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EC08-278 Grazing Crop Residues With Beef Cattle

Richard J. Rasby
University of Nebraska-Lincoln, rrasby1@unl.edu

Galen E. Erickson
University of Nebraska-Lincoln, gerickson4@unl.edu

Terry Klopfenstein
Universitiy of Nebraska-Lincoln, tklopfenstein1@unl.edu

Darrell R. Mark
University of Nebraska-Lincoln, dmark2@unl.edu

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Rick J. Rasby, Extension Beef Specialist
Galen E. Erickson, Extension Feedlot Specialist
Terry J. Klopfenstein, Extension Ruminant Nutritionist
Darrell R. Mark, Extension Livestock Marketing Specialist

Definition of terms:
AFO: Animal Feeding Operation
AUM: Animal Unit Month
CP: Crude Protein
IVDMD: ***In vitro*** dry matter digestibility
NDEQ: Nebraska Department of Environmental Quality
TDN: Total digestible nutrients

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Grazing Crop Residues with Beef Cattle

A major cost for beef cow-calf and backgrounding operations is the feeding of stored feeds in winter months. To lower feed costs, many producers try to extend the grazing season by using crop residues, of which Nebraska has an abundance available for late fall and winter grazing.

Although corn crop residue grazing is quite effective in reducing feed costs, a concern exists about possible adverse effects on subsequent crop yields. Another concern when grazing corn residue is whether genetic enhancements to corn may affect cattle performance. Residue grazing is an important management practice for many cattle operations primarily as either a winter feed resource for maintaining the breeding herd or putting weight on cull cows. In addition, spring-born calves weaned in the fall can also be wintered on cornstalks if appropriate strategies for supplementation are used.

Nutritional Content of Corn, Milo, and Soybean Residues

In vitro dry matter digestibility (IVDMD) and crude protein content of different residues are shown in *Table I*. IVDMD, an estimate of energy, is closely related to total digestible nutrients (TDN). The terms IVDMD and TDN will be used interchangeably in this Extension Circular.

The corn cob and stalk are lowest in protein and palatability. The leaf and husk are intermediate in nutrient quality, but high in palatability. The grain is highest in nutrient quality *(Table I)*.

Nutrient quality of a cornstalk field can vary depending on whether or not it was irrigated *(Table II)*. In dryland corn fields, the grain, husk and leaf, cob and stalk are generally equal to or greater in protein and energy content compared to residue components in irrigated corn fields. Although the proportions of husk and leaf and stalk differ between dryland and irrigated corn, the overall nutrient content per ton of dryland corn residue is expected to be slightly greater.

More residue, however, is left in an irrigated corn field after harvest. Research indicates about two times more residue is left in an irrigated field (over 9,000 lb per acre) compared to a dryland field (5,000 lb per acre). The amount of residual grain left in the field varies depending on factors such as harvest date, lodging due to insects and disease and harvest efficiency. Low amounts of eardrop in corn fields is more common today due to both genetic advances that result in stronger stalks and technical advances in combines that better harvest the corn.

Many of the nutrient quality aspects described for corn can also be applied to grain sorghum stubble; however, there are at least two differences *(Table I)*. The grain sorghum leaf is generally higher in protein than a corn leaf, but sorghum grain is not as well utilized as corn grain. The sorghum berry's hard outer coat makes it more difficult for the animal to digest. Cattle can founder in grain sorghum fields with excessive amounts of grain left after harvest, indicating there is some utilization.

The TDN content of the soybean leaf, pod and stalk are low (35 percent to 41 percent; *Table I*). The low energy content for soybean stubble residue is due to the high lignin content, especially in the stalk. Lignin is the undigestible cell wall component of the plant.

Table I. Average percentage composition of harvested crop residues — dry matter basis.

