USDA/NRCS Conservation Innovation Grant

Forage-Based Beef Production Strategies for Western North Dakota

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Final Report Summary of Work Performed:

The objective of this project is to demonstrate an alternative beef management system that incorporates early weaning and a standing annual forage feed supply for weaned calves and cows that will produce heavy backgrounded calves and wintered cows without concentrating manure and negatively impacting the environment. Total beef systems that capitalize on extended grazing for both spring-born early weaned calves and cows as a divergence from conventional fall weaning into drylot and reduced hay wintering is uncommon in southwestern North Dakota. Project innovation uses a “leader-follower” protocol in which early weaned calves are backgrounded without long periods of feedlot confinement grazing unharvested corn and cows are wintered grazing lower quality corn residue after calves have gleaned the more succulent plant parts.

Profit volatility is common in the cattle business, and drought limits precipitation during the critical spring growing period in the northern Great Plains. Information generated by this demonstration can be used to address vital land and livestock resource issues, i.e. maintaining ranching business vitality and profitability while protecting the environment and water resources.

Results from the demonstration have been summarized in the itemized “Integrated Crop and Livestock Management Fact Sheet” shown in Appendix I for use by NRCS personnel engaged in non-confinement grazing and livestock management education.

Project Objectives:

1. Demonstrate native range forage sparing potential through early weaning and the subsequent effect on cow BCS in a beef management system.

2. Demonstrate the extensive, non-confinement potential of unharvested corn as an extensive feed base for calf growth and backgrounding followed by cow grazing of corn residue remaining after calves glean the most succulent aerial plant parts.

3. Demonstrate the prevalence of *E. coli* O157:H7 and Salmonella in manure and document soil nutrient and organic matter following late summer and early winter grazing of unharvested corn; and also document nutrient load in runoff water.

The calving period during the demonstration was from March 20 of each year to the first week of May. Over 80% of the cows calved during the first 40 days of the calving season. Forty-eight cow-calf pairs (steer calves only) were used each year of the investigation and were assigned to either early- or normal-weaning groups based on calving date. Subsequently, the August early weaning occurred during the second week of August when the early weaned calves were weaned from their mothers. One-half of the calves in each weaning date group were sent directly to the University of Nebraska Panhandle Research and Extension Center Feedlot, Scottsbluff, NE and the remaining one-half were placed in replicated feedlot pens and fed hay for 9-14 days for weaning stress recovery. At the end of the weaning recovery period, the steer calves were vaccinated for bacterial and viral calfhood diseases and put into replicated 4.5 acre unharvested green growing corn fields. When the calves completed harvesting the higher quality corn plant material, they were removed from the corn fields, weighed and delivered to the UNL Panhandle Feedlot for finishing also. After the calves were removed from the corn fields, the calves’ mothers were put into the corn fields and grazed the corn stalk residue.

Pathogen prevalence was monitored among cows and their calves during grazing and feedlot conditions. Fecal grab samples and rectal swab samples taken at the rectal-anal junction were analyzed under the supervision of Margaret Khaitsa at North Dakota State University. Soil samples were taken each spring and analyzed for N, P, K, Su, Zn, Cu, and organic matter. Waste runoff water from fields grazed by cattle was analyzed for phosphate-phosphorus, potassium, total dissolved solids, and nitrate-nitrogen. During the 2-year study, western North Dakota was drier than normal which resulted in a single snowmelt event the last year of the demonstration.

Considering the extreme drought experienced during the second year of the investigation, the data and analysis were not combined. The summary tables and discussion provided are summarized in a Normal Precipitation Report and in a Drought Report for the second year of the study.

Project Deliverables

A. Workshops during the grant period (Appendix II):

1. Forage-Based Beef Production Strategies Field Day, September 26, 2007
2. 1st Annual Forage Beef & Cover Crop Workshop, September 24, 2008
3. 2nd Annual Forage Beef & Cover Crop Workshop, September 16, 2009

B. Tours:

1. Logan County, Kentucky Soil Conservation District tour of the CIG Forage-Based Beef Production Strategies project, September 17, 2008

C. Educational Electronic Media

The initial CIG proposal stated that an educational DVD would be prepared; however, it has been replaced with a Forage-Beef and Cover Crop website with live streaming video of field day presentations, educational PowerPoint presentations, and links to related sites. The website was selected, in lieu of the DVD, because it provides contact with a worldwide audience and can be updated with new information and links.

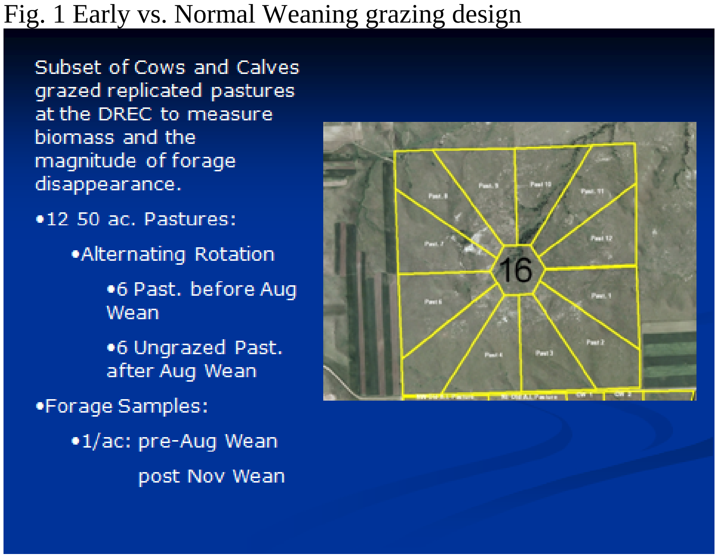
Website URL: http://www.ag.ndsu.nodak.edu/dickinso/cig/index.htm

Description of Significant Results, Accomplishments, and Lessons Learned:

1. Demonstrate native range forage sparing potential through early weaning and the subsequent effect on cow BCS in a beef management system.

