

# HIGH-STARCH VERSUS HIGH-FIBER ENERGY SUPPLEMENTS FOR STOCKER CATTLE ON WHEAT PASTURE: CATTLE PERFORMANCE AND ECONOMICS<sup>1</sup>

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## Story in Brief

An energy supplement formulated from high-fiber by-product feeds (soybean hulls and wheat middlings) and fed at a level of .75 to 1% of body weight was superior to a corn-based high-starch energy supplement in terms of increasing weight gains of growing cattle and supplement conversion. Initial stocking densities of treatments receiving an energy supplement were increased one-third and net returns (\$/head and \$/acre) were greatest, over 9 different feed cost/cattle profit potentials, when the high-fiber energy supplement was fed. As compared with nonsupplemented cattle, this supplementation strategy has the added advantage of having one-third more cattle on hand to graze-out a greater proportion of the wheat acreage base in years in which the government farm program encourages graze-out. By increasing stocking density in the fall, the additional cattle would typically be purchased on seasonally-low markets.

(Key Words: Energy Supplementation, Growing Cattle, Wheat Pasture.)

## Introduction

Provision of energy supplements for stocker cattle grazing wheat pasture has particular practical significance because of large potential fluctuations in amounts of available forage. The response of growing cattle on wheat and (or) other small grain pastures to supplemental grain has been very variable. In studies reported by Elder (1967), Lowrey et al. (1976a and 1976b) and Utley and McCormick (1975 and 1976) steer grazing days/acre or

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<sup>1</sup>This material is based upon work supported by the Cooperative State Research Service, U.S. Department of Agriculture, under Agreement No. 89-34198-4288.

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stocking densities were increased 1.25- to 2-fold by feeding grain at levels of 1 to 1.5% of body weight. Daily gains of steers were increased by .11 to .65 lb. Results of these studies are summarized in Table 1. Additional studies on wheat pasture are needed before confident recommendations can be made relative to this practice.

Energy supplements may have very different effects on ruminal pH and forage intake and utilization depending on the feedstuff composition of the supplement, the form and type of roughage and resulting rates of particle fragmentation (and therefore chewing and rumination times and salivation). To prevent the adverse effects of starch on ruminal fermentation, high fiber by-product feeds, such as wheat middlings, soybean hulls and corn gluten feed, offer opportunities to formulate energy supplements with fairly high energy densities. The potential for use of these by-product feeds in supplementing growing cattle on wheat pasture is particularly good because of the rapid rate of ruminal degradation of wheat forage and the relative low ruminal pH values of these cattle (Andersen and Horn, 1987). In general, supplementation studies using these by-product feeds for cattle grazing pastures or fed growing rations in drylot have resulted in higher ruminal pHs, decreased substitution ratios of supplement for forage and improved animal performance (Meijs, 1986; Trotter et al., 1981; McDonnell et al., 1982 and 1983; Merrill and Klopfenstein, 1984; Hibberd et al., 1986 and Fleck et al., 1988). These feedstuffs have not been studied as energy supplements for growing cattle on wheat pasture, and appear to have particularly good potential for use in self-fed energy supplements to stabilize stocking densities on wheat pasture.

The objective of this study was to compare cattle performance and the economics of providing a high-starch, corn-based versus a high-fiber energy supplement for growing cattle on wheat pasture.

## Materials and Methods

One hundred ninety two fall weaned steer calves grazed clean tilled wheat pasture (Pioneer 2157) and received no supplement other than free choice access to a commercial mineral mixture or were hand fed 6 days/week a corn-based energy supplement (i.e., high-starch supplement) or a high-fiber energy supplement that contained about 47% soybean hulls and 46% wheat middlings (as fed basis). A fourth treatment was fed the high-fiber energy supplement ad libitum. Composition of the supplements is shown in Table 2. All of the supplements contained monensin (about 40 mg/lb) and the ad libitum fed supplement contained 8% salt. Stocking density on wheat pasture was increased 33% (i.e., from 2 to 1.5 acres/steer) where the energy

Table 1. Response of growing beef cattle to grain supplementation on small grain pastures.

