. A native beef breed appears important for the conditions specified in this herd, since all but one of the top ten include at least one of these breeds.

Three Breed Rotation

The estimated performance of the top ten of the 56 possible three breed rotation crosses at weaning are given in table 5. Carrying capacities ranged from 76 for the Charolais-Holstein-Simmental to 97 for the Angus-Hereford-Jersey and Angus-Jersey-Red Poll crosses. Percent calf crop varied from 82 for the Charolais-Holstein-Simmental to 93 for the Angus-Hereford-Jersey, Angus-Hereford-Red Poll, Angus-Jersey-Red Poll and the Hereford-Jersey-Red Poll. Weaning weight varied from 466 pounds for the Hereford-Jersey-Limousin to 563 pounds for the Charolais-Holstein-Simmental cross. In return to labor the Angus-Hereford-Red Poll appears to have an advantage over all the other three breed crosses and the Angus-Hereford-Limousin is second, while those remaining in the top ten do not appear to differ appreciably. Crosses involving breeds with lower fertility and lower carrying capacities due to larger and/or heavier milking cows are at a disadvantage in weaning returns. The importance of at least one native beef breed is again obvious for the conditions of this herd, since both the Hereford and Angus appear together in five of the top ten crosses and one of the two breeds is present in the remaining five.

Table 4. Predicted Performance of Top Ten Two Breed Rotation Crosses at Weaning

Breed	Carrying capacity	Calf crop weaned	Weaning weight	Weaning return[a]
Ang-Her	96	0.92	473	43
Her-Pol	94	0.92	479	40
Ang-Pol	96	0.91	487	38
Her-Jer	98	0.92	448	29
Her-Lim	92	0.89	471	29
Ang-Lim	94	0.88	479	28
Her-Cha	88	0.86	506	26
Lim-Pol	92	0.88	485	25
Ang-Cha	89	0.85	514	24
Her-Sim	83	0.86	514	24

[a]Return to labor and management per unit.

Table 5. Predicted Performance of Top Ten Three Breed Rotation Crosses at Weaning

Breed	Carrying capacity	Calf crop weaned	Weaning weight	Weaning return[a]
Ang-Her-Pol	94	0.93	488	46
Ang-Her-Lim	93	0.91	483	38
Her-Lim-Pol	92	0.91	487	36
Ang-Her-Jer	97	0.93	467	35
Ang-Lim-Pol	93	0.91	492	35
Ang-Her-Cha	90	0.89	506	34
Ang-Her-Sim	87	0.90	512	33
Her-Jer-Pol	96	0.93	471	33
Ang-Jer-Pol	97	0.93	477	32
Her-Cha-Pol	89	0.90	510	32

[a]Return to labor and management per unit.

Specialized Crosses

All possible specialized crosses were simulated where each breed was taken as the bull breed in combination with all possible two breed rotation cross cows. These calculations were based on 40 percent of the cow herd in a two breed rotation to produce replacements and the remaining 60 percent bred to the specialized bull breed as a terminal cross. Six crosses had carrying capacities of 74 percent, and they were the six crosses involving the Holstein-Simmental cow. The Angus-Jersey cow contributed a carrying capacity of 100 percent. Percent calf crop varied from 81 for the Simmental x Charolais-Holstein to 94 for the Hereford x Angus-Jersey and Hereford x Angus-Red Poll. Weaning weights varied from 452 pounds for the Jersey x Angus-Hereford to 565 pounds for the Charolais x Holstein-Simmental. In return to labor (table 6) the Hereford x Angus-Red Poll was in first place above the next nine crosses which were not greatly different from each other. There are 168 possible specialized crosses involving these eight breeds and a breed

may appear 21 times as a bull breed and 42 times as a cow breed. The Hereford bull sired three of the top ten, and a Hereford cross cow produced five of the top ten crosses. The Angus breed was involved on the cow side in all but one of the top ten cows and in that one the Angus was the bull breed. The Charolais and Simmental each sired two of the top ten specialized crosses and the Limousin and Red Poll one each. The Red Poll appeared as a cow breed 4 times, the Limousin once and the Jersey once.

