UNIVERSITY OF ILLINOIS EXTENSION
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Utilizing Coproducts in the Grazing Program

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Introduction

The rapidly expanding ethanol industry is changing the dynamics of the beef industry. US production of ethanol has increased from 2.14 billion gallons in 2001 to 13.298 billion gallons in 2010, and is on track to approach 14 billion gal in 2011(US Energy Information Administration, 2011). There will likely be further expansion to meet the 15 billion gallons of ethanol mandated by the Energy Independence and Security Act of 2007. During this rapid increase of ethanol production, there has also been a rapid increase in land costs and competition for land use. The decrease in available forage acres has resulted in many producers either having to graze on fewer acres (increase stocking rates) or reduce cow numbers. Additionally, stored feed costs have also increased dramatically. However, this dramatic increase in ethanol production does provide opportunity for beef producers as well. Approximately 18 lb of dried distillers' grains with solubles (DDGS) are produced per bushel of corn used for production of ethanol. Assuming that 1 bushel of corn produces 2.7 gal of ethanol, there will be approximately 45 million tons of DDGS in 2012.

Corn Coproducts

Ethanol is produced either by wet or dry grind corn milling. The dry milling process results in production of DDGS, and the wet milling process results in the production of corn gluten feed (CGF). Because the majority of the starch is removed and fermented in the process, coproducts are primarily fiber, fat, and protein. The high fiber content limits their use in swine and poultry feeds, but makes them an excellent feed for ruminants such as beef cattle. Nutrient profiles (NRC, 1996) of DDGS, CGF, soyhulls, wheat middlings, and corn are shown in table 1. Corn coproducts make excellent supplements for grazing cattle because they are high in energy, protein, and phosphorous. Additionally, because the energy is primarily in the form of digestible fiber rather than starch, negative associative effects commonly seen with the supplementation of grain are not observed. Although high Sulfur concentrations are a concern with high corn coproduct inclusion in feedlot diets, low inclusions in forage-based diets pose minimal concern. Depending on inclusion rate of corn coproducts, phosphorous supplementation may not be necessary and calcium supplementation may need to be considered.

Cow-Calf

The goal of a well-managed grazing system is to reduce the need for supplementation and stored feeds. However, there are potential needs based on seasonality and stage of production. In a cow-calf operation, coproduct supplementation could be utilized during the "summer-slump," during the winter when grazing stockpiled fescue or corn crop residue, or with hay feeding in a drylot system. A 1400 lb cow with average milk production requires 30.5 lb of DM that is 59.1% TDN and 10.31% CP at peak lactation (60 d since calving), but she only needs 27.2 lb of DM that is 45.0% TDN and 6.0% CP when she is dry and in mid-gestation (NRC, 1996). Stockpiled forages and crop residues will typically meet the needs of the dry cow in mid-gestation, however, the need for supplementation (particularly protein) increases during late gestation. Also, a fall-calving herd would likely need supplementation while grazing stockpiled forage or crop residue. Unfortunately, minimal research has been done to evaluate coproduct supplementation while grazing in a cow-calf operation. Because of Driskill et al. (2007) conducted a winter grazing experiment where they compared grazing stockpiled endophyte-free, tall fescue and red clover with CGF supplementation to dry lot feeding tall fescue-red clover hay and CGF. Although cows maintained in dry lots did have greater BW and BCS than cows grazing stockpiled forage, BCS of cows grazing stockpiled forage was at the targeted level of the study. Cows grazing stockpiled forage and supplemented with CGF had lower costs of production than cows fed in dry lots (Driskill et al., 2007). Nuttelman et al. (2010) conducted 2 experiments where they evaluated supplementing WDGS with a low quality forage to spring-calving cow-calf pairs grazing subirrigated meadow in the summer. In experiment 1, 14.6 lb/d of 45% WDGS and 55% grass hay was supplemented to cows grazing at double the recommended stocking rate (1.2 AUM/acre) and compared to control cows grazing at the recommended stocking rate (0.6 AUM/acre). Supplemented cows had higher ADG than control cows (0.55 vs. -0.99 lb/d; $P < 0.01$) but there were no differences in grazed intake. In experiment 2, cows were assigned to one of four treatments: 1) recommended stocking rate (0.6 AUM/acre) with no supplement (CON); 2) 50:50 WDGS:wheat straw (HIGH); 3) 40:60 WDGS:wheat straw supplement (MED); or 4) 30:70 WDGS:wheat straw (LOW). The cow-calf pairs assigned to HIGH, MED, and LOW received 12.6 lb DM of the WDGS and wheat straw mixture and grazed at double the recommended stocking rate (1.2 AUM/acre). Cow ending BW was heavier ($P = 0.04$) at the conclusion of the study for HIGH compared to CON, LOW, and MED (944, 875, 899, and 906 lb, respectively). The CON cattle had lower ($P < 0.01$) grazed DMI than LOW, MED, HIGH (25.4, 13.5, 16.5 and 16.3 lb/d, respectively). When WDGS and wheat straw were supplemented it replaced grazed forage intake on nearly a 1:1 basis (Nuttelman et al., 2010). More work is needed evaluating coproduct supplementation of the cowherd while grazing during the "summer slump" and while grazing stockpiled forages and crop residue in the fall and winter.