Reference	Forage	Stocking density, steers/acre		Grain consumption, % of body wt	Daily gain of steers, lb		F/G <sup>a</sup>
		Control	Grain		Control	Grain	
Elder, 1967	Rye and wheat mix		+21%	1	1.38	1.72	9.4
Gulbransen, 1976	Oat	.....	Variable <sup>b</sup>	.....	2.44		10.3
Utley & McCormick, 1976	Rye	.77	1.49	1.5	2.33	2.98	7.2
Lowrey et al., 1976A	Rye, wheat ryegrass mix	1.01	2.02	1.2	1.98	2.09	7.0
Lowrey et al., 1976B	Rye, wheat ryegrass mix	1.01	2.02	1.1	2.20	2.33	6.7

<sup>a</sup> Grain conversion, lb/lb of increased gain per acre.

<sup>b</sup> Regression study.

Table 2. Composition of supplements<sup>a</sup>.

Treatment: Method of feeding:	High-starch Hand-fed	High-fiber Hand-fed	High-fiber Free-choice
	----- % As-fed -----		
Ground corn	82.91		
Soybean hulls		46.75	45.25
Wheat middlings	8.88	45.96	37.83
Sugarcane molasses	4.92	4.96	5.01
Calcium carbonate	1.84	1.59	2.23
Dicalcium phosphate	.61		1.11
Magnesium oxide	.12		.50
Salt	.67	.67	8.00
Rumensin 60 Premix	.06	.06	.07
Calculated nutrient content (as-fed basis)			
NE <sub>gain</sub> , Mcal/cwt	55.2	41.4	36.7
Crude protein, %	8.5	12.2	10.8
Calcium, %	.88	.88	1.34
Phosphorus, %	.44	.55	.67
Magnesium, %	.22	.31	.54
Monensin content, mg/lb	37.5	37.5	41.2

<sup>a</sup> All supplements were fed as 3/16-inch pellets.

supplements were fed. The supplements were fed for 96 days of the 115-day trial. Target level of consumption was .75 to 1% of mean body weight.

### **Economic Analysis of Supplementation Programs**

An enterprise budgeting analysis was conducted to evaluate the profitability of the alternative supplementation programs. Using input and livestock performance data, annual net return estimates were derived for each supplementation program and the control (no supplementation). A sample enterprise budget for the nonsupplemented, control cattle (moderate net return potential as discussed below) is presented in Table 3. Input data is reported at the top of the budget, while livestock receipt and expense estimates are presented in the following section. The estimated return of \$63.68 is a per-head return above operating (variable) costs.

To evaluate the sensitivity of results to both cattle and feed price conditions, per-head net returns were estimated for nine cattle/feed price combinations. Specific assumptions employed in the budgeting analysis are discussed below.

### **Budget Assumptions**

Obviously, the profitability of energy supplementation of wheat pasture stockers is highly dependent upon cattle market conditions. Since the profitability of stocker programs are primarily determined by the relationship between cattle purchase and sale prices, rather than the absolute sale price, a procedure was developed to represent situations of high, moderate and low profit potential. Using a representative wheat pasture stocker enterprise, per-head net returns (in 1990 dollars) were estimated over the 10-year period (1980-89) holding all costs and returns constant except calf price and selling price. Average monthly prices for November steer calves (450 lb) and March feeder cattle (700 lb) at the Oklahoma City Livestock Market were used. The ten annual per-head net returns were then divided into three groups to reflect high, moderate and low net return situations. Next, the calf price was set at the ten year average of \$89.00/cwt (1990 dollars). The sale price was then adjusted to reflect low (\$76.00/cwt), moderate (\$82.00) and high (\$86.00) net return situations. Thus, the high, moderate and low return scenarios reflect price spreads of \$3.00, \$7.00 and \$13.00/cwt, respectively.