Table 6. Predicted Performance of Top Ten Specialized Crosses at Weaning

Bull Cow	Carrying capacity	Calf crop weaned	Weaning weight	Weaning return[a]
Her x Ang-Pol	96	0.94	499	47
Her x Ang-Jer	100	0.94	478	41
Pol x Ang-Her	96	0.93	473	40
Sim x Ang-Her	96	0.90	491	40
Sim x Ang-Pol	96	0.90	509	40
Ang x Her-Pol	94	0.91	479	39
Cha x Ang-Her	96	0.88	491	39
Cha x Ang-Pol	96	0.89	509	39
Her x Ang-Lim	94	0.92	488	39
Lim x Ang-Her	96	0.90	478	39

[a]Return to labor and management per unit.

Total Industry Return

Although weaning performance is of primary importance to most South Dakota producers, the calves produced must perform satisfactorily for the feeder and packer if the industry is to prosper. Table 7 summarizes the return to labor on an individual basis for the four phases of the industry considered in the program. In addition, the last column of the table gives the totals for an overall industry evaluation of each straightbred and the top ten crosses of each of the three kinds of crosses.

Straightbred Evaluation

Among the breeds compared in this example, the Hereford and Angus stand out in total industry return per individual. The two breeds have a decided advantage at weaning time, a rather large advantage over a few of the breeds in the backgrounding phase and a small advantage in the feedlot phase. These breeds are near the bottom in return to the packer as calculated here; however, this may be due to the pricing structure in the estimates. Since a large proportion of commercial beef will be produced by crossbreeding, straightbred performance will largely be useful as an indicator of what a breed can contribute to the crossbreeding system.

Table 7. Return to Labor for Each Breeding Group Per Unit at Each Phase and Total for Industry

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	0	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

Two Breed Rotation

The top ten two-breed rotations are headed by the Angus-Hereford cross in individual return to the industry. Again, there is a decided advantage at weaning time, an advantage over all but two of the crosses in the backgrounding phase and a small advantage in the feedlot over all others. It should be pointed out, however, and this is true for the straightbreds as well, that the cattle with Charolais breeding tend to be the best feedlot cattle on an individual basis. This may mean that the prices used in the example are too low for Charolais cattle or, if they are typical of present market conditions, it means that feeders are not paying enough for the Charolais cross. In this example, the feeders could pay $2 per hundred more at weaning time for Angus-Charolais feeder cattle and still make as much per head as they do on the Angus-Hereford. The remaining two breed crosses in the top ten are crosses of the Angus or Hereford with the Red Poll, Limousin, Charolais and Jersey. The Limousin-Red Poll cross in ninth place is the only cross in the top ten not involving the Angus or Hereford.

Three Breed Rotation

Among the top ten three breed rotation crosses the Angus-Hereford-Red Poll and the Angus-Hereford-Limousin are essentially equal in industry return to labor. The Angus-Hereford-Charolais cross is in third place followed by the Angus-Limousin-Red Poll and the Hereford-Limousin-Red Poll essentially tied in fourth and fifth places. The Angus-Hereford-Red Poll has an advantage at weaning, is at a disadvantage in the backgrounding phase and is above average in the feedlot. All ten of the three breed rotation crosses have at least one native beef breed and the top three have both the Angus and Hereford represented.

Specialized Crosses

Among the top ten specialized crosses, the Limousin bull on the Angus-Hereford cow and the Red Poll bull on the Angus-Hereford cow were tied for the lead in individual industry return with $87. The Hereford on the Angus-Limousin cow was third at $85 and the Angus bull on either the Hereford-Limousin or Hereford-Red Poll cows were tied at $84. Six more crosses were tied at $83, indicating a very small spread among the top eleven specialized crosses on an industry wide basis. The top eleven specialized crosses in industry return have both the Angus and Hereford represented, with six of these represented by the Angus x Hereford cow. Industry return is not greatly different for any of the top specialized crosses and choice of cross will probably revolve around weaning performance first and feedlot performance second.

DISCUSSION

Research in recent years at several institutions including South Dakota State has established that there is not just one ideal type, but that the many and varied nutritional and management environments that beef cattle are exposed to require a variety of kinds of cattle. Each environment that is sufficiently different to influence production and reproduction significantly may require a different breed combination to maximize production. As more is learned about the breeds and as more is learned about the nutritional and managemental effects on a breed's productive and reproductive capabilities, computer programs of the kind presented here can be made even more useful. It is important to remember, too, that within the breeds there can be considerable variation in the traits that are used in the program. For example, in the Angus breed, there are still some of the very small type, there are some that have been selected strictly on mature size and then there are others with a good history of selection for performance at a young age. The example used attempted to find the breed average for this kind of variability but in so doing may not fit any specific sample. As we learn more about breed traits and as breeds change, the input and therefore the estimated crossbred performance will change. Then, as now, this kind of program should still offer a better basis for planning the crossbreeding program than is now available to most producers.