Stocker Cattle

As corn prices have increased, finishing costs in the feedlot have also increased. Producers are looking for ways to increase BW prior to placement in the feedlot. Forages supplemented with coproducts offer a relatively inexpensive approach to this goal. Griffin et al. (2009) summarized 14 trials in which cattle were supplemented with DDGS while grazing pasture. There were a total of 394 cattle that grazed cool or warm season (smooth bromegrass, bermudagrass, and Sandhills range) for 60 to 196 days (average, 119 days). Supplementation ranged from 0.0 to 8.0 lb/head daily, with an average of 2.8 lb/head daily. As supplementation levels increased, final BW ($P < 0.01$) and ADG ($P < 0.01$) increased linearly, but final BW ($P = 0.07$) and ADG ($P = 0.21$) tended to be quadratic (Figure 1). Griffin et al. (2009) also summarized seven trials in which cattle were pen fed a forage-based growing ration and supplemented DDGS. There were a total of 348 cattle that were fed either hay or a forage mixture containing 60% sorghum silage and 40% alfalfa hay for 82 – 95 days, with an average of 86 days. Supplementation ranged from 0.0 to 7.6 lb/head daily, with an average of 3.7 lb/head daily. As supplementation of DDGS increased, final BW ($P = 0.01$) and ADG ($P < 0.01$) increased quadratically (Figure 1). Although total intake increased quadratically ($P < 0.01$) with increasing levels of DDGS supplementation, forage intake also decreased quadratically ($P < 0.01$; Figure 2). Forage replacement per pound of DDGS supplementation also increased with increasing level of DDGS supplementation. Gustad et al. (2006) evaluated ADG response to increasing levels of DDGS (1.5 to 6.5 lb/d) while calves grazed corn stalk residue. Similar to pasture grazing studies, ADG increased ($P < 0.01$) with increasing levels of DDGS, with grazing calves ADG ranging from 0.9 to 1.8 lb/d (Gustad et al., 2006). Supplementing stocker cattle with coproducts can increase carrying capacity due to forage replacement and increase ADG.

