Supplementation and Management Programs for Growing Beef Calves

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Take Home Message

As forage, land, feed and fuel prices continue to increase beef producers should focus management efforts to optimize forage resources. Management and supplementation programs must also work in concert with market opportunities.

Delayed weaning for fall calving herds offers the opportunity to match forage supply with historically improving summer markets. During periods of reduced forage availability, weaning calves and providing supplemental feed can result in similar calf performance while reducing nutrient needs of cows. Using leader-follower grazing systems allows producers the opportunity to increase calf performance while maintaining adequate cow condition.

Feeding DDGS on the ground rather than in bunks did not negatively impact calf performance. However, as feed costs and value of gain increase producers should consider the potential increase in supplemental cost of gain due to wasted supplement.

Producers weaning calves on stockpiled forages can improve calf performance and forage utilization by supplementation. Appropriate supplement type (energy or protein) is dependent on forage quality. Supplemental F:G is variable therefore, producers should evaluate a range of projected costs and values of gain before supplementing calves grazing stockpiled forages.

Introduction

Beef producers face two key seasonal management challenges: forage production and market cycles. Midwestern forage production cycles are relatively stable in cool season forage regions characterized by a bimodal peak of forage production in early spring and autumn as shown in Figure 1. Forage production will vary with precipitation, temperature and fertility but the timing of available supply is relatively constant.

While less stable and with increased variation markets tend to act in a seasonal patterns as well. Seasonal market prices can be illustrated using a price index where the yearly average price is par (100%) and weekly market prices are divided by par to identify "seasons" where certain weight classes can be preferentially marketed.

An example of the Missouri 5-year (2006 - 2010) seasonal price trend for medium and large number 1 and 2 steers is shown in Figure 2. During weeks where indexed prices are greater than 100% indicates above average prices for the year for that weight class.

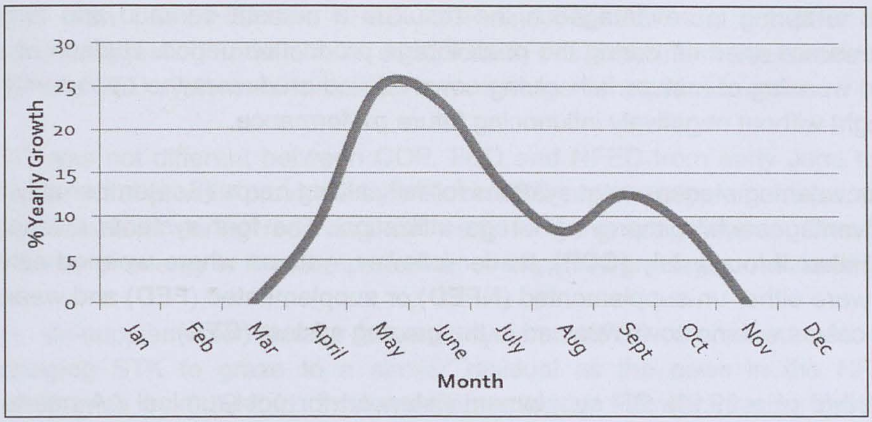

Figure 1. Cool-season forage production curve.