		Percent crude protein		*Percent IVDMD*[a]	
	Percent dry matter	*Range*	*Average*	*Range*	*Average*
Corn					
Grain	73	9.5 - 11.2	10.2	88 - 95	90
Leaf	76	6.2 - 7.5	7.0	41 - 65	58
Husk	55	3.0 - 4.0	3.5	63 - 72	68
Cob	58	2.1 - 3.8	2.8	59 - 65	60
Stalk	31	3.0 - 5.1	3.7	45 - 60	51
Milo					
Grain	74	10.3 - 11.0	10.5	85 - 95	90
Leaf	66	6.0 - 13.0	10.0	40 - 65	56
Stalk	25	3.3 - 3.9	3.6	53 - 58	57
Soybean residue					
Leaf	87	11.0 - 13.1	12.0	36 - 40	38
Stem	88	3.6 - 4.5	4.0	33 - 36	35
Pod	88	4.5 - 9.0	6.1	34 - 51	41
Soybean	89	49.0 - 52.0	50.5	91 - 94	92

[a]IVDMD = *In vitro* dry matter digestibility. IVDMD is approximately equal to TDN (Total Digestible Nutrients).

Table II. Proportions and quality of residue in irrigated and dryland field corn residue.

	Irrigated			*Dryland*		
Item	*Proportion percent*	*CP[a] percent*	*IVDMD[b] percent*	*Proportion percent*	*CP[a] percent*	*IVDMD[b] percent*
Grain	4.0	9.6	91.4	4.0	12.8	90.8
Leaf and husk	45.0	3.7	51.6	51.0	6.4	49.7
Stalk	40.0	3.0	42.6	33.0	5.9	47.8
Cob	11.0	2.6	33.6	12.0	4.6	36.2

[a]CP = Percent crude protein.
[b]IVDMD = *In vitro* dry matter digestibility.

Research has shown that, over time, the nutrient content of crop residue fields does decrease due to weathering. The greatest nutrient loss is energy content in the husk and leaves. Also, nutrient losses are greater in wet, humid conditions due to increased decomposition and weathering. Nutrient losses can result from trampling or cattle activity in wet, muddy field conditions.

Grazing Characteristics of Crop Residues

When grazing residue, cattle will select and eat the grain first, followed by the husk and leaf and finally the cob and stalk. Because of this selection process, the cornstalk residue diet consumed could be very high in energy content (70 percent TDN) at first to very low (45 percent TDN) at the end of grazing. Also, as the stocking rate (number of cows per acre) increases, the residue's nutrient content declines more rapidly since the grain and husk are being removed at a much faster rate.

Cows grazing cornstalks or grain sorghum stubble will consume 25-50 percent of the available residue in 30-100 days, depending on stocking density or stocking rate, leaving enough material to prevent soil erosion. In the Midwest, weather records indicate the range in number of continuous grazing days for crop residue as 65-111 days.

Weather can be the most important factor in successfully grazing crop residue. For example, snow and/or ice cover can reduce or eliminate access; mud may make grazing difficult and may result in decreased animal performance and forage waste. During years of heavy snow accumulation, grain sorghum stubble provides better grazing than cornstalks. The grain sorghum head is cut off near the top of the plant, leaving more standing forage in the form of leaves above the accumulated snow.

However, delayed frost, unseasonably warm temperatures and moisture allow grain sorghum plants to remain green or develop new growth after grain harvest.

This new green growth, commonly referred to as "sucker;" may be high in toxic prussic acid.

If "sucker" growth occurs, cattle should not graze the stubble until for at least seven days after a hard freeze.

Determining Stocking Rate of Crop Residues

Stocking rate influences the amount of grain, husk, and leaf available per animal. The amount of grain and husk available affect diet quality because both are highly digestible. The rate of decline in digestibility is affected by stocking rate, trampling, residue components available, and environmental factors. Previous comparisons have shown that gains increase as stocking rate decreases. Stocking rate influences the quality of the diet consumed and, consequently, the animal performance.

Residue (leaf and husk) yield is related to grain yield, but hybrids obviously vary in this relationship. With high-producing corn (irrigated or with ample rainfall) there will be about 16 lb dry leaf and husk per bushel corn yield. The specific relationship is:

lb leaf and husk per acre on a dry matter basis =
([bu/acre corn yield x 38.2] + 429) x 0.39.

Some residue disappears by trampling and other factors but approximately 50 percent of the leaf and husk is used. Therefore, 150 bu corn produces 2,400 lb of leaf and husk per acre on a dry matter basis. Half of that (1,200 lb) of husk and leaf is available for the animal to consume.