Storage Considerations

Storage options for coproducts depend on the product. Dry products can be stored for a long period of time as long as they are out of the wind and rain. Pelleted products such as CGF and soyhulls can be stored in bulk tanks or wagons. It is not recommended to store DDGS in bulk tanks or wagons as it tends to bridge and not flow well. Commodity sheds are the most ideal storage option if the size of the operation can justify the initial expense. Wet coproducts such as WDGS and wet corn gluten feed (WCGF) are more challenging to store. Wet products will develop appreciable spoilage in just a few days, especially in warm weather. They must be ensiled to store for long periods of time. Also, proximity to the plant affects feasibility when considering wet products. Trucking water long distances is not very economical. Because of the rapid spoiling and semi-load quantities of WDGS and WCGF, many small producers may not be able to utilize these products. Adams et al. (2008) conducted six experiments to evaluate different storage methods for WDGS with added forages. Multiple levels of grass hay, alfalfa hay, and wheat straw were mixed with WDGS and stored in a silo bag. They determined a minimum of 15% grass hay, 22.5% alfalfa hay, and 12.5% wheat straw were necessary to prevent the bag from splitting open. For storage in bunker silos, the recommended levels are 40% grass hay, 30% wheat straw, and 30% cornstalks (Adams et al., 2008).

Feeding Method

Consideration needs to be given to method of feed delivery when utilizing coproducts in a grazing system. The physical form of the coproduct will likely impact the decision. Soyhulls and CGF are typically in the pelleted form as well as some of the corn coproducts (bran) from newer ethanol plants that fraction out the oil. The general perception is that DDGS in the traditional meal form will have higher waste when fed on the ground then pelleted products. Waste ranges from losses due to wind blowing the DDGS away to cattle trampling it into the ground. Musgrave et al. (2010) compared feeding WDGS in a bunk or on the ground. In exp. 1, March-calving cows were supplemented for the last 90 days of gestation 1 lb/day while grazing native upland Sandhills winter range. The cows fed in the bunk had improved BCS, while cows fed on ground did not change (0.4 vs. 0.0; $P = 0.01$). In exp. 2, March-born steer calves were fed 2.25 lb for 60 days from mid-October to mid-December while grazing native upland Sandhills winter range. Steers fed in a bunk had higher ADG than steers fed on the ground (0.63 vs. 0.44 lb/day; $P = 0.04$). The authors retrospectively calculated the WDGS intake differences between treatments and determined that a reduction in intake of 0.31 – 0.45 would have accounted for the observed reduction in ADG. This calculates to the equivalent of 13-20% waste for the cattle fed on the ground (Musgrave et al., 2010). Musgrave et al. (2012) conducted a follow up study where they fed 2 lb of DDGS (meal-form) to March-born steer calves while grazing subirrigated meadow dominated by cool-season grasses, sedges, and rushes from mid-March to mid-May. Again, steers fed in a bunk had greater ADG than steers fed on the ground (1.19 vs. 0.92 lb/day; $P = < 0.001$). The 0.27 lb/day reduction in ADG calculates to a reduction in in intake between 0.8 and 0.9 lb/d. This reduction equates to 36-41% waste. At $200 (DM) per ton for DDGS, the cost of the wasted DDGS was between $0.08 and $0.09/day. However, Musgrave et al. (2012) calculated the cost associated with feeding in a bunk (bunk purchase/delivery and three year life span) to be $0.16/steer daily. The most economical method would then depend on whether your goal was to reach a targeted rate of gain or to reach a maximum rate of gain. In contrast, Sexten et al. (2011) found no difference in ADG between bunk and ground feeding. They fed 2.55 lb of DDGS (meal-form) to fall-born calves grazing tall-fescue pastures during the summer. Further research is needed, but class of cattle, time of year, and forage specie being grazed may have differential effects on feed delivery method.