The final choice of breeds used in the program will require some subjective decisions. For example, the cow-calf man might consider the Jersey breed as one of the breeds in his crossbreeding program because of the advantage at weaning. However, in this example the Jersey breed did not serve the rest of the industry efficiently, and alternative choices exceeding the Jersey cross at weaning are available. Use of this program gives an opportunity to evaluate the possible crosses that may not satisfy all phases of the industry.

Choice of crossing system (two breed rotation vs. three breed vs. specialized) will likely depend upon the breeds considered and the breed estimates used (tables 8 and 9). The sections of table 7 dealing with the Angus, Hereford and Charolais breeds and their crosses are listed in table 8 where they can be more conveniently compared. The small amount of variation in return to labor in all phases except weaning and to some extent in backgrounding is immediately apparent. The Angus-Hereford two breed rotation would appear to be the cross of choice with the Charolais x Angus-Hereford specialized cross second choice. In table 9 where the breeds involved are the Angus, Hereford and Red Poll the situation is somewhat different. Again the Angus-Hereford two breed rotation has an advantage but it is not as large and the three breed rotation would likely be the second choice rather than a specialized cross. In fact, some producers might prefer the three breed rotation to the two breed in view of the slightly higher return at weaning. This is, of course, offset on an industry basis by slightly lower returns in the backgrounding and feedlot phases.

In general, one cannot help but be impressed by the generally high ranking of the Angus-Hereford two breed rotation cross under the conditions of this herd. This may be a little clearer when the highest breeding groups on industry return are grouped together with the Angus-Hereford cross (table 10). At weaning the Angus-Hereford rotation is exceeded only by the best three breed rotation and only by a small amount. It ranks in the middle for backgrounding and is essentially equal to the Angus in feedlot return. It is comparable to the others in packer return and leads the others in industry return.

Table 8. Return at 4 Phases and Total for Industry for Crosses Involving Angus, Hereford and Charolais

	Weaning	Background	Feedlot	Packer	Industry
Straightbred					
Angus	24	10	62	-17	80
Hereford	30	14	54	-17	80
Charolais	0	5	68	-16	56
Two Breed Rotation					
Ang-Cha	24	3	68	-17	78
Ang-Her	43	7	60	-17	92
Her-Cha	26	3	64	-17	76
Three Breed Rotation					
Ang-Her-Cha	34	2	65	-17	84
Specialized Cross					
Ang x Her-Cha	27	5	66	-15	83
Cha x Ang-Her	39	3	62	-21	83
Her x Ang-Cha	34	0	65	-17	81

Table 9. Return at 4 Phases and Total for Industry for Crosses Involving Angus, Hereford and Red Poll

	Weaning	Background	Feedlot	Packer	Industry
Straightbred					
Angus	24	10	62	-17	80
Hereford	30	13	54	-17	80
Red Poll	19	-10	47	0	56
Two Breed Rotation					
Ang-Her	43	7	60	-17	92
Ang-Pol	38	- 5	56	- 9	81
Her-Pol	40	- 4	52	- 8	79
Three Breed Rotation					
Ang-Her-Pol	46	- 2	57	-11	89
Specialized Cross					
Ang x Her-Pol	39	- 1	57	-11	84
Her x Ang-Pol	47	- 6	56	-13	83
Pol x Ang-Her	40	1	58	-12	87

Table 10. Comparison of Breeding Groups with Highest Industry Return to Angus x Hereford Rotation

	Weaning	Background	Feedlot	Packer	Industry
Best Straightbred (Tie)					
Angus	24	10	62	-17	80
Hereford	30	14	54	-17	80
Best Three Breed					
Ang-Her-Pol	46	-2	57	-11	89
Best Specialized					
Lim x Ang-Her	39	7	60	-19	87
Ang-Her Rotation	43	7	60	-17	93

Ranking the breeding groups on highest return at weaning (table 11) eliminates the Angus from the Straightbred group and the Hereford x Angus-Red Poll becomes the highest ranking Specialized cross. In this comparison the Angus-Hereford cross is surpassed by a small amount by both the three breed rotation and the specialized cross at weaning and by the Hereford in backgrounding but is high enough in all phases to out rank all others in industry total.