This is equivalent to about 1.76 Animal Unit Month (AUM), or 1,200 lb of husk and leaf per acre at 50 percent use/680 lb of feed per AUM. One AUM is the amount of forage required to sustain a 1,000 lb cow or equivalent for one month and it has been determined that a 1,000 lb cow will consume 680 lb of dry matter monthly. A 1,200 lb cow is 1.2 AU and would consume 816 (680 lb x 1.2 AU) pounds of forage dry matter per month. If the corn yield was 150 bu/ac and that yield produces 2,400 lb of husk and leaf per acre on a dry matter basis, and 50 percent of the husk and leaf are consumed, then this residue field would provide 1.5 AUMs (1,200 lb of husk and leaf on a dry matter basis per acre/816 lb of forage per month for a 1,200-lb cow = 1.47 AUMs) per acre for a 1,200-lb cow or 44 days of grazing (30 days per month x 1.5 AUMs = 44 days of grazing). If one acre would feed a 1,200-lb cow for 44 days then it would feed a 600-lb calf for 88 days. Higher grain yields provide more AUMs and lower yields less. One acre of irrigated corn stalks or grain sorghum stubble will provide approximately 1.5 to 2 AUMs of grazing. This

number depends, though, on factors such as harvest conditions and subsequent weather conditions.

Grazing Strategies

Do not force cattle to eat the cobs and stalks. Ordinarily, dry cows will maintain body weight, and may gain half to 1 lb per head daily, on corn and grain sorghum residue grazing programs when grain, husks, and leaves are available. Both mature cows and first-calf heifers in late gestation, grazing crop residues that contain no grain, may need protein supplementation and, as grazing days increase energy supplementation depending on cow condition. For calves grazing crop residues, energy and protein will need to be supplemented to achieve daily gains of more than 1 lb.

Producers who graze livestock on crop residue should have an emergency feed supply, such as hay or silage, for use during severe weather. Also, supplemental forage can extend the crop residue grazing period and enhance animal performance. Snow cover up to 5 inches will probably not reduce grazing. Don't be in a hurry to provide cattle with supplemental feed or they will become dependent on it and seem to have less interest in grazing. The concern in regard to weather is when freezing rain is followed by extended periods of cold temperatures. This causes the residue to be coated with ice. It can remain stuck to the ground, making it difficult for cattle to eat.

Strip grazing (fencing off portions of a residue field) or moving cattle from field to field provides a more uniform nutrient intake. Daily gains of cattle are greater when fields are strip-grazed versus whole-field grazed. However, if residue fields are strip-grazed and there are extended periods of deep snow, some of the best feed may be ungrazed because of snow cover.

Whole-field grazing is the most common grazing strategy. Early whole-field grazing has the potential to allow cattle to consume the best feed (grain and husk) prior to snow fall or muddy conditions. Whole-field grazing should allow cows to put on weight during the early phase, with weight being maintained or lost after grain has been consumed. To keep cows gaining or maintaining weight using unsupplemented crop residue, move cows to a fresh field frequently (every 45 to 50 days).

Fall-calving cows can utilize crop residue for fall/winter grazing. If the amount of ear drop is low, one management option may be to early wean fall calves at 90-120 days of age. Weaning calves has three advantages:

- it lowers the nutrient needs of the cow;
- it allows grain or supplements that contain corn milling by-products and higher quality roughage to be fed directly to the calf; and
- it maintains the cow on crop residue.

Another option would be to supplement fall-calving, lactating cows while grazing corn stalk residue. Fall-calving cows grazing crop residues, which are not supplemented and suckling a calf, will lose body condition; however, they will likely regain condition on summer pasture before their next calving the following fall. Pay close attention to first-calf heifers as their nutrient needs are high and will be the ones that could lose weight if not supplemented. Corn by-products are excellent supplements because they are good protein and energy sources and lactating cows grazing corn residue are likely to be deficient in both protein and energy, especially when the corn not removed by the combine is consumed. On the other hand, if the fall-calving cow is pregnant with her next calf, a management strategy may be to not supplement and let the cow lose condition as she will likely gain body condition while grazing spring and summer pasture. Again, in this situation, pay attention to first-calf heifers. Finally, a grazing strategy for fall-calving, lactating cows may be to move them to a fresh stalk field every 30 to 45 days without any supplementation.

Cows will graze soybean stubble if allowed access to both cornstalks and soybean stubble, consuming the pods or beans left on the ground. Again, because of the high lignin content of the soybean stem, there is little energy in this portion.