Frequency of Feeding

Previous research has shown that protein supplements can be provided infrequently with comparable performance to cattle supplemented daily (Schauer et al., 2005, Bohnert et al., 2002, Huston et al., 1999). This is primarily due to ruminant's ability to recycle N. Thus, coproduct supplements being fed as a protein supplement should be able to be fed at a reduced frequency as well. Musgrave et al. (2010) compared 3 times and 6 times per week supplementation of the daily equivalent of 1.0 lb/d of WDGS while grazing native upland Sandhills winter range. Cow BW and BCS did not differ between frequencies. However, supplements provided as an energy source has not proven as effective. Typically, energy supplements are grain based; thus, contain significant levels of starch. When supplement frequency is reduced, more supplement is fed at each feeding which results in the potential for negative associative effects between starch and fiber digestibility. Because coproducts contain digestible fiber rather than starch, they may be suitable for infrequent energy supplementation while cattle are grazing. Stalker et al. (2005) compared 3 times and 6 times per week supplementation of DDGS to growing heifers consuming grass hay. Heifers fed 6 times per week had higher ADG than heifers fed 3 times per week (1.74 vs. 1.58 lb/d; $P = 0.01$). The authors speculated that the difference could be due to high ruminal fat concentration (Stalker et al., 2005) resulting from high DDGS level on day of supplementation for the 3 times per week cattle. Additional work evaluating coproducts with differing fat levels is needed. Clearly, infrequent supplementation is appealing to producers if comparable performance can be obtained.

Conclusion

The rapid expansion of the ethanol industry as created new dynamics within the beef industry. Considerably higher land prices and feed prices have necessitated beef cattle producers to explore options for maximizing profit in grazing systems. Coproducts (primarily DDGS) that have are also the result of the ethanol industry provide an excellent supplement to grazing cattle. They are an excellent source of energy, protein, and phosphorous. In cow-calf operations, coproducts can be utilized during the "summer slump" or while grazing stockpiled forages or crop residues in the fall and winter. Coproducts make an excellent supplement in stocker operation to increase ADG and increase carrying capacity. Storage, feeding method, and feeding frequency will vary depending on coproduct, supplementation goals, and size of operation. Understanding how coproduct supplementation fits your operation will provide another tool for maximizing profit.

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Table 1. Nutrient composition of corn and common coproducts

Feed	TDN	Protein	Fat	Calcium	Phosphorous	Sulfur
Corn, % DM	88	9.8	4.3	0.03	0.31	0.14
DDGS, % DM	88	29.5	10.3	0.32	0.83	0.40
CGF, % DM	80	23.8	3.91	0.07	0.95	0.47
Soyhulls, % DM	80	12.2	2.1	0.53	0.18	0.11
Wheat Midds, % DM	83	18.4	3.2	0.15	1.00	0.17