Feed costs incurred in the 1989-90 experiments were approximately \$7.00/cwt for all four rations. This expense included ingredient costs as well as a milling charge of \$30/ton for pelleting and grinding plus \$12/ton for bulk delivery of the supplements and reflects the "high feed cost" situation. Feed costs associated with the "moderate" and "low" cost situations are \$5.50 and \$4.00/cwt, respectively. The "low" feed cost estimate was based upon the

**Table 3. Enterprise budget for the production of wheat pasture stockers with moderate net return potential and without energy supplementation, 1989-90.**

Days on pasture	115	Calf price (\$/lb)	0.89	
Gain (lb)	246	Steer price (\$/lb)	0.82	
Death loss (%)	0.01	Hauling cost (\$/cwt)	0.35	
Calf weight (lb)	465	Marketing charge (\$/cwt)	1.72	
Suppl. hay (lb)	200	Vet-med expenses (\$/hd)	8	
Energy suppl. (lb)	0	Interest rate (%)	0.12	
Labor (hr)	1.27	Hay price (\$/lb)	0.03	
Stk. dens (A/hd)	2	Suppl. price (\$/lb)	0.07	
		Wage rate (\$/hr)	5	
Pasture option	1	Mach. cost (\$/hd)	6.09	
1. Per acre	20			
2. Per lb of gain	0.3			
3. Per cwt stock	2.5			
<b>LIVESTOCK RECEIPTS:</b>				
	UNIT	PRICE	QUANTITY	VALUE
Steers	cwt	82.00	7.11	583.02
Less Death Loss	cwt	82.00	0.07	5.83
Total Receipts				577.19
<b>OPERATING INPUTS:</b>				
Steer Calves	cwt	89.00	4.65	413.85
Energy Supplement	lb	0	0.07	0.00
Supplemental Hay	lb	0.03	200	6.00
Hauling	cwt	0.35	11.69	4.09
Marketing	cwt	1.72	7.04	12.11
Vet-Med Expenses	hd	8.00	1	8.00
Mach. Operating Costs	hd	6.09	1	6.09
Interests on Oper. Capital	dol	0.12	141.82	17.02
Labor	hr	5.00	1.27	6.35
Pasture	acre	2.00	20	40.00
Total Operating Costs				513.51
Return Above Operating Costs	(\$/head)			63.68

lowest November price of the four rations' primary ingredients (middlings and corn) observed during the 1980-1989 period.

Labor was divided into two components: labor required to feed energy supplement and a base labor requirement that includes labor used in receiving cattle, checking cattle, etc. The base labor requirement was 1.27 hours/head for cattle stocked at a density of 2 acres/head, and 1.09 hours/head for a stocking density of 1.5 acres/head. Additional labor used to feed energy supplement was estimated as .96 hour/head for hand feeding and .48 hour/head for free-choice feeding. Labor was valued at \$5.00 per hour. Machinery operating costs primarily reflect fuel, lubrication and repair expenses for a 3/4 ton pickup and were estimated using machinery cost calculations from the Oklahoma State University Enterprise Budget Generator. Veterinary expenses were \$8.00 per head and include implants, eartags, worming and vaccinations, as well as a prorated share of sickpen charges. Hauling and marketing charges were assessed at rates of \$.35/cwt and \$1.72/cwt, respectively. Interest on operating capital reflects the cost of capital used to purchase the calf and other expense items, and was estimated based upon an annual interest rate of 12 percent.

Land was valued based upon its opportunity cost, the value that could have been received had it been used in its most profitable alternative use. In this case, land values are based upon the rental income that could be earned had the pasture been leased instead of grazed by the owner-operator. Results from two independent surveys conducted by the Department of Agricultural Economics indicated a wide variation in wheat pasture lease rates and terms. Based upon survey responses, a range of \$20.00 to \$40.00 per acre was determined to encompass most wheat pasture lease situations in Oklahoma.