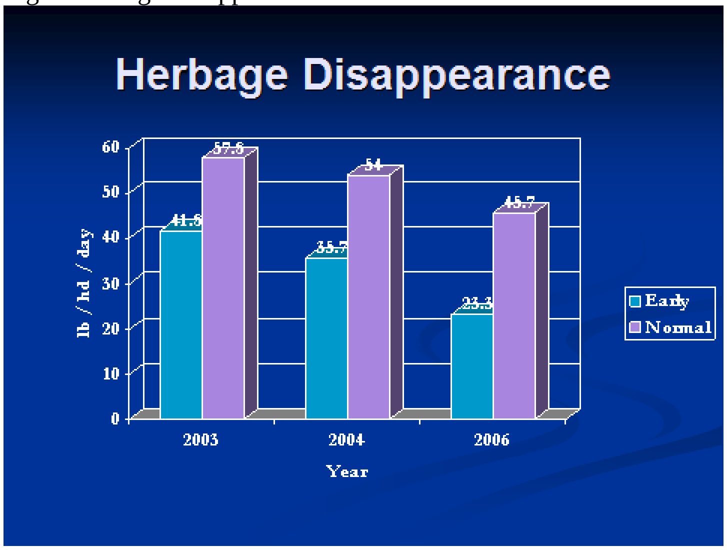
The key to successful early weaning management in a beef system is energy allocation. The energy requirement for the lactating cow is approximately 30% greater than that of the non-lactating cow. Thus, when calves are weaned early, the cow's requirement for lactation stops and range forage energy and nutrients are only needed for the cow's maintenance and growth. Research has shown that cows in body condition score of 5 to 6 (1-9 System) require less winter feed to maintain condition and have improved reproductive performance the next breeding season. Forage production and disappearance data was obtained over a three year period on a section of native range (146-96, Sec. 16) located in Dunn County, North Dakota. The early and normal weaning grazing design and forage sampling procedure is shown in Fig. 1.

Fig. 1 Early vs. Normal Weaning grazing design



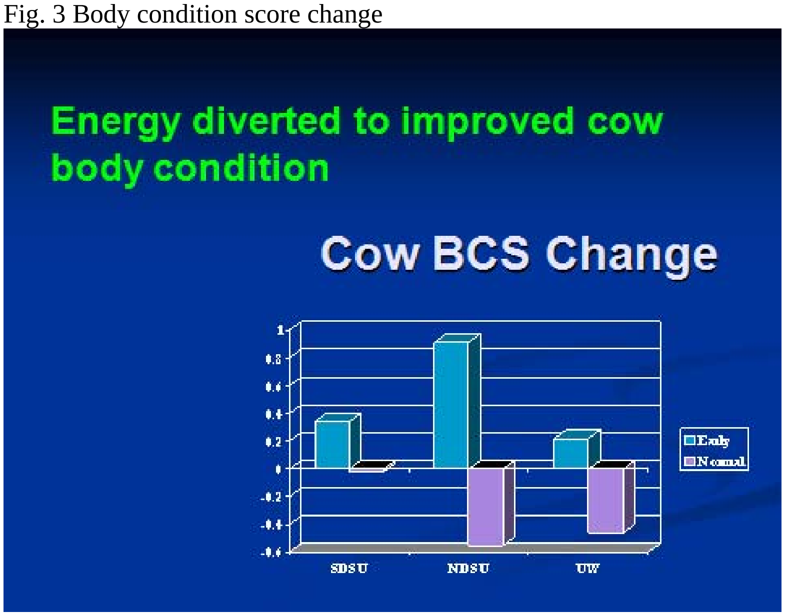
Forage or herbage disappearance expressed in pounds/head (cow)/day is shown in Fig. 2. The differential between cows that nursed calves varied between the years measured, but was actually very consistent at an average 18.9 pounds/cow/day less for cows that had their calves weaned early.

Fig. 2 Herbage Disappearance in Pounds/Cow/Acre



With the cessation of lactation facilitated by early weaning, energy allocation is naturally diverted from milk production to increased body condition. In Fig. 3 the effect of early weaning is depicted among three participating cow herds located at the Dickinson Research Extension Center, SDSU Antelope Station, Buffalo, SD, and the University of Wyoming. Early weaning consistently improved body condition score and ranged from 0.2 to 0.8 BCS points.

Fig. 3 Body condition score change



We have been able to demonstrate that early weaning will result in spared native forage. The next question in a beef system is to identify how to allocate the stored forage energy that was spared through early weaning. These data do not suggest a replacement for best management practices that incorporate rotational grazing, but reallocates how the spared forage may be utilized. Early weaning and the resultant spared forage can be used initially to improve plant vigor and provide for stocking flexibility, i.e. increase winter grazing capabilities, extensive heifer development at lower cost, and/or increase cow herd size.

