Distillers Grains Supplementation in a Forage System with Spayed Heifers

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Summary

Spayed heifers were developed into yearlings by grazing corn residue and bromegrass, followed by native range, and were finished on a common diet. Treatments were 2 lb or 5 lb of wet distillers grains with solubles (WDGS; DM basis) supplement on corn residue daily, and modified distillers grains with solubles (MDGS) fed at 0.6% BW daily or no MDGS during summer grazing. Feeding 5 lb increased winter ADG by 0.68 lb (year 1) or 0.40 lb (year 2) compared to 2 lb, and increased HCW after finishing. Summer supplementation increased summer ADG by 0.50 lb (year 1) or 0. 44 lb (year 2), but increased F:G during finishing. There were no differences in DMI, DOF, or marbling.

Introduction

In the last seven years, corn prices have increased nearly 250%. Rising grain prices have increased the incentive to add additional weight to cattle prior to finishing, which may be done with a forage-based backgrounding system. Backgrounding systems utilize readily available, grazed forages to develop yearlings for summer grazing, target different marketing windows, and create a year-round beef supply. In a yearling system, growing calves backgrounded on corn stalks through the winter are commonly supplemented to meet protein requirements, but summer supplementation is a relatively recent development that has arisen as a result of readily available, competitively priced distillers grains.

Distillers grains from the corn milling industry work well in forage-based systems as there is little interference with fiber digestion, unlike when grain is supplemented. Distillers grains are high in CP, energy, and phosphorus and have been shown to increase ADG and BW with increasing levels of supplementation. In addition to increasing ADG, supplementing distillers grains reduces forage intake approximately 17% on pasture. Cattle supplemented with distillers grains during the summer had increased summer ADG, greater final BW at finish, required fewer DOF, and were more profitable than non-supplemented cattle (*2011 Nebraska Beef Cattle Report,* pp. 24-25; *2012 Nebraska Beef Cattle Report,* pp. 112-114).

The objective of this experiment was to determine optimal winter and summer supplementation level and interaction of timing within a forage-based system using spayed yearling heifers. In addition, forage replacement when modified distillers grains plus solubles (MDGS) are fed at 0.6% BW on Sandhills range would be investigated.

Procedure

Treatments were arranged in a 2 x 2 factorial with level of winter supplement serving as one factor, and summer supplementation vs. no summer supplementation as the second factor.

Winter Phase

Each year of a two-year study, 229 crossbred heifers (initial BW = 473 ± 56 lb), were processed according to University of Nebraska–Lincoln protocol, limit-fed five days, and initial weight was the average of two-day weights. Heifers were backgrounded on corn residue over the winter and supplemented with 2 lb DM wet distillers grains with solubles (WDGS; **LO**) or 5 lb DM of WDGS (**HI**). After grazing corn residue approximately 145 days, heifers were surgically spayed, and grazed bromegrass pasture approximately 30 days.

Summer Phase

Upon removal from bromegrass pasture, heifers were weighed (same procedure as above) and the weight was used as heifers' ending BW from the winter phase and beginning BW of summer phase. Heifers were processed for summer grazing, implanted with a Revalor-G implant, and assigned to summer treatment.

Heifers were transported to the UNL Barta Brothers Ranch where heifers grazed native Sandhills range 120 days (year 1) or 111 days (year 2). Grazing days were shortened in year 2 due to drought. Summer treatments included daily supplementation of modified distillers grains at 0.6% BW (SUP) or no supplementation (NO SUP).

Pastures were stocked to test the forage savings hypothesis that when distillers grains is fed at 0.6% BW daily, there is approximately a 17% forage savings rate (*Professional Animal Scientist,* 28:443). This was tested by stocking pastures with an equal number of cattle, but due to the size of available pastures, supplemented cattle were provided 24% less animal unit months (AUMs). Pastures were stocked at 0.64 AUM/ac for unsupplemented cattle and 0.84 AUM/ac for supplemented cattle. It was hypothesized that there would be similar amounts of residual forage between pastures grazed by supplemented and unsupplemented cattle at the end of each grazing rotation. Forage residual height measurements

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Table 1. Winter, summer, and system performance of yearling spayed heifers supplemented distillers grains in a forage-based system