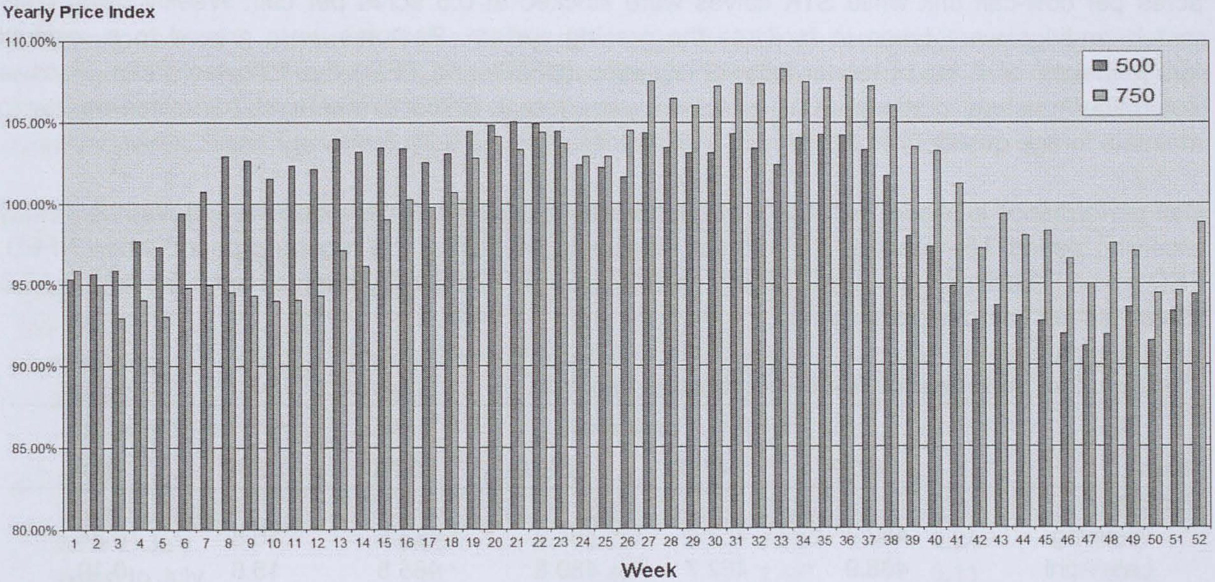

Figure 2. Five-year average index price for Missouri 500 and 750 pound medium and large 1-2 steers.

Seasonal price indices offer producers the opportunity to evaluate market timing relative to other weight classes at similar times of the year. Market timing is a marginal marketing plan as, "past performance does not guarantee future results". However as George Santayana said, "Those who cannot remember the past are condemned to repeat it."

Beef management systems with the goal of matching forage supply to nutrient demand and market opportunities offer increased likelihood for profitability. This paper will highlight current research programs at the University of Missouri focused on identifying and testing management and supplementation systems to assist producers in accomplishing these goals.

Weaning Management Systems for Fall Calving Herds

Fall calving herds have the advantage in favorable marketing opportunities for weaned calves in early spring however suffer from nutrient demand and supply challenges during lactation. While marketing weaned calves in spring is advantageous the result is a nutrient demand and forage supply challenge since cows are dried off during the peak forage production period. Hudson et al., (2010) suggested delayed weaning of mature fall-calving cows offered producers the opportunity to increase calf weaning weight without negatively influencing future performance.

We recently evaluated four weaning management systems for fall calving herds (September calving) to maintain marketing advantages while improving forage utilization. The four systems evaluated cow-calf pairs grazing together through July (**CCP**), leader-follower systems where weaned calves grazed prior to cows and were either un-supplemented (**NFED**) or supplemented (**FED**) and weaned un-supplemented stocker calves with no cows retained in the grazing system (**STK**).

FED calves were fed 2.7 lb/d of a 39.9% CP supplement balanced for post-ruminal AA needs of calves gaining 2.7 lb/d. Systems including cows were stocked on tall fescue-legume pastures at 1.2 acres per cow-calf unit while STK calves were stocked at 0.5 acres per calf. Weekly rising plate meter readings were taken to facilitate the grazing system. Pastures were grazed to a residual forage height of 2 in. In leader-follower systems (NFED and FED) the follower group of cows determined pasture rotations. In all systems excess forage (2750 lb/acre) was harvested as hay to maintain forage quality.

Calf performance is shown in Table 1. No performance differences were observed during the 14 day receiving period. Un-weaned CCP did not increase ADG during the receiving period when NFED, FED and STK calves were experiencing weaning stress. Additionally supplemental feeding of FED calves did not improve performance.

Table 1. Calf performance from April through late July.

	Treatment[a]					
Item	**CCP**	**NFED**	**FED**	**STK**	**SEM[b]**	***P* =**
BW, lb						
Weaning	452.7	452.4	454.2	453.5	15.8	0.64
Late April	468.9	462.7	480.8	465.8	15.6	0.10
Early June	615.2^{x}	561.5^{y}	616.3^{x}	539.1^{y}	18.0	< 0.0001
Late July	667.1^{x}	592.7^{y}	667.7^{x}	540.5^{z}	22.6	< 0.0001
ADG, lb						
Wean to April	1.16	0.73	1.95	0.88	0.40	0.06
April to June	3.22^{x}	2.23^{y}	3.00^{x}	1.62^{z}	0.21	0.0003
June to July	1.11^{x}	0.67^{xy}	1.10^{x}	0.10^{y}	0.19	0.003
Wean to July	2.16^{x}	1.45^{y}	2.05^{x}	0.86^{z}	0.15	< 0.0001

[a] CCP = cow calf pairs, NFED = weaned, leader-follower grazing, un-supplemented, FED = weaned, leader-follower grazing, supplemented, STK = weaned calves.
[b] Largest standard error of least squared means.
[xyz] Means within rows without a common superscripts differ $P < 0.05$.