2. Demonstrate the extensive, non-confinement potential of annual forage as an extensive feed base for calf growth and backgrounding followed by cow

grazing of corn residue remaining after calves glean the most succulent aerial plant parts.

Summary of Integrated Livestock and Annual Forage Grazing Results:

In the first objective we have demonstrated that early weaning consistently spares native forage and improves cow body condition. Cows that go into the winter with improved body condition require less winter feed to maintain condition and cows with body condition scores of 5 or better have shorter postpartum intervals, more prebreeding estrous cycles, and a potential for higher first service pregnancy rate.

While early weaning is very beneficial for the cow and native forage sparing, calf management is equally important, and to become a readily adopted practice, growth performance must exceed that which is obtainable grazing native pasture, and the practice must be economical. Without a management plan for the calves, early weaning would be impossible. Even with a plan, the practice requires extra management.

Results from the 1st year of the demonstration (Normal Precipitation)

Standing peak dryland corn forage nutrient quality was determined mid-September and tracked through to mid-January. Corn forage CP declined from Sep to Nov (9.16 to 8.66) and IVDMD declined from 75.2% to 57.0% (Table 1).

Peak DM corn production for the EW steers averaged 2.20 Ton/acre (Table 2) and peak DM corn production for the NW group was 1.93 Ton/acre (Table 3). Early weaned steers utilized an average 1.46 Ton/acre over the 70 day grazing period and NW steers utilized 0.41 Ton/acre. Field loss in stockpiled corn set aside for grazing after normal weaning was excessive averaging 0.90 Ton/acre. Compared to the EW treatment, the large field loss reduced available days of grazing by 70%.

Comparative systems backgrounding performance is shown in Table 4. Steer weight at EW did not differ (P=0.44), but gain among the NW-CN steers was reduced significantly (P=0.043) due to field crop shrink. Average daily gain for EW and NW steers was similar and greater (p=0.004) than the control steers despite significant crop shrinkage. System backgrounding economics are shown in Table 5 where gain value, input costs, net returns, and cost/lb of gain are summarized. The backgrounding cost/lb. of gain was $0.5933, $1.71, $0.5097, and $0.6564 for the NW-FLT, NW-CN, EW-CN, and EW-FLT, respectively. Net return/steer among the steers in EW-CN system was 33.5% greater than the EW-FLT system and 16.3% greater than the NW-FLT system. Stockpiling corn for grazing after normal weaning was not successful resulting in a net loss/steer of -$33.38. The stocking rate for early weaned calves that grazed unharvested dryland corn was calculated to be 0.25acres/calf/month and the stocking rate for stockpiled corn reserved for unharvested corn gazing after normal weaning was determined to be 0.82 acres/calf/month (Table 6). Following grazing by calves, cows grazed stalk residue. Stalking rate for cows expressed in acres/cow/month is shown in Table 6 for 1,000, 1,200, and 1,400 pound cows. The stocking rate for 1,200 pound cows grazing corn stalk residue previously grazed by EW and NW calves was 0.70 and 0.87 acres/cow/month, respectively.

For the purpose of comparing beef production from corn grazing during backgrounding with grain production, steer net return value per acre after expenses was converted to a corn grain equivalent yield per acre. Comparative values are shown in Table 7 over a range of corn prices per bushel from $3.00 to $5.00/bu. At $4.00/bu, the corn equivalent value of beef produced among the EW steers was equivalent to 87.5 bushels of corn/ac. The corn equivalent value of beef produced among the NW steers was equivalent to 26.2 bushels of corn/ac.

The effect of alternative weaning date and corn grazing on finishing performance is shown in Table 8. Early weaning and corn grazing backgrounding resulted in variable feedlot starting weights (P = 0001), and a large variation in the number of days on feed (P = 0.0001); however, harvest age (P = 0.27) and 4% shrunk harvest weight (P = .409) did not differ. For gain and FE, EW-FLT steers gained at the slowest rate (P = 0.001), were more efficient (P = 0.008), and feed and yardage cost/lb. of gain were lower (P = 0.0002). By contrast, EW-CN steers that were the most profitable at the end of corn grazing backgrounding were less efficient (P = 0.008) and feed and yardage cost/lb. of gain was higher (P = 0.0002) during retained ownership finishing. The NW-CN steers that grazed stockpiled dryland corn were the least efficient (P = 0.008) and had the highest feed and yardage cost/lb. of gain (P = 0.0002).

The primary health issue was bovine respiratory disease, which has been summarized in Table 9. The incidence of BRD among EW steers sent directly to the feedlot after weaning mid-August was markedly greater than for any of the later arriving treatment groups and treatment cost was 3.5 times greater than either the control or treatment groups that grazed corn during backgrounding.

The effect of alternative weaning date and corn grazing on carcass closeout measurements is shown in Table 10. Carcass closeout values for HCW (P = 0.78), dressing percent (P = 0.51), fat depth (P = 0.243), and yield grade (P = 0.23) did not differ. Corn grazing steers had significantly larger ribeye area (p = 0.053). Days on feed, which varied due to management system, directly affected marbling score (P = <0.0001) and the number of carcasses that grading USDA Choice or better (P = 0.10). The number of days on feed and the percent USDA Choice were 141.5/66.7%, 165.7/79.2%, 192.0/81.1%, and 280.8/94.4% for the NW-CN, EW-CN, NW-FLT, and EW-FLT, respectively.