Estimating the Ear Drop

Estimating the amount of corn left in a field helps producers determine a grazing strategy. An 8-inch ear of corn contains about half a pound of corn grain, therefore 112, 8-inch ears would equal 1 bushel (1 bushel = 56 pounds). By counting the number of ears, the amount of corn can be estimated. If corn is planted in 30-inch rows, count the number of ears in three different 100-foot furrow strips and divide by two to give an approximate number of bushels per acre. Small ears and broken ears should be counted as half ears, while very large ears could be counted as an ear and a half. Any amount beyond 8-10 bu/ac will require a well-planned grazing strategy to ensure that too much grain is not consumed.

Estimating Milo Head Drop

Because of the hard outer coat, the grain in a milo stubble field is essentially unavailable to cattle, yet when there are large amounts of grain available, founder can occur. One milo head has about .12 lb of grain, and about 466 milo heads would equal 1 bushel of milo (1 bushel = 56 pounds). As fields approach 10 bushels left in the field, producers need to implement well-planned grazing strategies to avoid founder.

Supplementation Strategies for Cattle Grazing Crop Residues

Nutrient (protein, energy, mineral, vitamin) requirements for beef females increase as their stage of production moves from mid-gestation to calving. Spring-calving cows using crop residue while lactating in the fall will require supplemental energy and protein to meet their lactation nutrient requirements. Consider corn milling by-products, high in both protein and energy, as feeds to consider, if priced economically. Although the spring-born calves will weigh between 400 to 600 lb, they will be in better positions to weather storms; however, there usually isn't a lot of protection in or around a corn field.

For a 1,200-lb mature cow (potential to produce 18 pounds of milk daily) consuming about 25.1 lb of intake on a dry matter basis, the percent of protein in the diet should be 6.0 to 6.5 percent in mid-gestation and 7.0 to 7.5 percent for cows in late gestation. Restated in pounds, cows described above need 1.6 lb of crude protein daily in mid-gestation and 1.9 lb of crude protein in late gestation. Likewise, energy (Total Digestible Nutrients or TDN) needs increase from mid-gestation to late gestation. The percent of TDN needed in the daily ration is about 50 percent (12.6 lb TDN) and about 56 percent (14.1 lb TDN) for cows in midgestation and late gestation, respectively.

For first-calf heifers, the lb of crude protein and TDN needed on a daily basis follow the same pattern as they move from mid-gestation to late gestation. If a first-calf heifer weighs about 1,020 lb at her first calving, she will eat about 22 lb of feed daily on a dry matter basis. The percent of the ration needing to be crude protein is 8.1 percent (1.78 lb daily) and 8.6 percent (1.89 lb daily) for first-calf heifers in mid- and late gestation.

Likewise, the percent of the ration that needs to be TDN is 57 percent (12.5 lb daily) and 59 percent (13.0 lb daily) in mid- and late gestation. The reason for the higher percentage of nutrients required by heifers compared to cows is that first-calf heifers weigh less; therefore, the amount they can daily consume is less. In addition, heifers still have a nutrient requirement for growth. Diet quality and nutrient density is important because research data indicates that feed intake decreases by 17 percent in heifers as they approach their first calving. Rumen capacity is likely reduced because of the growing fetus.

Periodically, producers should check what nutrients are available in the residue field. If corn is visible in the manure of gestating cows grazing corn residue, supplementation other than vitamins and minerals is probably not necessary. *Cows in mid- to late gestation forced to eat the cob and stalk will lose weight and body condition.* It is essential to monitor body condition of cows and manage them to achieve moderate body condition before calving (moderate condition score 5 for mature cows and condition score 6 for first-calf heifers using the scale 1 = very thin to 9 = obese).

After approximately 40 days of cows grazing a corn field that has less than one bu/ac of ear-drop, protein appears to be slightly deficient for late-gestating beef cows. If a protein supplement is fed, it must contain degraded intake protein (DIP). This protein supplement could contain some non-protein nitrogen (NPN), but it is recommended that 10 percent or less of the protein in the supplement come from a NPN source. When supplementing cattle, all animals must get their share. Feeding the protein source every other day or every third day means larger quantities are fed and, in theory, timid and young cows are more likely to get their share compared to daily feedings.