Table 11. Comparison of Breeding Groups With Highest Weaning Return to Angus x Hereford Rotation

	Weaning	Background	Feedlot	Packer	Industry
Best Straightbred					
Hereford	30	14	54	-17	80
Best Three Breed					
Ang-Her-Pol	46	-2	57	-11	89
Best Specialized					
Her x Ang-Pol	47	-6	56	-13	83
Ang-Her Rotation	43	7	60	-17	93

Selecting the best breeding group on the basis of feedlot return produces a whole new array of crosses (table 12). The Charolais breed is the highest straightbred and is involved in every cross. In this case the Angus-Hereford rotation is no longer the highest two breed rotation and is replaced by the Angus-Charolais rotation. The feedlot performance of these groups does not vary more than $2 and all exceed the Angus-Hereford rotation by $6 to $8. However, these groups are rather low in return at weaning and all are substantially under the Angus-Hereford in industry return.

Table 12. Comparison of Breeding Groups with Highest Feedlot Return to Angus x Hereford Rotation

	Weaning	Background	Feedlot	Packer	Industry
Best Straightbred					
Charolais	0	5	68	-16	56
Best Two Breed Rotation					
Ang-Cha	24	3	68	-17	78
Best Three Breed Rotation (Tie)					
Ang-Cha-Hol	21	-8	66	-11	68
Ang-Cha-Lim	25	4	66	-18	77
Ang-Cha-Sim	23	-1	66	-15	73
Best Specialized Cross (Tie)					
Ang x Cha-Hol	10	-8	68	- 7	63
Ang x Cha-Lim	15	6	68	-12	68
Ang x Cha-Sim	12	0	68	-15	74
Ang-Her Rotation	43	7	60	-17	93

The high ranking of the crosses of the Angus and Hereford breeds is a result of the intermediate size and milk production, high fertility and relatively higher prices assigned to these breeds in the input and to the conditions of this herd. These results may not apply to every situation. For example, this program is based on a low gain backgrounding system of feeding. It is generally thought that breeds with higher growth potential are at a disadvantage under this feeding regime. An accurate evaluation of full feeding starting at weaning is not available with the present program but can only be approximated by estimating what feed and gain data should be for the three periods (backgrounding, growing and finishing) if the animals were fed at a higher level. This was done by reducing the finishing gain by 10% and using this as the gain for the entire feeding period, and by changing the base feed requirement to 6.5, 7.0 and 8.2 pounds feed per pound of gain for the three periods. Feed costs were changed to $0.021 per pound of feed for the entire postweaning feeding period.

There were only a few minor changes in the ranking of the various crosses for industry return under the higher feeding level. The straightbred cattle and the two breed rotation did not change. In the three breed rotation under full feeding the Angus-Hereford-Jersey moved from ninth to seventh and this was the only change. In the specialized cross 5 crosses moved up one to two places in

the ranking, but the differences among all of the top ten in industry return were still very small with only $5 separating first from tenth. These results should be verified by utilizing a program written specifically for the full feed postweaning rather than trying to adapt the present backgrounding program. However, the small changes apparent here do not make it appear likely that the order will change very much.

Perhaps the most important lesson from all of this is that the crossing program needs to be tailored to the individual situation. Research at South Dakota State and elsewhere has indicated that there is no one ideal type that can fit the many environment and management situations existing in the beef cattle industry. The questionnaire in the appendix lists several factors one should consider in planning a crossbreeding program. Most of these are factors that are not built into the computer program directly, although they may be considered by the producer in arriving at breed estimates for various performance traits. Range versus corn belt type management, time of selling calves, price differentials and manner in which calves are handled after weaning are some of the important items of this kind. Genetic defects and the probability of their occurrence with the use of certain breeds is another consideration and one that is not included in the computer program. Breeding pasture requirements of the different systems and other management requirements will be important in the final decision, also. The specialized cross, for example, will usually require more management than a rotation system and the three breed rotation would require more breeding pastures than a two breed rotation.