The combined effect of calf placement cost, ingredient cost, treatment cost, freight, and interest cost affected finishing net return and are shown in Table 11. Calf placement cost had the most influence on net return. Closeout net returns were $3.11, -$84.06, $0.16, and $39.62/head for the NW-FLT, NW-CN, EW-CN, and EW-FLT, respectively.

Table 1.Corn Nutrient Change (Sept. – Jan.)

	C- Prot	***NDF***	***ADF***	***IVDMD%***	***IVOMD***	***Ca***	***P***
	%	%	%	%	%	%	%
Whole Plant/Stalks:							
Sept. 25, 2007	9.16	61.0	30.0	75.2	74.8	0.20	0.16
Nov. 15, 2007	8.66	70.2	40.5	59.0	57.0	0.23	0.12
Jan. 12, 2008(Residue)	4.36	79.8	50.3	43.5	40.9	0.32	0.05
Corn Grain:							
Sept. 25, 2007	14.1	12.2	3.10	90.8	90.4	0.03	0.37
Cobs:							
Sept. 25, 2007	4.33	81.5	39.2	64.1	63.1	0.01	0.12
Litter (trash on ground):							
Jan. 12, 2008	9.57	72.1	36.7	64.7	64.8	0.31	0.11

Table 2. Early Wean Corn Utilization

	Peak	***Calf***	***Cows***
	Production T/Ac	Utilization T/Ac	Residual Stalks T/Ac
Fields:			
4	2.05	1.11	0.94
6	1.92	1.24	0.68
8	2.64	2.02	0.62
Total Tons	6.61	4.37	2.24
Avg DM, T/Ac	2.20	1.46	0.75

Table 3. Normal Wean Corn Utilization

	Peak Production Sept	*Start Graze Nov*	*Field Loss*	*Calf Utilization*	*Cows Residual Stalks*
	T/Ac	T/Ac	T/Ac	T/Ac	T/Ac
Field					
5	2.11	1.18	0.93	0.54	0.64
7	1.6	0.89	0.71	0.27	0.62
9	2.08	1.02	1.06	0.41	0.61
Total Tons	5.79	3.09	2.70	1.22	1.87
Avg DM, T/Ac	1.93	1.03	0.90	0.41	0.62

Table 4. Alternative Beef System Backgrounding Performance

	NW- Control Pasture	*NW – Corn Grazing*	*EW – Corn Grazing*	*EW – Feedlot*	*SE*	*P-Value*
Weaning Date	Nov 7	Nov 7	Aug 15	Aug 15		
No. Steers	54	24	24	57		
Pre-Unhvsted Corn Grazing (Drylot):						
Days in Drylot[a]	----	13	13	----		
Drylot St. Wt.(Aug 15, Nov 7), lb	----	627	468	----		
Drylot End Wt., lb	----	639	481	----		
Drylot Gain, lb	----	12.0	13.0	----	2.91	0.52
Drylot ADG (Drylot), lb	----	0.923	1.00	----	0.22	0.53
System Days	84	21	70	86		
System Wt at Ely Wean (Aug 15) lb	436	457	468	405	22.1	0.44
System End Wt., lb	600	693	662	611	33.19	0.15
Gain, lb	164[ab]	54[b]	181[a]	206[a]		0.043
ADG, lb	1.95[b]	2.57[a]	2.59[a]	2.40[a]	0.126	0.004

[a]Weaned steers were held in drylot for 13 days before placement in the corn fields to get over weaning.

Table 5. Alternative Beef System Unharvested Corn, Pasture, and Feedlot Economics

	NW- Ctrl Pasture/ Feedlot	*NW – Corn Grazing*	*EW – Corn Grazing*	*EW – Feedlot*	*SE*	*P-Value*
No. Steers	54	24	24	57		
Gain Value [a,b,c,d]	$9,979	$1,413	$4,724	$10,980		
Input Cost:						
Pasture (Rent @$14.00/ac)[e]	$5,254					
Corn ($164/ac)		$2,214	$2,214			
Feedlot				$7,302		
Backgrounding Net Return	$4,725	-$801	$2,510	$3,678		
Backgrounding Net Return/Head	$87.50	-$33.38	$104.58	$69.56		
Cost/Lb. Gain	$0.5933	$1.71	$0.5097	$0.6564		

[a]NW Control Gain Value (8,910lb@$112/cwt)
[b]NW Corn Grazing Gain Value (4,334lb@$109/cwt)
[c]EW Gain Value (1,296lb@$109/cwt)
[d]Gain Value (9,804lb@$112/cwt)
Pasture Rent Calculation: 2.78 months, 2.5 AUM; = 6.95 Ac/AUM @ $14/Ac; = $97.30 x54 = $5,254.20

Table 6. Steer and Cow Stalking Rate for Unharvested Corn and Stalk Residue Grazing

	Normal Weaned Cows	***Normal Weaned Steers***	***Early Weaned Cows***	***Early Weaned Steers***
Steer Unharvested Corn, Ac/Steer/Month		0.82		0.25
Corn Residue, T/Ac	0.624		0.748	
Stalk Residue Requirement, Ac/Cow/Month				
1,000 Lb Cow	0.73		0.59	
1,200 Lb Cow	0.87		0.70	
1,400 Lb Cow	1.02		0.82	
Residue Value @$40/Ton Hay Equivalent	$337.00		$420.00	