Due to the short receiving period duration and two-day weigh periods at the beginning and end of the receiving period calves could have shrunk sufficiently to mask treatment differences.

BW and ADG were greater for CCP and FED by the June grazing season midpoint. By the conclusion of the grazing season in late July CCP and FED were heavier than NFED with STK lighter than CCP, FED and NFED. CCP and FED ADG did not differ during any of the grazing periods suggesting under similar conditions to this experiment beef producers could interchange the CCP and FED systems to match on-farm management and resources.

ADG was not different between CCP, FED and NFED from early June to late July suggesting the supplemental protein provided by milk or FED protein supplement (supplemental F:G = 4.4) was most beneficial during receiving and early in the grazing season. These data would support the tendency of energy to limit the performance of calves grazing cool season forages.

The un-supplemented leader-follower system, NFED, increased calf gain compared to STK. Managing STK to graze to a similar residual as the cows in the NFED system reduced calf performance by 0.59 lb/d. Implementing a leader follower grazing system or maintaining forage quality by mowing can improve calf performance.

Cow performance is shown in Table 2. No differences in cow performance were observed from weaning to early June. However CCP gained less than NFED from June to Late July. Over the entire grazing season CCP gained 0.44 lb/d less than either weaned treatments. Similar results were observed for BCS change where CCP gained less condition than NFED or FED.

Table 2. Cow performance from April through late July.

	Treatment[a]				
Item	**CCP**	**NFED**	**FED**	**SEM[b]**	***P* =**
BW, lb					
Weaning	1265.6	1261.4	1262.8	13.8	0.89
Early June	1364.5	1361.3	1381.8	15.1	0.31
Late July	1366.9[x]	1396.5[xy]	1404.8[y]	22.1	0.02
ADG, lb					
Wean to June	1.89	2.03	2.35	0.33	0.17
June to July	0.05[x]	0.75[y]	0.50[xy]	0.24	0.02
Wean to July	1.02[x]	1.42[y]	1.47[y]	0.11	0.002
BCS					
Weaning	6.0	6.0	6.1	0.06	0.24
Late July	6.6[x]	7.1[y]	7.0[y]	0.09	< 0.0001
Weaning to July	0.65[x]	1.0[y]	0.9[y]	0.13	< 0.0001

[a] CCP = cow calf pairs, NFED = weaned, leader-follower grazing, un-supplemented, FED = weaned, leader-follower grazing, supplemented.
[b] Largest standard error of least squared means.
[c] 1 to 9 scale.
[xyz] Means within rows without a common superscripts differ $P < 0.05$.

NFED and FED cows were able to gain more under a leader-follower grazing system where forage quality is expected to be poorer than forage on offer to CCP. Requirements for gain would be significantly greater for CCP due energy demand for lactation. Forage quality on offer to grazing system leaders was not sufficient to support lactation and the level of gain observed in NFED and FED treatments.

Cows from all treatments were in adequate condition prior to calving (> 6.0) suggesting systems tested under the conditions of this experiment did not negatively influence cow performance. Cows were diagnosed for pregnancy prior to treatment initiation and stratified by pregnancy status. Insufficient n were available to evaluate reproductive efficiency.

Allowing fall-born calves to nurse dam throughout the summer grazing season increased calf gain and reduced cow performance. However cows were maintained in acceptable condition prior to calving.

Weaning calves prior to the grazing season and using a leader-follower grazing system improved performance compared to grazing stocker calves. Providing a supplement balanced for post-ruminal AA needs improved calf performance to a level comparable to calves nursing cows without reducing cow performance.

Supplementation Delivery Method

Supplements are provided to growing cattle to correct nutrient deficiencies, extend forage supply, carry feed additives, increase animal performance, improve forage utilization, or manage animal behavior (Kunkle et al., 2000). To take advantage of late summer market opportunities for heavier calves beef producers may extending forage supply and increase animal performance using supplemental feed.