Item	LO[1]		HI[2]		SEM	P-value[3]		
	NO SUP[4]	SUP[5]	NO SUP[4]	SUP[5]		Winter	Summer	W x S
Winter								
Initial BW, lb — Year 1	453	451	453	451	4.4	0.96	—	—
Initial BW, lb — Year 2	495	495	486	499	4.4	0.24	—	—
ADG, lb — Year 1	0.70[b]	0.68[b]	1.41[a]	1.32[a]	0.02	<0.01	—	—
ADG, lb — Year 2	0.97[b]	0.97[b]	1.39[a]	1.32[a]	0.02	<0.01	—	—
Ending BW, lb[6] — Year 1	572	568	689	671	1.76	<0.01	<0.01	0.02
Ending BW, lb[6] — Year 2	671	673	741	750	4.4	<0.01	0.25	0.48
Summer								
ADG, lb — Year 1	1.43[c]	1.98[a]	1.19[d]	1.63[b]	0.02	<0.01	<0.01	0.07
ADG, lb — Year 2	1.01[c]	1.45[a]	0.84[d]	1.28[b]	0.04	0.01	<0.01	1.0
Growing System								
ADG, lb — Year 1	1.03	1.25	1.30	1.45	0.02	<0.01	<0.01	0.12
ADG, lb — Year 2	1.01	1.19	1.30	1.36	0.02	<0.01	<0.01	0.55
Ending BW, lb[7] — Year 1	755[d]	818[c]	840[b]	880[a]	2.8	<0.01	<0.01	0.02
Ending BW, lb[7] — Year 2	792	847	840	900	2.05	<0.01	<0.01	0.18

[1]LO = supplemented at 2 lb WDGS daily during winter backgrounding phase on corn residue.
[2]HI = supplemented at 5 lb WDGS daily during winter backgrounding phase on corn residue.
[3]*P*-Value: Winter = effect of winter supplementation treatment across year 1 and 2; Summer = effect of summer supplementation treatment across year 1 and 2; W x S = effect of winter x summer treatment interaction across year 1 and 2.
[4]NO SUP = not supplemented during summer grazing.
[5]SUP = supplemented at 0.6% BW daily with MDGS during summer grazing period.
[6]Winter ending BW = Summer phase initial BW.
[7]Growing System ending BW = Summer ending BW.
[a,b,c,d] = Within a row (year), values lacking common superscripts differ when year or year x treatment interaction was significant at $P \leq 0.10$.

were taken at the conclusion of each grazing rotation to test this hypothesis.

Finishing

In late September, heifers were transported to the University of Nebraska Agricultural Research and Development Center (ARDC) near Mead, Neb., re-implanted with Revalor®-200, weighed (same procedure as before), and adapted to a common finishing diet. Initial BW at finishing phase entry differed between treatments, thus DOF among treatment groups were varied to produce carcasses with a similar 12th rib fat thickness. This was achieved through use of serial slaughter, with half of each treatment group's cattle slaughtered at an earlier date, and half slaughtered at a later date to produce differences in 12th rib fat thickness. These differences then allowed carcass measurements to be adjusted to a common fat thickness for an equitable comparison.

There were interactions with year so the two years were statistically analyzed separately as 2 x 2 factorial arrangement of treatments. Feedlot pen (two per year) was the experimental unit.

Results

Winter

By design, there was no difference in initial BW ($P > 0.24$) between LO and HI treatment groups in either year (Table 1). Supplementation at HI level increased ADG 0.68 lb ($P < 0.01$) in year 1, and 0.40 lb ($P < 0.01$) in year 2, compared to LO. The additional ADG and 110 lb greater ($P < 0.01$) winter ending BW for HI in year 1 or 73 lb greater ($P < 0.01$) winter ending BW for HI than LO in year 2 is a response to the additional energy provided with HI level, whereas the LO treatment was only designed to meet protein requirements.

Summer

In year 1, there was a winter by summer interaction ($P = 0.07$) for summer ADG with LO, SUP having the greatest daily gain at 1.98 lb, followed by HI, SUP at 1.63 lb, LO, NO SUP at 1.43 lb, and HI, NO SUP gained 1.19 lb. In year 2, there was no interaction and winter treatment and summer treatment were both significant ($P = 0.01$). Winter supplementation at the HI level reduced summer ADG ($P < 0.01$) by 0.18 lb/day and summer supplementation of MDGS increased ADG 0.44 lb ($P < 0.01$). In both years, the greater summer gain by LO is a classic compensatory gain response, which illustrates gain following a period of restriction (winter backgrounding) are greatest for cattle which had the greatest nutritional restriction, which in this study was LO. Across all treatments, summer gains in year 2 averaged 0.19 kg less than year 1, illustrating potential differences in performance related to drought and forage availability.