Table 7. Corn Grazing Grain Equivalent, Bu/Acre

	Corn Bushel Price	***Early Wean – Grain Yield Equivalent***	***Normal Wean – Grain Yield Equivalent***
Steer Grazing Gain Value	$3.00	116.6	34.9
	$4.00	87.5	26.2
	$5.00	70.0	20.9
Corn Stalk Residue Grazing (Cows)	$3.00	10.4	8.3
Based on $40/Ton Hay	$4.00	7.8	6.2
	$5.00	6.2	5.0
Combined Steer Gain and Cow	$3.00	127.0	43.2
Stalk Grazing Value	$4.00	95.3	32.4
	$5.00	76.2	25.9

Table 8. Effect of Alternative Weaning Date and Corn Grazing on Steer Finishing Performance

	NW- Control Pasture/F-lot	***NW – Corn Grazing***	***EW – Corn Grazing***	***EW – Feedlot***	***SE***	***P-Value***
Start Wt., lb	600.0[c]	747.7[b]	690.3[d]	404.8[a]	0.00	<0.0001
Shrunk Finished End Wt., lb[a]	1186.9	1224.0	1249.9	1203.1	23.01	0.409
Days on Feed	192[d]	141.5[b]	165.7[c]	280.8[a]	3.44	<0.0001
Kill Age, Days	408.1	415.1	404.6	412.1	3.17	0.270
Gain, lb	586.9[c]	476.3[b]	559.6[d]	798.3[a]	9.46	0.0001
ADG, lb	3.06[b]	3.37[c]	3.38[c]	2.85[a]	0.056	0.0011
Fd/Head/Day (As Fed), lb	29.7[b]	36.0[d]	33.0[c]	27.0[a]	0.749	<0.0001
Fd/Head/Day (Dry Matter), lb	20.2[b]	24.5[d]	22.4[c]	17.8[a]	0.506	<0.0001
DM Feed:Gain, lb	6.60[b]	7.27[c]	6.62[b]	6.27[a]	0.157	0.008
Fd & Yard Cost/Day, $	$2.096[b]	$2.723[d]	$2.383[c]	$1.715[a]	0.053	<0.0001
Fd & Yard Cost/Lb of Gain, $	$0.6850b	$0.8080c	$0.7050b	$0.6017a	0.016	0.0002

[a] 4% Shrink

Table 9. Alternative Production Effect on Health Pulls and Treatment Costs

	NW- Control Pasture/Feedlot	*NW – Corn Grazing*	*EW – Corn Grazing*	*EW – Feedlot*
Pulls: 1	3.7%	3.75%	0.0%	17.5%
2				8.77%
3				3.51%
Avg. Treatment Cost/Head	$1.72	$3.87	$0.0	$9.92

Table 10. Effect of Alternative Weaning Date and Corn Grazing on Carcass Measurements

	NW – Control Pasture/F-Lot	*NW – Corn Grazing*	*EW – Corn Grazing*	*EW – Feedlot*	*SE*	*P-Value*
Hot Carcass Wt., lb	737.8	745.3	762.9	745.5	14.77	0.78
Carc. Dressing Percent, %	62.0	60.6	61.1	60.6	0.72	0.51
Ribeye Area, sq. in.	11.51[b]	12.3[a]	12.3[a]	11.7[b]	0.17	0.053
Fat Depth, in.	0.586	0.547	0.581	0.638	.0304	0.243
Yield Grade[a]	3.46	3.35	3.45	3.59	0.075	0.229
Marbling Score	442[b]	438[b]	453[b]	539[a]	12.75	0.0005
% Choice Carcasses	81.1	66.7	79.2	94.4	6.32	0.109

[a]Yield Grade correlation to percentage of boneless, closely trimmed retail cuts: 1 = 54.6%, 2 = 52.3%, 3 = 5.0%, 4 = 47.7%, and 5 = 45.4%

Table 11. Effect of Alternative Weaning Date and Corn Grazing on Finishing Economics

	NW – Control Pasture/ F-lot	*NW – Corn Grazing*	*EW – Corn Grazing*	*EW – Feedlot*
Expenses:				
Calf Value	$666.00	$783.22	$724.50	$566.72
Feed and Yardage	$402.06	$384.85	$394.52	$480.34
Treatment Cost	$1.72	$3.87	$0.0	$9.92
Freight ($4.5/mile; 425 miles)	$23.90	$29.88	$27.71	$16.20
Interest @ 6.0%	$34.18	$27.55	$30.90	$49.00
Total Expense	$1,127.86	$1,229.37	$1,177.63	$1,122.18
Carcass Value	$1,130.97	$1,145.31	$1,177.79	$1,161.80
Profit (Loss)	$3.11	-$84.06	$0.16	$39.62

Results from the 2nd year of the demonstration (Drought)

The second year of the demonstration was plagued with a severe drought. Although critical growing season precipitation was very short, the alternate pasture grazing system employed for these weaning date investigations provided sufficient grazable forage for the normal weaning date group (Nov. 1).

Annual corn forage seeded for grazing did not develop ears and overall tonnage was reduced significantly. The small crop limited the number of days for grazing to less than one-half of the previous year and the EW treatment lost money. Basically, the poor corn crop was salvaged, but at a loss. Corn nutrient analysis, production, and utilization are summarized in Tables 1, 2, and 3.

Steer performance comparing the NW group that continued to graze native range with the EW group indicated that ADG was comparable while the corn crop lasted. These comparative results are shown in Table 4.

The EW and NW corn grazing treatment group comparisons are shown in Table 5. The NW group grazed corn after weaning in November when the corn crop is mature and dried down. With no ears in the drought stressed crop, the pounds of gain among the NW steers was 58.6% less than the EW steers.