## Results and Discussion

Effects of the supplements on performance of the cattle from November 17, 1989 to March 12, 1990 (115 days) and supplement conversions are shown in Table 4. Weight gains were increased ( $P < .02$ ) by supplementation (i.e., control versus mean of all supplements) and by the high-fiber versus the high-starch supplement ( $P < .02$ ). Gains tended to be decreased ( $P < .10$ ) by feeding the high-fiber supplement free-choice versus hand-feeding. Conversion of supplements, expressed as lb of supplement (as-fed) per lb of increased gain per acre, ranged from 4.88 to 6.54 which is substantially lower than conversions of 9 to 10 that have traditionally been used in evaluating energy supplementation programs for wheat pasture stocker cattle. Conversion of supplement was improved ( $P < .09$ ) by the high-fiber versus high-starch supplement and by hand-feeding versus ad libitum feeding the

Table 4. Effect of type of energy supplement and method of feeding on performance of steers grazing wheat pasture.

Treatment: Method of feeding:	Control	High-starch Hand-fed	High-fiber Hand-fed	High-fiber Free-choice
Number of steers	48 <sup>a</sup>	48	48	48
Stocking density, acres/head	2	1.5	1.5	1.5
Supplement consumption <sup>b</sup> , lb/day <sup>c</sup>		4.20	4.27	4.98
% of body wt		.71	.72	.84
Initial wt, (11/17) lb	464	464	463	466
Final wt, (3/12) lb	710	716	732	725
Daily gain, (115 days) lb	2.14	2.19	2.35	2.25
Beef gain, lb/acre	123	168	180	173
Supplement conversion <sup>d</sup>		5.95	4.88	6.54

<sup>a</sup> Four replicates of 12 steers/replicate per treatment.

<sup>b</sup> Control steers had free-choice access to a commercial mineral supplement.

<sup>c</sup> Supplements were fed 96 days of the 115-day trial.

<sup>d</sup> Lb of supplement (as-fed) per lb of increased gain per acre.



high-fiber supplement. Greater variation in daily intake of the free-choice (2.01 to 8.72 lb) versus hand-fed (3.0 to 5.0 lb) supplement and potential effects on rumen function and forage intake may be part of the explanation for the decreased conversion of the high-fiber supplement fed free-choice.

### **Budget Analysis Results**

Results from budgeting the three supplementation programs and control are summarized in Table 5. Net returns are returns above operating costs, as estimated in the enterprise budget in Table 3. To reflect the variety of pasture leasing situations present in central Oklahoma, per-head net return estimates are reported for four different land values. As mentioned earlier, land is valued at its opportunity cost, the value it could earn in its next best alternative use. For example, if surplus pasture could be leased at a rate of \$3.00/cwt/month and 500 pound steers were stocked at a density of 2 acre/head, a pasture charge of \$30.00 per acre should be assessed. Land values of \$20.00, \$30.00 and \$40.00 per acre are considered. The final situation reflects a lease rate of \$2.50/cwt/month. In this case, both supplemented and unsupplemented cattle are assessed a land charge of \$45.00/head. With the exception of the land charge, all cost and return values are identical across the four leasing situations.

Several expenses are increased as a result of implementing the supplementation programs. The most significant increases occur in the feed, labor and machinery operating cost categories. Hauling and marketing costs also increase nominally as a result of selling heavier cattle. An expense that is lowered through supplementation is the pasture cost. For example, as a result of the .5 acre/head reduction in stocking density, the pasture charge is reduced from \$40.00 to \$30.00/head when land is valued at \$20.00/acre. Under high feed costs, total operating costs exceed those reported in Table 3 by \$25.26, \$26.13 and \$28.46 for the high-starch, high-fiber (hand fed) and high-fiber (free choice) programs, respectively. The profitability of the supplementation program depends upon whether revenues from additional gain are sufficient to cover these additional expenses.