Cows and First-Calf Heifers

As long as cows have grain to select in a cornstalk field, the diet is probably above 8 to 9.5 percent crude protein and as high as 70 percent TDN *(Figure 1)*. This will exceed the protein and energy needs of a 1,200-lb cow in mid-gestation and gestating beef cows will gain weight and body condition. Based on *Figure 1*, average TDN content of the diet of calves grazing a cornstalk field that has approximately one bushel of ear-drop per acre about is 66 percent and the protein content is likely between 7 percent and 8 percent the first 25 days that the residue is grazed. As the number of days of crop residue grazing increase, energy content decreases *(Figure 1)*. It appears that for the first 40 days of stalk grazing, average content of the diet will be between 56 percent to 58 percent TDN and likely above 6 percent crude protein. For the 1,200-lb cow in mid-gestation and average body condition, energy is adequate but the diet is slightly deficient in protein as cows approach 40 days of stalk grazing.

Mature cows are approximately 0.38 lb deficient in crude protein. This protein deficiency could be made up by feeding 2.5 lb of alfalfa (18.0 percent CP, 58 percent TDN, 88 percent dry matter) per head per day, 1.5 lb of a 32 percent range cube (90 percent dry matter) per head per day, or 3.5 pounds of wet distillers grains (30 percent crude protein, 112.5 percent TDN, 35 percent dry matter) per head per day. Under typical stalk grazing conditions, supplementation for mature cows in body condition which score 5.0 or better shouldn't be considered until after 40 to 45 days of grazing.

As grazing days on the same residue field increase, nutrient quality decreases because cows are selecting the most nutritious components. During this same time, spring-calving cows move closer to calving and nutrient needs increase. At recommended stocking rates, move cows to a fresh field after about 50 to 60 days of grazing in the same cornstalk field, to avoid a lot of supplementa-

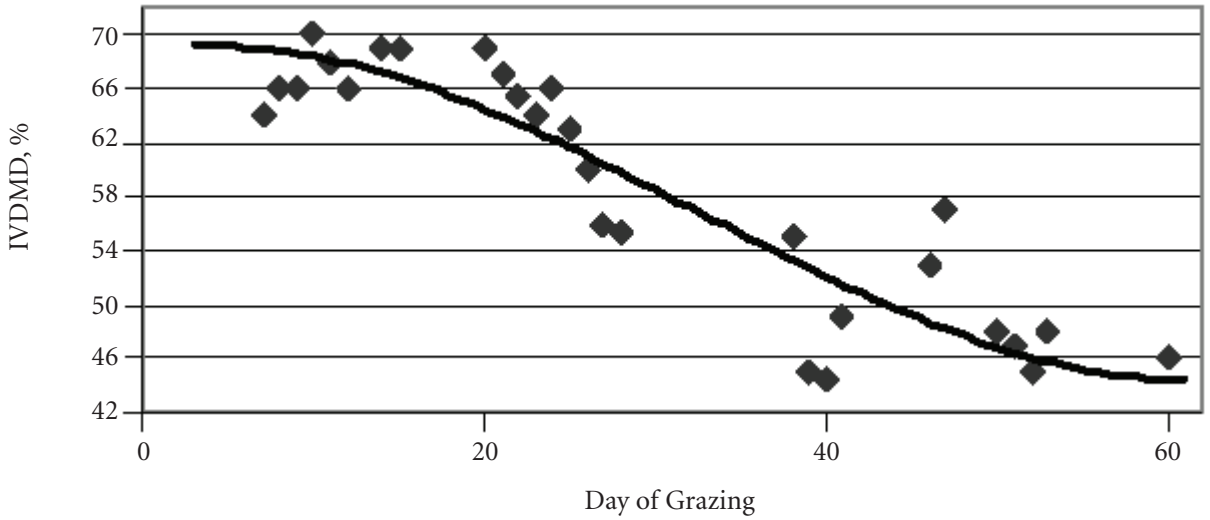

Figure 1. ***In vitro*** **dry matter disappearance (IVDMD) of the roughage fraction of diets selected by esophageally fistulated calves grazing cornstalks.**

tion. Nutrient quality of a stalk field between 50 and 60 days of continuous grazing will average about 48 percent TDN and about 4.9 percent crude protein and cows in late gestation will be deficient in protein and energy *(Figure 1)*. Mature cows are about 0.67 lb deficient in protein and 1.9 lb deficient in energy daily. All calculations are based on a stalking rate determined using grain yield and that 50 percent of the remaining residue is used (guidelines for determining stocking rate provided in an earlier section).