Forage System

There were no winter by summer supplementation treatment inter-

Table 2. Finishing performance and carcass characteristics of yearling spayed heifers supplemented distillers grains in a forage-based system .

	LO[1]		HI[2]			*P*-value[3]		
Item	NO SUP[4]	SUP[5]	NO SUP[4]	SUP[5]	SEM	Winter	Summer	W x S
Days on feed — Year 1	125	126	126	120	3	0.53	0.45	0.39
Days on feed — Year 2	124	124	124	124	0	1.0	1.0	1.0
Final BW, lb — Year 1	1225[c]	1243[c]	1335[a]	1289[b]	13.2	<0.01	0.31	0.08
Final BW, lb — Year 2	1190	1221	1243	1280	15.4	0.03	0.10	0.85
DMI, lb — Year 1	27.9	27.1	27.5	27.06	.7	0.96	0.23	0.57
DMI, lb — Year 2	28.6	27.7	27.5	28.2	1.5	0.79	0.92	0.66
ADG, lb — Year 1	3.78	3.39	3.96	3.45	0.1	0.34	0.02	0.66
ADG, lb — Year 2	3.23	3.06	3.28	3.10	0.13	0.78	0.28	0.96
F:G, — Year 1	7.14	7.81	6.94	7.58	0.05	0.14	<0.01	0.93
F:G, — Year 2	8.85	9.09	8.40	9.01	0.10	0.25	0.07	0.34
HCW, lb — Year 1	772[c]	783[c]	843[a]	812[b]	8.9	<0.01	0.33	0.08
HCW, lb — Year 2	750	770	781	805	11	0.03	0.10	0.84
LM area, $cm.^2$ — Year 1	12.6[b]	13.3[a,b]	14.0[a]	12.9[b]	0.02	0.21	0.82	0.03
LM area, $cm.^2$ — Year 2	12.6	12.6	13.0	13.2	0.02	0.01	0.76	0.44
Marbling score[6] — Year 1	629	618	603	627	23	0.73	0.79	0.49
Marbling score[6] — Year 2	585	582	582	586	13	0.97	0.97	0.77
Calculated YG[7] — Year 1	3.22a	2.99[b]	3.06[a,b]	3.26[a]	0.08	0.51	0.85	0.05
Calculated YG[7] - Year 2	3.14	3.25	3.22	3.25	0.13	0.79	0.61	0.76

[1]LO = supplemented at 2 lb WDGS daily during winter backgrounding phase on corn residue.
[2]HI = supplemented at 5 lb WDGS daily during winter backgrounding phase on corn residue.
[3]*P*-Value: Winter = effect of winter supplementation treatment over two years; Summer = effect of summer supplementation treatment over two years; W x S = effect of winter x summer treatment interaction across year 1 and year 2.
[4]NO SUP = not supplemented during summer grazing.
[5]SUP = supplemented at 0.6% BW daily with MDGS during summer grazing period.
[6]Marbling: $Small^{00}$ = 500, $Small^{50}$ = 550, $Modest^{00}$ = 600.
[7]Calculated YG = (2.5 + (5.51 x 12^{th} rib fat thickness) – (0.70 x LM area) + (0.2 x KPH) + (0.0084 x HCW)).
[a,b,c] = Within a row (year), values lacking common superscripts differ when year or year x treatment interaction was significant at $P \leq 0.10$.

actions ($P > 0.12$) when examining the entire forage-based growing system for ADG (Table 1). With HI supplementation, ADG increased ($P < 0.01$) 0.24 lb in both year 1 and year 2. With summer supplementation, ADG increased 0.20 lb in year 1 ($P < 0.01$) and ADG increased 0.13 lb in year 2 ($P < 0.01$).

In year 1, there was a winter by summer treatment interaction ($P = 0.02$) for system ending BW with HI, SUP having greatest ending BW at 880 lb, followed by HI, NO SUP at 840 lb, LO, SUP at 818 lb, and finally LO, SUP at 755 lb. In year 2, HI winter supplementation increased system ending BW ($P < 0.01$) 51 lb, and SUP increased system ending BW ($P < 0.01$) 57 lb.