Net returns from the three supplementation programs are compared to returns earned from unsupplemented cattle in Table 6. Each of the values represents the difference between per-head returns earned with the supplementation program and returns under the control. For example, in the low feed/low cattle price situation with a \$20.00 land value, net returns under the high-fiber, hand-fed program exceed returns earned without supplementation by \$3.93/head (\$25.38-21.45). Feeding of the high-fiber supplement using the hand-fed method is the most profitable supplementation program evaluated. Per-head returns from the program exceed returns without supplementation for four of the nine price situations

**Table 5. Per-head net returns from control and three alternative supplementation programs, 1989-90.**

	Control	High-starch Hand-fed	High-fiber Hand-fed	High-fiber Free-choice
	-----\$/Head-----			
<b>\$20.00/ACRE:</b>				
Low Feed/Low Cattle	21.45	13.25	25.38	17.65
Low Feed/Moderate Cattle	63.68	55.84	68.98	60.66
Low Feed/High Cattle	84.80	77.13	90.78	82.16
Moderate Feed/Low Cattle	21.45	6.97	19.00	10.21
Moderate Feed/Mod. Cattle	63.68	49.56	62.60	53.21
Moderate Feed/High Cattle	84.80	70.86	84.43	74.72
High Feed/Low Cattle	21.45	0.70	12.62	2.77
High Feed/Moderate Cattle	63.68	43.29	56.22	45.77
High Feed/High Cattle	84.80	64.58	78.02	67.28
<b>\$30.00/ACRE:</b>				
Low Feed/Low Cattle	1.45	-1.75	10.38	2.65
Low Feed/Moderate Cattle	43.68	40.84	53.98	45.66
Low Feed/High Cattle	64.80	62.13	75.78	67.16
Moderate Feed/Low Cattle	1.45	-8.03	4.00	-4.79
Moderate Feed/Mod. Cattle	43.68	34.56	47.60	38.21
Moderate Feed/High Cattle	64.80	55.86	69.43	59.72
High Feed/Low Cattle	1.45	-14.30	-2.38	-12.23
High Feed/Moderate Cattle	43.68	28.29	41.22	30.77
High Feed/High Cattle	64.80	49.58	63.02	52.28
<b>\$40.00/ACRE:</b>				
Low Feed/Low Cattle	-18.55	-16.75	-4.62	-12.35
Low Feed/Moderate Cattle	23.68	25.84	38.98	30.66
Low Feed/High Cattle	44.80	47.13	60.78	52.16
Moderate Feed/Low Cattle	-18.55	-23.03	-11.00	-19.79
Moderate Feed/Mod. Cattle	23.68	19.56	32.60	23.21
Moderate Feed/High Cattle	44.80	40.86	54.43	44.72
High Feed/Low Cattle	-18.55	-29.30	-17.38	-27.23
High Feed/Moderate Cattle	23.68	13.29	26.22	15.77
High Feed/High Cattle	44.80	34.58	48.02	37.28
<b>\$2.50/CWT/MO:</b>				
Low Feed/Low Cattle	16.45	-1.75	10.38	2.65
Low Feed/Moderate Cattle	58.68	40.84	53.98	45.66
Low Feed/High Cattle	79.80	62.13	75.78	67.16
Moderate Feed/Low Cattle	16.45	-8.03	4.00	-4.79
Moderate Feed/Mod. Cattle	58.68	34.56	47.60	38.21
Moderate Feed/High Cattle	79.80	55.86	69.43	59.72
High Feed/Low Cattle	16.45	-14.30	-2.38	-12.23
High Feed/Moderate Cattle	58.68	28.29	41.22	30.77
High Feed/High Cattle	79.80	49.58	63.02	52.28

**Table 6. Comparison of per-head net returns from three alternative supplementation programs to the control, 1989-90.<sup>a</sup>**