Producers are encouraged to utilize the computer program and the crossbreeding questionnaire in planning their individual programs. A blank form for the computer input data is supplied along with the questionnaire and cost estimate sheet in the appendix. A charge of $5 will be made to cover costs. The computer listing is far more complete than the tables included here. Fixed and feed costs at different stages are listed as are the yield of retail cuts for each breed and cross. In addition, specific crosses not listed here in the top ten tables can be evaluated for relative ranking. The results received will be based on estimates, some of which are fairly well established while others may not be well established. Plans based on the best current information available should be more useful than plans overlooking many of the items considered or more useful than indiscriminate crossbreeding not based on any plan.

REFERENCES

Dearborn, D. D. 1970. Talk given to Range Management Society. Denver, Colo.

Neville, W. E., Jr. and M. E. McCullough. 1969. Calculated energy requirements of lactating and non-lactating Hereford cows. J. Anim. Sci. 29:823.

Card 1

Name _____ Address _____ Zip code _____

Card 2

N[a]	Cost/100 cows		Wng Wt. Base	Feed Cost Cents per Pound			Fixed Cost Cents per Day			Base Feed Requirement			Carc Price	Grade Spread
	Fixed	Variable		Backgrnd	Growth	Finish	Bkgnd	Grow	Fin	Bkgnd	Grow	Fin		
1	2 3 4 5	6 7 8 9	10 11 12	13 14 15	16 17 18	19 20 21	22 23	24 25	26 27	28 29	30 31	32 33	34 35	36 37 38

Card 3

Breed	Cow Size	Annual Milk Production	Male Fert	Female Fert	Calf Livability	Ind. Growth	Maternal Ability	Wean. Price
1 2 3	4 5 6 7	8 9 10 11	12 13	14 15	16 17	18 19 20	21 22 23	24 25

Card 3 (Continued)

Daily Gain			Breed-Feed Efficiency	Selling Price		Dress. Percent	Cut-ability	Percent Choice	
Background	Growing	Finishing		Background	Feedlot				
26 27 28	29 30 31	32 33 34	35 36 37	38 39	40 41	42 43	44 45	46 47	

[a]N = Number of breeds.

Appendix Page 2

Simumate Form II

Animal Science Department

South Dakota State University

Crossbreeding Questionnaire

You have indicated an interest in crossbreeding and want more information before implementing a crossbreeding program. Completion of the following questionnaire will help fit the program to your situation.

1. Herd size (cows that calve) Present _____
   10 year projection _____
2. Breed(s) of cow _____
   Give numbers if more than one breed.
3. Artificial insemination:
   in use _____
   possible _____
   not possible _____
4. Number of breeding pastures available or could be made available:
   _____
5. Replacement heifers:
   prefer to raise _____
   prefer to buy _____
   want information _____
6. List any breeds that would not be considered:
   _____
   _____
7. Disposition of calves:
   Sell at weaning _____
   Sell at yearling _____
   Feed own to slaughter _____
8. If you feed your calves do you:
   defer (rough over winter and then to grass) _____
   put on feed at weaning _____
   other _____
9. Is your cow herd maintained under:
   typical range conditions _____
   cornbelt farm conditions _____
10. Supplemental feed for cows is:
    available _____
    not available _____

NAME: _____

ADDRESS: _____

Appendix Page 3

Simumate Form III

Beef Budget (per cow)

		Av. S.D. Cost	Your Cost	
FIXED				
Pasture		36.00	_____	
Winter feed (roughage)		27.00	_____	
Power and fuel		4.00	_____	
Depreciation and repairs on equipment		2.00	_____	
Housing		2.50	_____	
	Total	71.50	_____	x 100 = _____ (1)
VARIABLE				
Grain - supplement - salt - mineral		6.00	_____	
Breeding charge		7.00	_____	
Vet. and medicine		2.00	_____	
Taxes and ins. on cow		4.00	_____	
Interest		20.00	_____	
Miscellaneous		3.00	_____	
Replacement[a]		8.00	_____	
	Total	50.00	_____	x 100 = _____ (2)

(1) Enter this figure in Columns 2 through 5 in Card 2 - Simumate Form I.
(2) Enter this figure in Columns 6 through 9 in Card 2 - Simumate Form I.
[a] Costs exceeding credit from cull cow.