NRC, 1996

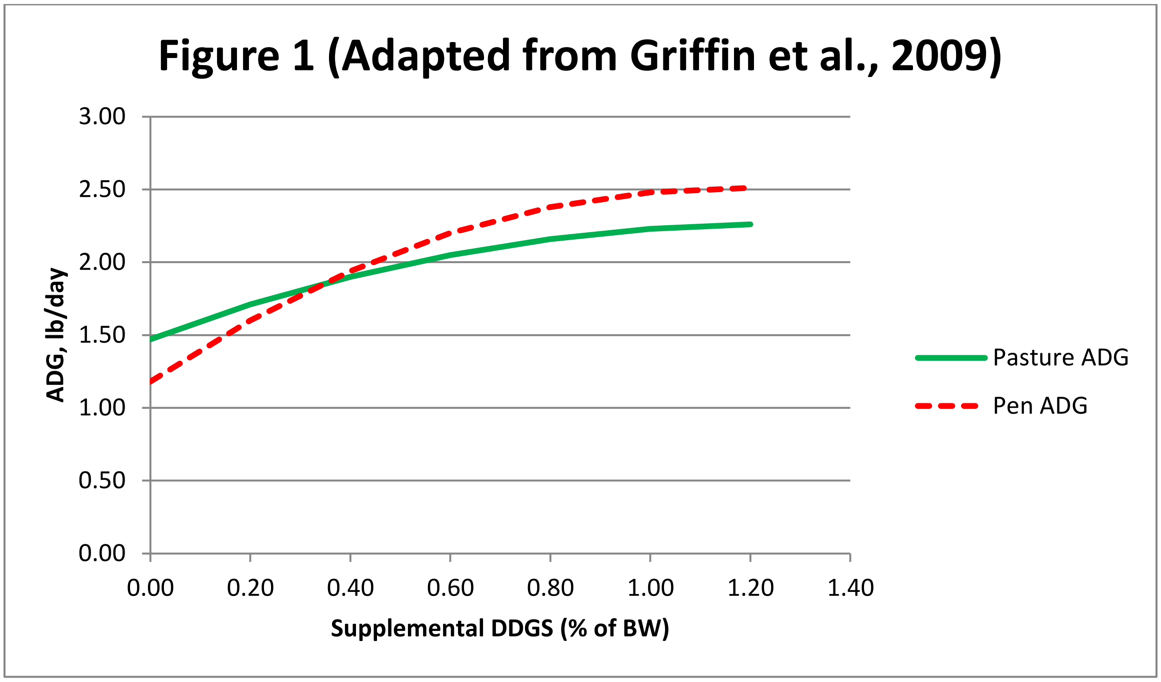

Figure 1 (Adapted from Griffin et al., 2009)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
ADG, lb/day
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
Supplemental DDGS (% of BW)
Pasture ADG
Pen ADG

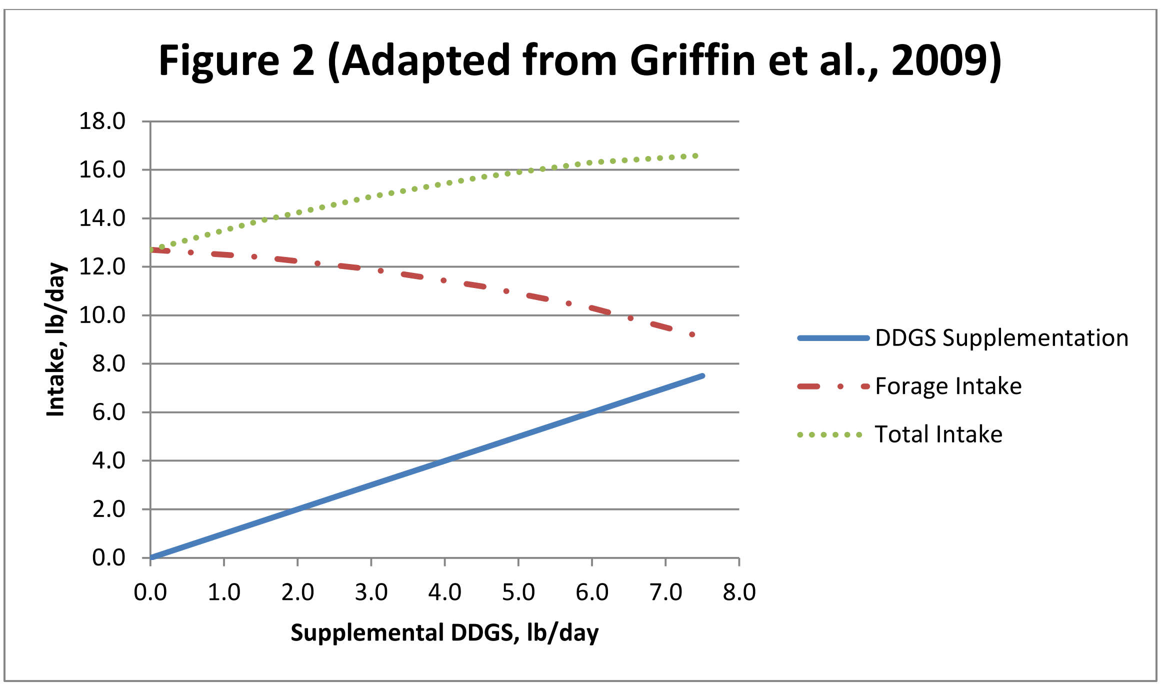

Figure 2 (Adapted from Griffin et al., 2009)
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Intake, lb/day
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
Supplemental DDGS, lb/day
DDGS Supplementation
Forage Intake
Total Intake