Labor saving opportunities due to reduced protein and energy supplement delivery frequency have been previously reported (Bohnert et al., 2002; Kunkle et al., 2000; Loy et al., 2008; Stalker et al., 2009). Supplemental feed delivery methods comparing feeding on the ground or in a bunk were only recently evaluated (Jaderborg et al., 2009; Musgrave et al., 2010).

Supplemental feed waste was increased with ground feeding methods by 13-20% when feeding wet distillers grains at 2.25 lb/steer (DM basis) (Musgrave et al., 2010). Similarly supplement waste was 22% for cows fed 8.0 lb/cow of wet beet pulp (DM basis) on the ground (Jaderborg et al., 2009). Conversely when corn screenings were fed at 2.85 lb/cow in bunks or inverted tires no waste was reported compared to 2.1 to 2.4% waste for wet beet pulp suggesting waste was greater for wet feeds.

Musgrave et al., (2010) also evaluated 3x or 6x per week feeding frequency and reported no structure by frequency interaction ($P > 0.10$) suggesting reduced feeding frequency does not influence waste when supplementing with WDGS.

Reduced DMI variation between supplemented animals is possible when feed offered is increased (Bowman and Sowell, 1997). Feeding on alternate days offers the opportunity to reduce labor costs while reducing supplement intake variation.

We hypothesize feeding distillers dried grains plus solubles (DDGS) on ground every other day during the spring and early summer grazing period would optimize labor and minimize supplement waste without influencing calf performance.

Two experiments were conducted to test this hypothesis evaluating crossbred beef calf performance when supplements were fed in a feed bunk or on the ground while grazing tall-fescue pastures under rotational management (**EXP 1**) or continuous grazing (**EXP 2**). Feeding systems evaluated were bunk-fed (**BNK**), ground-fed (**GRD**) or not-fed (**CON**) DDGS supplement. BNK calves were fed in 10 foot bunks while supplement for GRD calves was fed in three equal piles > 15 feet apart.

Meal from DDGS supplement was offered on alternate days. In EXP 1 calves were fed supplemental DM at an equivalent of 2.55 lb/head/d. EXP 2 calves were fed supplemental DM at an equivalent of 0.5% of BW/head/d. Supplement DM was adjusted every 21 days using interim full weights.

In both EXP four or five calves were stocked per replicate at 0.45 acres/head in one of 12 predominately tall fescue pastures. Treatments were blocked by endophyte infection and forage availability. In EXP 1 pastures were subdivided into 4 paddocks while in EXP 2 pastures were continuously grazed. Excess forage was harvested as hay on May 20, 2009 in 2 paddocks in EXP 1.

Grazing initiation was April 29, 2009 in EXP 1 and April 19, 2011 in EXP 2. Treatments concluded on July 23, 2009 for EXP 1 and July 14, 2011 for Experiment 2 resulting in 85 and 86 day grazing periods respectively.

Fall-born calves (n=58) were stratified by sex and sire breed and assigned to pasture replicates (n=12) in EXP 1. While in EXP 2, 58 purchased heifers were stratified by weight and assigned to pasture replicates (n=12).

Two-day full weights were used to evaluate performance and treatment differences. Feed waste was not quantified. Feeding method by endophyte infection level was not detected ($P > 0.10$), feeding method results are presented for EXP 1 in Table 3 and EXP 2 in Table 4.

Supplementation increased ($P < 0.05$) ADG by 26.6% in EXP 1 and 36.4% in EXP 2. No differences ($P > 0.10$) were observed in final weight, ADG or supplemental F:G between BNK and GRD.

Numerical differences were consistent for ADG and supplemental F:G. ADG was 0.16 and 0.17 lb/head/d greater for BNK than GRD in EXP 1 and 2 respectively. BNK feeding reduced supplemental F:G by 35% and 19.4% compared to GRD for EXP 1 and 2 respectively. GRD feeding numerically increased supplemental feed cost of gain by $38.59/cwt for EXP 1 and $29.03/cwt for EXP 2 (DDGS $225/ton).

Feeding supplemental DDGS on the ground did not significantly reduce performance of calves grazing tall fescue regardless of pasture management system. During periods of increased supplemental feed costs and value of gain producers should consider the cost of purchasing and maintaining feed bunks.