	High-starch Hand-fed	High-fiber Hand-fed	High-fiber Free-choice
	-----\$/Head-----		
<b>\$20.00/ACRE:</b>			
Low Feed/Low Cattle	-8.20	<b>3.93</b>	-3.80
Low Feed/Moderate Cattle	-7.84	<b>5.30</b>	-3.02
Low Feed/High Cattle	-7.67	<b>5.98</b>	-2.64
Moderate Feed/Low Cattle	-14.48	-2.45	-11.24
Moderate Feed/Mod. Cattle	-14.12	-1.08	-10.47
Moderate Feed/High Cattle	-13.94	-0.37	-10.08
High Feed/Low Cattle	-20.75	-8.83	-18.68
High Feed/Moderate Cattle	-20.39	-7.46	-17.91
High Feed/High Cattle	-20.22	-6.78	-17.52
<b>\$30.00/ACRE:</b>			
Low Feed/Low Cattle	-3.20	<b>8.93</b>	<b>1.20</b>
Low Feed/Moderate Cattle	-2.84	<b>10.30</b>	<b>1.98</b>
Low Feed/High Cattle	-2.67	<b>10.98</b>	<b>2.36</b>
Moderate Feed/Low Cattle	-9.48	<b>2.55</b>	-6.24
Moderate Feed/Mod. Cattle	-9.12	<b>3.92</b>	-5.47
Moderate Feed/High Cattle	-8.94	<b>4.63</b>	-5.08
High Feed/Low Cattle	-15.75	-3.83	-13.68
High Feed/Moderate Cattle	-15.39	-2.46	-12.91
High Feed/High Cattle	-15.22	-1.78	-12.52
<b>\$40.00/ACRE:</b>			
Low Feed/Low Cattle	<b>1.80</b>	<b>13.93</b>	<b>6.20</b>
Low Feed/Moderate Cattle	<b>2.16</b>	<b>15.30</b>	<b>6.98</b>
Low Feed/High Cattle	<b>2.33</b>	<b>15.98</b>	<b>7.36</b>
Moderate Feed/Low Cattle	-4.48	<b>7.55</b>	-1.24
Moderate Feed/Mod. Cattle	-4.12	<b>8.92</b>	-0.47
Moderate Feed/High Cattle	-3.94	<b>9.63</b>	-0.08
High Feed/Low Cattle	-10.75	<b>1.17</b>	-8.68
High Feed/Moderate Cattle	-10.39	<b>2.54</b>	-7.91
High Feed/High Cattle	-10.22	<b>3.22</b>	-7.52
<b>\$2.50/CWT/MO:</b>			
Low Feed/Low Cattle	-18.20	-6.07	-13.80
Low Feed/Moderate Cattle	-17.84	-4.70	-13.02
Low Feed/High Cattle	-17.67	-4.02	-12.64
Moderate Feed/Low Cattle	-24.48	-12.45	-21.24
Moderate Feed/Mod. Cattle	-24.12	-11.08	-20.47
Moderate Feed/High Cattle	-23.94	-10.37	-20.08
High Feed/Low Cattle	-30.75	-18.83	-28.68
High Feed/Moderate Cattle	-30.39	-17.46	-27.91
High Feed/High Cattle	-30.22	-16.78	-27.52

<sup>a</sup> Bold numbers represent positive differences

when land is valued at \$20.00/acre. Under a \$30.00/acre land value, returns from the hand-fed high-fiber supplement are positive under low and moderate feed prices, and are positive for all price situations under high land values. The high-starch (hand fed) and high-fiber (free choice) programs are considerably less profitable; per-head net returns exceed those of control cattle only under low feed costs with land values of \$30.00/acre or more.

Several potential cost reductions from the supplementation programs were not factored into the budgeting analysis due to a lack of definitive data. One important area of potential savings may result from reduced death loss and (or) medical expenses due to a reduction in the incidence of bloat from feeding monensin to the supplemented cattle. As shown in Table 3, net returns are increased nearly \$6.00/head (i.e., \$5.83/head) for each 1% reduction in death loss. Other savings might be realized from reduced labor or machinery use and costs of cattle facility, fence and water development by concentrating cattle in fewer pastures. The negative values reported in Table 6 may also be interpreted as the savings that must be realized through reduced death loss, medical expenses, and other cost reductions not accounted for that would make supplementation profitable relative to the control program.