Spring-calving heifers in mid-gestation grazing residue fields the first 25 days will likely meet both their protein and energy needs and should gain weight and body condition. After the grain has been consumed, protein and energy supplementation will be needed. Between days 25 and 45 for heifers grazing cornstalk residue, TDN content averages 54 percent *(Figure 1)* and crude protein during this time period will be about 5.0 percent to 5.5 percent. For the 1,020-pound heifer in mid-gestation and average body condition, energy and protein in the diet are deficient. These heifers are approximately 0.68 pounds deficient in crude protein and 0.7 lb deficient in TDN. These deficiencies could be made up by feeding 4.0 to 5.0 lb of alfalfa (18.0 percent CP, 58 percent TDN, 88 percent dry matter) per head per day, 2.4 lb of a 32 percent range cube (90 percent dry matter) per head per day, or 6.5 lb of wet distillers grains (30 percent CP, 112.5 percent TDN, 35 percent dry matter) per head per day.

Corn milling by-products like distillers grains and corn gluten feed would be good choices as a supplement in this situation because they are excellent protein and energy sources and complement forage diets that are deficient in these nutrients. Heifers in late gestation, grazing the same stalk field for 60 days, will need supplementation of both energy (2.4 lb per day deficient of TDN) and protein (0.8 lb per day deficient in crude protein). It would be recommended to move first-calf heifers to a fresh stalk field after 50 to 55 days of grazing or start feeding them harvested feeds.

Lactating cows, such as fall-calving cows, grazing crop residue also must be managed carefully. As long as lactating cows can select grain in the field, their energy needs should be met but protein will need to be supplemented. So the first 25 to 30 days on a fresh stalk field, a 1,200-lb cow producing 18 to 20 lb of milk daily would eat about 27 lb of dry matter and need a diet that is about 10 percent protein (2.7 lb) and 64 percent TDN (17.3). If the crop residue consumed during the first 30 days is 66 percent TDN and 9 percent crude protein, then the lactating cow is 0.3 lb deficient in protein. After 40 days of grazing the same stalk field, substantial supplementation of protein and energy will be needed. Again, this may be a situation where corn milling by-products will work. It may be as beneficial to move the lactating cows to a fresh field every 35 to 45 days unless there is substantial ear-drop.

Management options for the lactating females would include:

- supplementing protein and energy,
- not supplementing and letting them lose weight and body condition assuming the breeding season is over, and
- weaning the calves and not supplementing the cow and feeding the weaned calf directly.

Salt, mineral and vitamin A supplements are recommended for all cattle grazing crop residues during the time that cows are not being fed a protein or energy supplement. The supplemental mineral profile will change

depending on the type of supplement fed. If corn milling by-products are used as the source of supplement, then phosphorus in the mineral supplement can be eliminated. These supplements can be supplied free-choice.

Calves

Forage bulk of crop residues will cause lower performance for young cattle, as their rumen capacity per unit of body weight is less than that of mature cows. Supplementing protein for calves grazing cornstalks should result in gains of 0.5 to 1.0 lb per day. This may be adequate if a producer is wintering calves for low rates of gain and plans to summer them on grass. Previous research indicates that faster rates of gain (1.5 lb per day or greater) are more economical. Supplementing the calf with energy and protein will support higher gains. Data indicate that the protein supplement should have at least 0.36 lb of escape protein (undegradable intake protein, UIP, or by-pass protein) per head per day to get the best weight gains with calves. Total protein supplementation may need to be as high as 0.9 lb per day. Calves will need more supplemental protein early in the grazing period than later because of their need to use the higher energy content of the diet early in the crop residue grazing period. *Figure 2* illustrates the effect of supplementation of calves grazing corn stalk residue. As supplementation of dry distillers grain increased, performance and average Daily Gain (ADG) increased. Calves gain about 1.5 lb/day when supplemented between 3 to 4 lb of dried distillers grains per head per day. Steer calves weaned in the fall supplemented with 5.0 to 6.0 lb per head per day of corn gluten feed while grazing cornstalks will gain between 1.5 to 1.9 lb per head per day.