In the system economic analysis, net crop insurance payments were figured into the analysis. The analysis, shown in Table 6, resulted in net returns/steer of $69.25 for the NW pasture group, -$37.74 for the NW group that grazed corn, and $14.92 for the EW group that grazed green corn.

The steers from each weaning date treatment were followed from the end of backgrounding grazing unharvested standing corn to final harvest. As in the first year of the demonstration, the steers were fed at the University of Nebraska Panhandle RE Center Feedlot, Scottsbluff, NE and final harvest was at the Cargill Meat Solutions plant located in Fort Morgan, CO.

Not only did these steers go through one of the driest summers on record in ND, but the price of corn fed in the feedlot was historically high. The number of days on feed (DOF) for the EW steers was 41 days longer than for the NW steers. The EW steers gained 164 pounds more during the finishing period, but ADG was similar (NW - 3.26 vs EW - 3.39).

Finishing economic analysis has been summarized in Table 8. And due to the high corn grain cost, both the EW and NW groups in the demonstration lost money. However, because the NW steers were on feed for fewer days (41) they lost less money (EW -$266.98 vs NW - $144.54). Carcass quality was better among the EW steers that were on feed longer. The EW steer carcasses were numerically heavier, had larger ribeye area (P = 0.07), greater fat depth (P = 0.06), similar yield grade (P = 0.37), higher marbling score (P = 0.004), and numerically higher quality grade (Percent Choice Carcasses) (NW – 78.0 vs. 86.3).

Table 1. Corn Nutrient Analysis (Drought Stressed – Ears Did Not Develop)

	C- Prot	***NDF***	***ADF***	***IVDMD***	***IVOMD***	***Ca***	***P***
Whole Plant, %	10.71	59.10	31.50	66.65	66.11	0.35	0.13

Table 2. Early Wean Corn Utilization (Dry Matter)

	Peak Production, T/Ac	*Calf Utilization, T/Ac*	*Cows Residual Stalks, T/Ac*
Fields:			
4	0.88	0.35	0.53
6	0.93	0.47	0.46
8	1.70	1.53	0.17
Total DM, T/Ac	3.51	2.35	1.16
Avg. DM, T/Ac	1.17	0.78	0.38

Table 3. Normal Wean Corn Utilization (Dry Matter)

	Peak Production Sept, T/Ac	*Start Graze Nov, T/Ac*	*Field Loss, T/Ac*	*Calf Utilization, T/Ac*	*Cows Residual Stalks, /Ac*
Fields:					
5	0.50	0.64	0.14	0.50	0.14
7	1.52	0.66	-0.86	0.52	0.14
9	1.27	0.46	-0.81	0.27	0.19
Total DM, T/Ac	3.29	1.76	-1.53	1.29	0.47
Avg. DM, T/Ac	1.10	0.59	-0.51	0.43	0.16

Table 4. Normal vs Early Weaning: 2008 Steer Calf Performance

	Normal Wean Native Pasture	*Early Wean Corn Grazing*	*SE*	*P-Value*
No. Steers	24	24		
Weaning Date	11-3-2008	8-13-2008		
Days Grazing EW to NW	82 (2.69 Mths)			
Days of Drought Corn Grazing		44		
Weight at EW	482	482	17.64	0.99
Weight at Normal Weaning, lb	658			
Weight at End of Corn Grazing, lb		574	16.79	0.024
Gain	176	91	6.51	0.0008
ADG	2.14	2.07	0.13	0.76

Table 5. Standing Unharvested Corn Grazing: Early vs Normal Weaned Steers

	Normal Wean Native Pasture	*Early Wean Corn Grazing*	*SE*	*P-Value*
No. Steers	24	24		
No. Days Grazed	30	30		
Start Corn Grazing Wt., lb	657	499	23.33	0.008
End Corn Grazing Wt., lb	691	574	30.96	<0.0001
Gain, lb	34	75	3.10	0.0012
ADG, lb	1.13	2.50	0.093	0.0007

Table 6. Pasture vs Early and Normal Wean Grazing Economics

	Normal Wean Native Pasture	*Normal Wean Corn Grazing*	*Early Wean Corn Grazing*	*SE*	*P-Value*
No. Steers	24	24	24		
Days of Grazing	82	30	30		
Total Gain Value, $	1306.79	250.91	672.25	35.01	<0.0001
Gain Value/Ac, $	26.04[a]	55.76[b]	149.39[c]	5.13	<0.0001
Gain Value/Hd, $	163.35[a]	31.36[b]	84.03[c]	4.37	<0.0001
Net Crop Ins. Pymt./Hd., $	---	23.00	23.000		
Gain Value + Ins./Hd, $	163.35[a]	54.51[b]	107.17[c]	4.36	<0.0001
Pasture or Corn Prod/H, $	94.10	92.25	92.25		
Net Return/H, $	69.25	-37.74	14.92	4.37	<0.0001

Table 7. Early vs Normal Weaning: Effect on Finishing Performance

	Normal Wean Corn Grazing	*Early Wean Corn Grazing*	*SE*	*P-Value*
No. Steers	24	24		
Days on Feed	198	239	4.51	0.003
Kill Age, Days	459	438	3.39	0.020
Start Wt., lb	697	602	20.81	0.033
End Wt. (4% Shrink), lb	1343	1412	35.65	0.042
Gain, lb.	646	810	14.53	0.001
ADG, lb	3.26	3.39	0.038	0.094