Finishing Phase

In both years, there were no statistical differences in DOF across treatments or DMI (Table 2). Feedlot ADG was not affected ($P > 0.78$) by winter supplement level in either year. This is in contrast to a six-study summary (*2014 Nebraska Beef Cattle Report*, pp. 36-38) using a similar systems approach, which showed cattle supplemented at a high winter level and then summered without supplementation, tended to gain more (0.20 lb) during finishing than cattle in the same system backgrounded at a low supplement level. Data from this study using HI, NO SUP and LO, NO SUP cattle was included in that analysis, so the lack of difference observed here suggests the inclusion of SUP cattle in these data diluted the effect seen in the *2014 Nebraska Beef Cattle Report* (pp. 36-38). Feedlot ADG was 0.46 lb less with summer MDGS supplementation ($P = 0.02$) in year 1. There were no differences in feedlot ADG observed in year 2. Feed efficiency was not impacted by winter treatment ($P > 0.14$) but decreased ($P < 0.07$) 0.54 lb with summer supplementation in year 1 and year 2.

In year 1, there was a winter by summer treatment interaction ($P = 0.08$) for final BW with HI, NO SUP finishing 46 lb heavier than HI, SUP, which was followed by LO, SUP and LO, NO SUP which were similar. In year 2, HI winter supplementation increased ($P = 0.03$) final BW 57 lb and summer supplementation increased ($P = 0.10$) final BW 35 lb.

Carcass Characteristics

Using serial slaughter data, carcass data were adjusted to 0.5 inches rib fat. In year 1, consistent with final BW data, there was a winter by summer treatment interaction for HCW with HI, NO SUP producing the heaviest carcasses, followed by HI, SUP 31 lb less, and then LO, SUP and LO, NO SUP were similar. Similar to year 2 final BW data, HCW in year 2 was increased ($P = 0.03$) with HI by 33 lb and decreased ($P = 0.10$) 22 lb with SUP.

In year 1, winter and summer treatments interacted ($P = 0.03$) to produce the largest LM area in HI, NO SUP and LO, SUP, followed by HI, SUP and LO, NO SUP. Year 2 data were clearer, with HI cattle having

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0.54 in^2 larger ($P = 0.01$) LM area than LO cattle, and no summer effect. Larger LM area are primarily due to heavier carcass weights. Treatments had no effect on marbling scores ($P > 0.49$). There was a treatment interaction for yield grade in year 1, with LO, SUP and HI, NO being most desirable, followed by LO, NO and HI, SUP. There were no yield grade differences in year 2. Finally, there were no overweight carcasses (greater than 1,000 lb) across treatments in either year, contrary to previous research using steers.

Forage Savings

There was no difference ($P = 0.50$) in residual forage height between pastures grazed by supplemented and unsupplemented cattle during the summer (Table 3). Numerically, pastures grazed by unsupplemented cattle had 0.6 in. greater residual forage. Because pastures were stocked assuming a 24% forage savings rate by SUP to utilize available acres and considering Watson et al., (*Professional Animal Scientist,* 2012. 28:443), this numerical difference suggests forage savings may be less than the 24% that pastures were stocked for.

Table 3. Season average forage residual height.

Item	Residual height, inches	SEM	*P*-value
NO SUP[1]	6.42	0.58	0.50
SUP[2]	5.84		

[1]NO SUP = Pastures grazed by non-supplemented cattle.
[2]SUP = Pastures grazed by supplemented cattle.

A similar, but more intensive study was conducted during the same years (*2014 Nebraska Beef Cattle Report,* pp. 34-35), which affirmed the 17% forage savings hypothesis through clipping quadrats in paddocks grazed by unsupplemented and supplemented cattle. However, heifers supplemented on the ground numerically left 107 lb/ac more live material at the conclusion of the grazing season, indicating forage savings was greater than the assumed 17% for that study. Therefore, these combined data indicate forage savings when supplementing MDGS at 0.6% BW/day on a native Sandhills range situation results in a 17% to 24% forage savings.

Heifers responded to more supplement in the winter when grazing stalks and produced 42 lb heavier carcasses after finishing. Because the heifers need to be supplemented at some level, the extra expense for feeding 5 lb WDGS vs 2 is essentially only for the WDGS. Supplementation in the summer is not common and has the expense of delivery of supplement. While ADG was increased by summer supplementation, F:G was increased in the feedlot and carcass weight was increased only 6 lb. This suggests that biologically, and perhaps from a management standpoint, the extra WDGS is better used in the winter period.

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