Future research should consider the impact of nutrient concentration and forage cover near bunk feeding areas. Additionally strategic de-worming programs may also influence performance of calves fed on the ground.

Table 3. Performance of fall-born calves supplemented in bunks, on ground or un-supplemented while rotationally grazing tall fescue pastures (EXP 1).

	Treatment[a]				Contrast P =	
Item	CON	BNK	GRD	SEM[b]	CON vs. BNK + GRD	BNK vs. GRD
BW, lb						
April 29, 2009	450.0	446.0	454.3	5.24	0.99	0.31
July 23, 2009	581.2	610.9	616.8	15.0	0.13	0.79
ADG, lb	1.54	2.03	1.87	0.10	0.02	0.30
Supplemental F:G		6.37	9.80	1.34		0.14

[a] CON = Un-supplemented control, BNK = Bunk-fed, GRD = Ground-fed.
[b] Largest standard error of least squared means.

Table 4. Performance of heifers supplemented in bunks, on ground or un-supplemented while continuously grazing tall fescue pastures (EXP 2).

	Treatment[a]				Contrast P =	
Item	CON	BNK	GRD	SEM[b]	CON vs. BNK + GRD	BNK vs. GRD
BW, lb						
April 19, 2011	642.7	641.2	643.1	2.55	0.87	0.63
July 14, 2011	731.2	768.9	756.6	6.22	0.006	0.21
ADG, lb	1.03	1.49	1.32	0.084	0.01	0.21
Supplemental F:G		10.75	13.33	2.06		0.44

[a] CON = Un-supplemented control, BNK = Bunk-fed, GRD = Ground-fed.
[b] Largest standard error of least squared means.

Supplementation Programs for Calves Grazing Stockpiled Tall Fescue

Stockpiled tall fescue offers beef producers the opportunity to reduce stored forage needs for the cow herd. Additionally producers with minimal feeding facilities can use stockpiled pastures to wean or precondition calves prior to marketing while shifting calves to a more favorable marketing window. "Bunk breaking" calves while grazing stockpile prior to marketing may improve ADG and forage utilization.

Providing energy supplements to calves grazing stockpile with adequate CP (> 12%) improves performance however when CP is less than 12% growing cattle may benefit from protein supplementation (Poore and Drewnoski, 2010). Titgemeyer and Löest, (2001) suggested supplementing grazing cattle with UIP if DIP levels were adequate would improve performance only slightly and is likely not economical.

Beck et al., (2006) suggested ADG of un-supplemented calves grazing tall fescue is limited by energy and essential AA and that corn supplementation alone results in an essential AA deficiency. However when tested *in vivo* supplemented calves had greater ($P < 0.02$) ADG compared to un-supplemented calves but supplemental UIP level did not affect ADG ($P > 0.36$) in calves fed to gain 2.0 lb/d.

Beck et al., (2006) used similar ratios but differing total amounts of fish, feather and poultry blood meal to develop UIP supplements resulting in comparable ratios but differing levels of post-ruminal AA. The objectives of this experiment were to evaluate the effects of supplementation, source of supplemental UIP and endophyte infection on performance of calves grazing stockpiled tall fescue. We hypothesized feeding supplemental UIP balanced for essential AA would improve performance of calves grazing stockpiled tall fescue.

Spring-born (February - March) Simmental-Angus steer and heifer calves were used during autumn 2009 (n = 57) and 2010 (n = 48). Treatments were non-supplemented control (**C**), balanced post-ruminal AA protein supplement (**BAL**) and unbalanced post-ruminal AA protein supplement (**UN**). Supplement compositions are shown in Table 5.

Table 5. As-fed supplement composition of fed to calves grazing stockpiled tall fescue.

	2009-2010		2010-2011	
Ingredient	BAL[b]	UN	BAL	UN
HPDDGS, (38% CP)	47.8	92.1	51.88	100.0
SoyPlus soybean meal	35.2		38.25	
Soybean hull pellets	7.9		8.58	
Corn oil	1.2		1.29	
GPP mineral premix[c]	7.9	7.9		

[a] Supplement DM offered at 0.75% of BW daily.
[b] BAL = balanced post-ruminal AA, UN = unbalanced post-ruminal AA.
[c] Composition (%): Corn (50), Lime (39.5), Salt (5), Dyna K (2.5), RTM (1.25), Vit ADE (1.25) Rumensin 80 (0.50).