Table 8. Early vs Normal Weaning: Effect on Finishing Economics

	Normal Wean Corn Grazing	*Early Wean Corn Grazing*	*SE*	*P-Value*
Feed/Head/Day (DM), lb	20.7	19.92	1.45	0.711
Feed/Lb of Gain (DM), lb	6.34	5.89	0.38	0.447
Feed Cost/Lb of Gain, $	1.06	1.03		
Feed Cost/Head, $	684.79	828.19	17.14	0.010
Yardage/Head, $	68.86	83.39	4.30	.075
Freight/Head, $	23.00	21.00		
Total Direct Expense, $	776.65	932.58	17.30	0.016
Purchased Calf:				
Direct Feedlot Expense, $	776.65	932.58		
Steer Cost/Head, $	640.10	586.74	12.42	.034
Total Expense, $	1416.75	1516.78	18.36	0.018
Carcass Value, $	1089.11	1122.60	13.24	0.17
Net Return, $	-327.64	-394.18	16.90	0.059
Retained Ownership:				
Direct Feedlot Expense, $	776.65	932.58		
Cow Cost, $	457.00	457.00		
Total Expense, $	1233.65	1389.58	17.30	0.015
Carcass Value, $	1089.11	1122.60		
Net Return, $	-144.54	-266.98	23.28	0.007

Table 9. Early vs Normal Weaning: Effect on Carcass Closeout Measurements

	Normal Wean Corn Grazing	*Early Wean Corn Grazing*	*SE*	*P-Value*
Hot Carcass Wt., lb	805.67	820.33	11.27	0.35
Fat Depth, in	0.456	0.513	0.0105	0.060
Rib Eye Area, sq. in.	12.26	12.78	0.133	0.072
Yield Grade	3.17	3.21	0.028	0.37
Marbling Score	543	619	15.73	0.0042
Quality Grade (Pct. Choice or better)	77.97	86.3	6.79	0.18

3. Demonstrate the prevalence of *E. coli* O157:H7 and Salmonella in manure and document soil nutrient and organic matter following late summer and early winter grazing of unharvested corn; and also document nutrient load in runoff water.

Soil nutrient analysis results are shown in Table 1. Soil samples were taken in the fall for the corn fields that were grazed by the EW steers and the fields where the NW steers grazed after the ground was frozen were taken in the spring. The soil sample results differ numerically, but statistically, there is no difference except for the number of pounds of nitrogen/Ac. The spring sample was significantly higher, which would be expected. It also should be noted that soil organic matter was similar between grazing treatment groups and ranged from 3.73% in the EW fields to 4.13% in the fields grazed by NW steers.

Waste water analysis was compromised by drought that limited spring snowmelt runoff to the last year of the study. Waste water collected was compared to Southwest Rural Water collected from the cattle water tanks. The analysis results are shown in Table 2. Compared to the water tanks, phosphate-phosphorus in runoff water was 5.4 times higher, and the potassium content was 11.9 times higher. The total dissolved solids and nitrate-N did not differ.

Surveys for both *E. coli* and *Salmonella* were conducted during the demonstration. Results of the survey are shown in Figures 1 and 2 below. The prevalence of *E. coli* in cows was highest in September and declined rapidly to zero when sampled in November and December. Prevalence in calves was significantly lower than in cows and by the December sampling period had dropped to between 5-10% of the calves sampled.

Salmonella prevalence in cows declined from the September sample to February and then increases seasonally in April. For calves, *Salmonella* remained relatively stable between 45-50% of the steers sampled except for the December sample when 100% of the steers tested positive for *Salmonella*.

Table 1. Soil Nutrient Analysis and Organic Matter Content following Early and Late Weaning

	N	*P_2O_5*	*K_2O*	*Sulfur*	*Zinc*	*Copper*	*OM*
Units	Lbs/Ac	ppm	ppm	Lbs/Ac	ppm	ppm	Pct
Early Wean Fields	189	19.3	365.3	79.3	1.03	1.64	3.73
Late Wean Fields	298	24.7	493.3	76.0	1.29	1.67	4.13
Std Error	21.72	1.81	51.7	9.39	0.159	0.428	0.481
P-Value	0.024	0.106	0.155	0.814	0.308	0.971	0.588

Table 2. Waste Runoff Water Nutrient Analysis

	PO_4-P (mg/l)	*Potassium (mg/l)*	*TDS (mg/l)*	*Nitrate – N (mg/l)*
Field Runoff Water	2.375	50.1	338.3	0.02
Southwest Rural Water	0.443	4.21	356.3	0.0
Std Error	0.437	7.18	27.24	0.0
P-Value	0.011	0.001	0.650	0.100