Returns are expressed on a per acre basis in Table 7. Per-acre net returns are estimated by dividing per head returns by the appropriate stocking density (2 acre/head for the control and 1.5 acre/head for each of the supplementation programs). Per-acre returns should be compared when land is the limiting factor of production; that is, the producer wishes to maximize total returns from a fixed acreage of land. Per-acre returns from the high-fiber, hand-fed program exceed those of the control for all nine price situations when pasture is valued at \$20.00 or \$30.00/acre (Table 8). With the exception of three price situations (moderate feed/low cattle, high feed/low cattle and high feed/moderate cattle), per-acre returns from the high-starch and free-choice programs also exceed returns earned without supplementation.

**Table 7. Per-acre net returns from control and three alternative supplementation programs, 1989-90.**

	Control	High-starch Hand-fed	High-fiber Hand-fed	High-fiber Free-choice
	-----\$/Acre-----			
<b>\$20.00/ACRE:</b>				
Low Feed/Low Cattle	10.73	8.83	16.92	11.77
Low Feed/Moderate Cattle	31.84	37.23	45.99	40.44
Low Feed/High Cattle	42.40	51.42	60.52	54.77
Moderate Feed/Low Cattle	10.73	4.65	12.67	6.81
Moderate Feed/Mod. Cattle	31.84	33.04	41.73	35.47
Moderate Feed/High Cattle	42.40	47.24	56.29	49.81
High Feed/Low Cattle	10.73	0.47	8.41	1.85
High Feed/Moderate Cattle	31.84	28.86	37.48	30.51
High Feed/High Cattle	42.40	43.05	52.01	44.85
<b>\$30.00/ACRE:</b>				
Low Feed/Low Cattle	0.72	-1.17	6.92	1.77
Low Feed/Moderate Cattle	21.84	27.23	35.99	30.44
Low Feed/High Cattle	32.40	41.42	50.52	44.77
Moderate Feed/Low Cattle	0.72	-5.35	2.67	-3.19
Moderate Feed/Mod. Cattle	21.84	23.04	31.73	25.47
Moderate Feed/High Cattle	32.40	37.24	46.29	39.81
High Feed/Low Cattle	0.72	-9.53	-1.59	-8.15
High Feed/Moderate Cattle	21.84	18.86	27.48	20.51
High Feed/High Cattle	32.40	33.05	42.01	34.85
<b>\$40.00/ACRE:</b>				
Low Feed/Low Cattle	-9.28	-11.17	-3.08	-8.23
Low Feed/Moderate Cattle	11.84	17.23	25.99	20.44
Low Feed/High Cattle	22.40	31.42	40.52	34.77
Moderate Feed/Low Cattle	-9.28	-15.35	-7.33	-13.19
Moderate Feed/Mod. Cattle	11.84	13.04	21.73	15.47
Moderate Feed/High Cattle	22.40	27.24	36.29	29.81
High Feed/Low Cattle	-9.28	-19.53	-11.59	-18.15
High Feed/Moderate Cattle	11.84	8.86	17.48	10.51
High Feed/High Cattle	22.40	23.05	32.01	24.85
<b>\$2.50/CWT/MO:</b>				
Low Feed/Low Cattle	8.23	-1.17	6.92	1.77
Low Feed/Moderate Cattle	29.34	27.23	35.99	30.44
Low Feed/High Cattle	39.90	41.42	50.52	44.77
Moderate Feed/Low Cattle	8.23	-5.35	2.67	-3.19
Moderate Feed/Mod. Cattle	29.34	23.04	31.73	25.47
Moderate Feed/High Cattle	39.90	37.24	46.29	39.81
High Feed/Low Cattle	8.23	-9.53	-1.59	-8.15
High Feed/Moderate Cattle	29.34	18.86	27.48	20.51
High Feed/High Cattle	39.90	33.05	42.01	34.85