Supplements were offered at 0.75% of BW (DM basis) in bunks daily and formulated to support 2.0 lb/head ADG. Supplemental DMI was adjusted every 21 days based on interim weights. In 2009, the trace mineral premix with ionophore was included in the supplement while mineral was offered free choice in 2010. The free choice mineral mixture contained 10% Ca, 6% P, 25.5% Salt, 1% Mg, 1,000 ppm Cu, 10 ppm Se, 3,000 ppm Zn, 100,000 IU of Vit A, 12,500 IU of Vit D, 100 IU of Vit E and 1600 g/ton monensin.

A completely randomized design with a 2 x 3 factorial arrangement was used to evaluate performance. Factors included two endophyte infection levels (> 80% and < 30%) and three dietary treatments (C, BAL and UN) resulting in two replications per treatment combination and 12 blocks. In 2009, each dietary treatment had three blocks with four steers and one heifer and one block with two steers and two heifers. In 2010, each dietary treatment had four blocks with two steers and two heifers.

Calves were weaned for 14 days prior to treatment initiation. All calves were vaccinated with Pyramid 5 + Presponse SQ and dewormed with Cydectin. Steers were implanted with Revalor-G at treatment initiation.

Calves were randomly assigned to high (> 80%) endophyte infected (**E+**) or low (< 30%) endophyte infected (**E-**) tall fescue pastures. Calves were stratified by sex, weight and age in 2009 and by sex, weight, sire and age across blocks in 2010. Two-day weights were taken at the beginning and at the end of treatments. Treatment started October 28, 2009 and October 26, 2010 and ended January 7, 2010 and January 11, 2011 for years 1 and 2, respectively.

Fescue pastures were clipped to less than 4 inches by late August each year and subsequently fertilized with 50 lb of nitrogen per acre and stockpiled until treatment initiation. Pasture DM was allocated at 3% of BW/head/d in 3.5 day allocations. Calves were given access to a new allocation with no back fence once residual forage height reached 1.8 inches as determined by rising plate meter.

Supplementation increased ADG by 1.38 lb/d ($P < 0.001$), resulting in 103.5 lb greater ($P < 0.001$) final BW (Table 6). No difference ($P > 0.10$) in supplemental DMI, ADG or total gain between BAL and UN was observed.

Table 6. Effect of protein supplementation and endophyte infection on performance of calves grazing stockpiled tall fescue.

	Treatment[ab]							P =		
	BAL		UN		C			BAL+UN vs. C	BAL vs. N	E+ vs. E-
Item	**E+**	**E-**	**E+**	**E-**	**E+**	**E-**	**SEM[c]**			
BW, lb										
Initial	567.3	569.5	571.8	568.9	568.4	572.2	28.0	0.94	0.89	0.93
Final	707.7	746.7	723.5	727.7	604.3	641.6	17.8	< 0.001	0.93	0.10
ADG, lb/d	1.84	2.32	1.99	2.08	0.46	0.89	0.16	< 0.001	0.63	0.004
Supplement										
DMI, lb/d	4.71	4.86	4.77	4.78	-	-	0.12	< 0.001	0.94	0.23
F:G	3.40	3.40	3.09	4.07	-	-	0.18	Supplement * endophyte P = 0.06		

[a] BAL = balanced post-ruminal AA, UN = unbalanced post-ruminal AA.
[b] Tall fescue endophyte infection level, E+ = > 80% infection, E- = < 30% infection.
[c] Largest standard error of least squared means.

A supplement by endophyte infection interaction was observed for supplemental F:G ($P = 0.06$). UN grazing E- were least efficient while UN grazing E+ pastures were most efficient with BAL intermediate. Mean supplemental F:G was 3.49 for BAL and UN. Producers should evaluate a range of value and cost of gain due to variation in supplemental F:G observed with calves grazing tall fescue (Beck et al., 2006; Elizalde et al., 1998).

Under the conditions of this experiment if value of gain was equal to $90/cwt ($5.00 below current average) supplementation of calves grazing stockpiled tall fescue would be profitable at feed costs of $515/ton DM. Alternatively using $325/ton supplemental feed cost, the most expensive supplement in these experiments, value of gain would have to be less than $56.71/cwt for supplementation to be un-profitable.