Fig. 1 *E. coli* Prevalence Survey Results

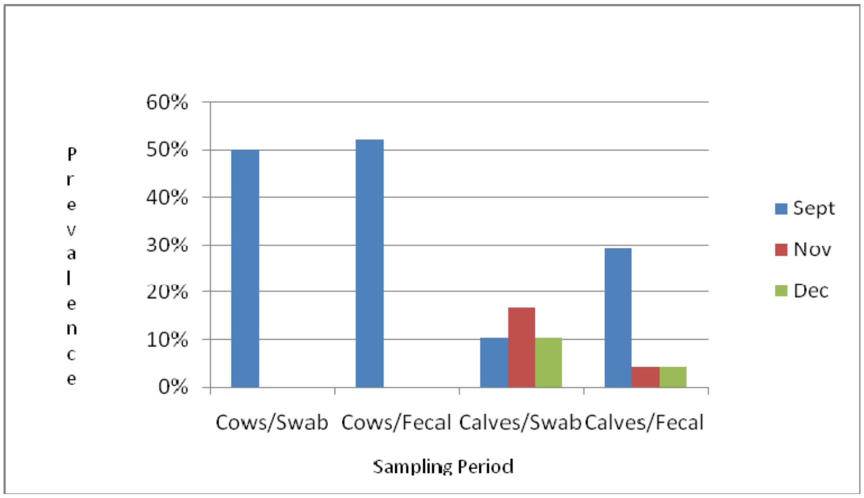
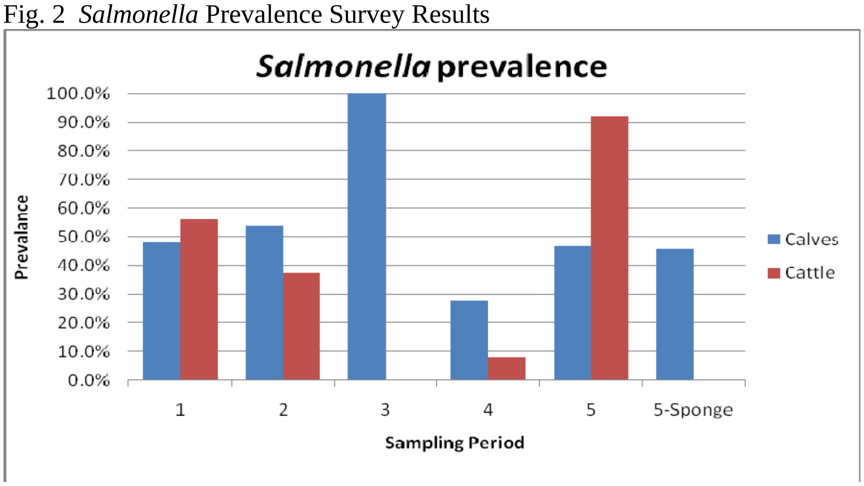


Fig. 2 *Salmonella* Prevalence Survey Results



Appendix I

Integrated Crop and Livestock Management Fact Sheet

General Statement:

Integrating crop and beef cattle production using an early weaning technique in which calves are removed from their mothers as much as 91 days sooner than calves are often conventionally weaned positively impacts productions economics resulting in greater net returns to the cow-calf enterprise while improving the range resource.

Impact on Cows and Native Range:

1. Cows that have their calves weaned as much as 91 days early react to the termination of lactation by increasing in body weight and body condition. Depending on cow frame size, the increase in weight and condition can be used to reduce winter feed cost.

2. Calf removal has the potential to reduce native range herbage disappearance by up to 36.9%.

2. Winter feed costs required to maintain brood cows during the winter represents the highest single cost in beef cattle production. Cows grazing corn stalks following EW calves can have their grazing season extended at very low cost because the cost of corn production has been expensed to cash crop calf production. The added weight gain cows experience after EW will provide reserves for corn stalk grazing without additional supplementation. However, when cows are expected to graze stalks more than 45 days,

1 to 2 pounds of a protein supplement needs to be provided. Cows weighing from 1,200 to 1,400 pounds will need approximately 0.75 acre of stalks/cow/month.

Impact on Early Weaned Calves:

1. Early weaned calves weighing from 300 to 400 pounds can be successfully weaned and backgrounded grazing standing unharvested corn. EW calves will gain from 2.0 to 2.6 lb/day at a cost of $0.51/lb of gain. The cost of gain for conventionally weaned calves is somewhat higher costing $0.59/lb of gain; however, *conventional weaning does not improve the range resource or cow condition*.

2. Once the annual forage corn crop has been seeded and weeds controlled, the work is nearly done. Calves grazing standing corn are supplied with a nutrient dense, whole-plant, diet that does not need additional supplementation. In this demonstration, protein supplementation was not provided after frost killed the plant and the corn dried down. Corn grain in the plant was expected to supply an adequate amount of protein to the rumen micro flora. Feed cost is reduced by grazing because there are no fuel, equipment, labor, or depreciation expenses incurred when the cattle do the work. EW calves have the potential for higher net return than NW calves.

3. Beef gain value is competitive with conventional corn production. The EW steer gain expressed in corn grain equivalents has been calculated to be as follows: The value of beef gain, when corn is priced at $3.00/bu is equivalent to 117 bu/ac. and beef gain, when corn is priced at $4.00/bu is equivalent to 88 bu/ac. These beef to corn grain equivalents are very competitive in SW North Dakota.
4. Compared to steers put directly into the feedlot that often experience respiratory illness, EW steers that grazed unharvested standing corn did not experience health problems such as pneumonia, foot rot, laminitis, pinkeye, or bloat. Treatment costs for chronic diseases were zero.

5. When finished, EW and NW steers return approximately the same net return. EW steers have lower placement cost, whereas NW steers are on feed less days. Due to the greater number of days on feed, EW steers have higher quality carcasses as evidenced by higher marbling score and a greater number of carcasses grading USDA Choice or better.

6. Nutrient load in waste water was higher in phosphate-phosphorus and potassium, but TDS and nitrate-N were similar to SW Rural water from stock tanks.

7. Fecal pathogens surveyed followed seasonal patterns.