**Table 8. Comparison of per-acre net returns from three alternative supplementation programs to the control, 1989-90.<sup>a</sup>**

	High-starch Hand-fed	High-fiber Hand-fed	High-fiber Free-choice
	-----\$/Acre-----		
<b>\$20.00/ACRE:</b>			
Low Feed/Low Cattle	-1.89	<b>6.19</b>	<b>1.04</b>
Low Feed/Moderate Cattle	<b>5.39</b>	<b>14.15</b>	<b>8.60</b>
Low Feed/High Cattle	<b>9.02</b>	<b>18.12</b>	<b>12.37</b>
Moderate Feed/Low Cattle	-6.08	<b>1.94</b>	-3.92
Moderate Feed/Mod. Cattle	<b>1.20</b>	<b>9.89</b>	<b>3.63</b>
Moderate Feed/High Cattle	<b>4.84</b>	<b>13.89</b>	<b>7.41</b>
High Feed/Low Cattle	-10.26	-2.31	-8.88
High Feed/Moderate Cattle	-2.98	<b>5.64</b>	-1.33
High Feed/High Cattle	<b>0.65</b>	<b>9.61</b>	<b>2.45</b>
<b>\$30.00/ACRE:</b>			
Low Feed/Low Cattle	-1.89	<b>6.19</b>	<b>1.04</b>
Low Feed/Moderate Cattle	<b>5.39</b>	<b>14.15</b>	<b>8.60</b>
Low Feed/High Cattle	<b>9.02</b>	<b>18.12</b>	<b>12.37</b>
Moderate Feed/Low Cattle	-6.08	<b>1.94</b>	-3.92
Moderate Feed/Mod. Cattle	<b>1.20</b>	<b>9.89</b>	<b>3.63</b>
Moderate Feed/High Cattle	<b>4.84</b>	<b>13.89</b>	<b>7.41</b>
High Feed/Low Cattle	-10.26	-2.31	-8.88
High Feed/Moderate Cattle	-2.98	<b>5.64</b>	-1.33
High Feed/High Cattle	<b>0.65</b>	<b>9.61</b>	<b>2.45</b>
<b>\$40.00/ACRE:</b>			
Low Feed/Low Cattle	-1.89	<b>6.20</b>	<b>1.04</b>
Low Feed/Moderate Cattle	<b>5.39</b>	<b>14.15</b>	<b>8.60</b>
Low Feed/High Cattle	<b>9.02</b>	<b>18.12</b>	<b>12.37</b>
Moderate Feed/Low Cattle	-6.08	<b>1.94</b>	-3.92
Moderate Feed/Mod. Cattle	<b>1.20</b>	<b>9.89</b>	<b>3.63</b>
Moderate Feed/High Cattle	<b>4.84</b>	<b>13.89</b>	<b>7.41</b>
High Feed/Low Cattle	-10.26	-2.31	-8.88
High Feed/Moderate Cattle	-2.98	<b>5.64</b>	-1.33
High Feed/High Cattle	<b>0.65</b>	<b>9.61</b>	<b>2.45</b>
<b>\$2.50/CWT/MO:</b>			
Low Feed/Low Cattle	-9.39	-1.31	-6.46
Low Feed/Moderate Cattle	-2.11	<b>6.65</b>	<b>1.10</b>
Low Feed/High Cattle	<b>1.52</b>	<b>10.62</b>	<b>4.87</b>
Moderate Feed/Low Cattle	-13.58	-5.56	-11.42
Moderate Feed/Mod. Cattle	-6.30	<b>2.39</b>	-3.87
Moderate Feed/High Cattle	-2.66	<b>6.39</b>	-0.09
High Feed/Low Cattle	-17.76	-9.81	-16.38
High Feed/Moderate Cattle	-10.48	-1.86	-8.83
High Feed/High Cattle	-6.85	<b>2.11</b>	-5.05

<sup>a</sup> Bold numbers represent positive differences

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