Supplement formulation to provide balanced post-ruminal AA to calves grazing stockpiled tall fescue was not beneficial at the level of ADG observed in this experiment. Data suggest unbalanced post-ruminal AA supplementation and microbial protein production can provide adequate AA required for 2.0 lb/d ADG.

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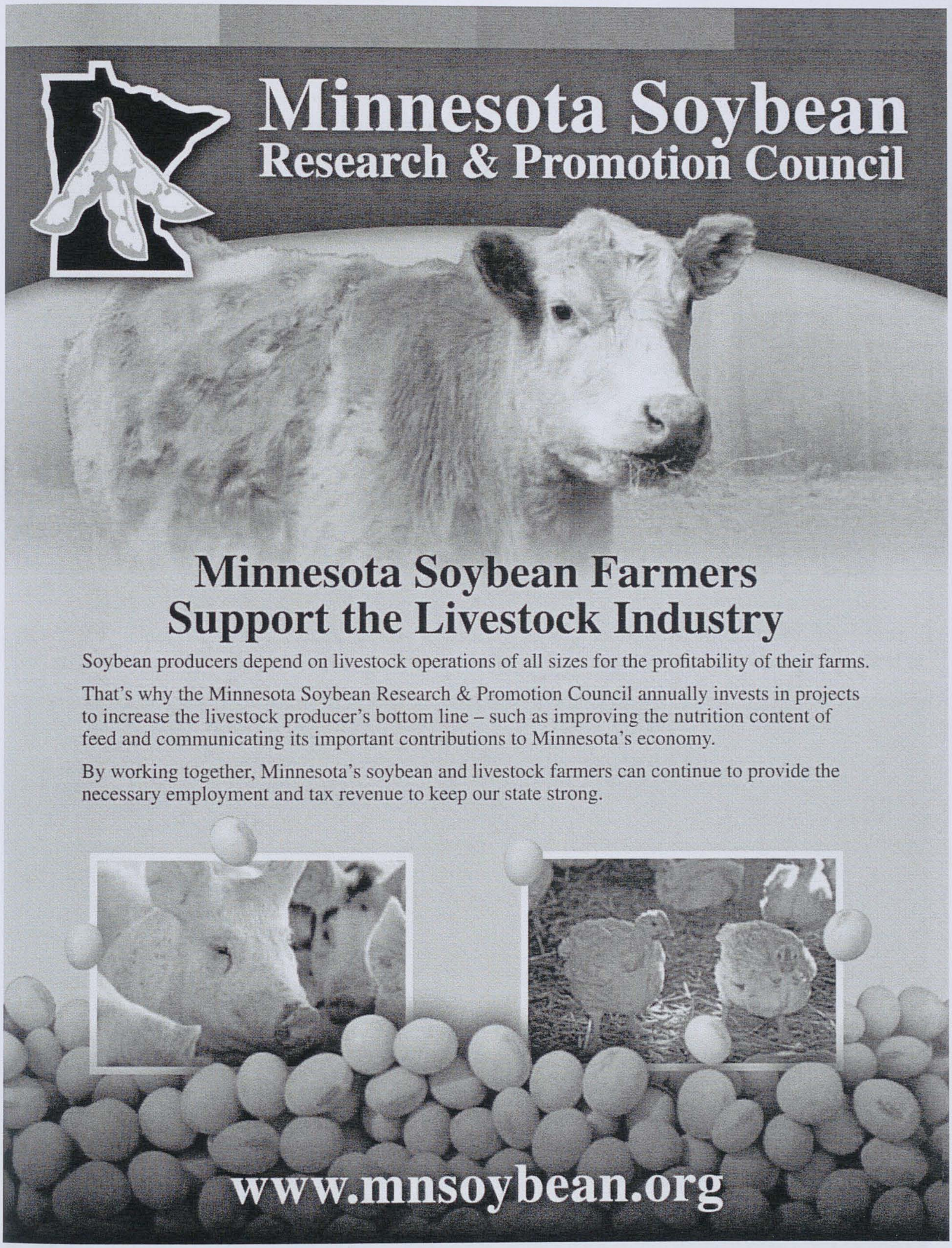
Notes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