Corn milling by-products (i.e. corn gluten feed, and distillers grains) are excellent supplements. They are excellent sources of protein (16 to 30 percent), phosphorus (0.8 to 1.0 percent), and energy (100 to 125 percent energy value of corn grain). Corn milling by-products could be used as a protein and/or energy supplement for calves grazing crop residues. Distillers grain is a good source of by-pass protein (65 percent by-pass or undegraded intake protein, UIP). If you supplement with corn milling by-products, then phosphorus supplementation is not necessary. Minerals and vitamins can be offered "free choice." If feeding distillers grain or corn gluten feed, provide adequate calcium (i.e. limestone) in the diet because of the high phosphorus content of these feeds.

Milo Stubble Supplementation

On average, the leaves of milo stubble offer energy and protein adequate for cows in mid- to late gestation, but not for heifers in late gestation *(Table I)*. Monitor body condition of mature cows grazing milo stubble. If they appear to be losing condition, supplement protein. If the nutrient quality is low, cows are about 0.45 pounds deficient in protein and need to be supplemented similar to that described above. Remember, because of the milo's hard outer coat, it is not utilized as well as corn grain by the cow.

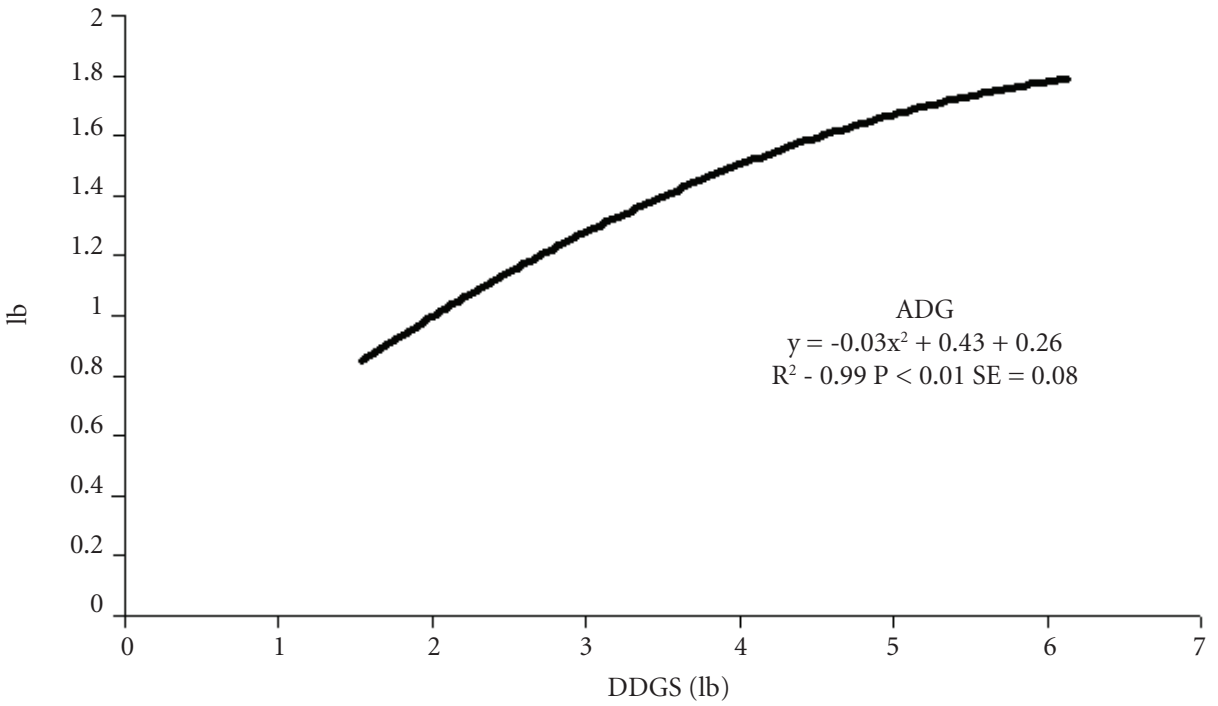

Figure 2. Average daily gain (lb) of calves supplemented with dry distillers grains plus solubles while grazing corn stalk residue.

Grazing Strategies for Cornstalk Fields with Excess Grain

Consumption of excess grain (more than 8-12 bu/ac) left in the field can cause both acidosis and founder in cattle. Founder, an abnormal hoof growth condition, results from excessive grain intake, which causes an increase in rumen acid production. In severe cases of acidosis, the result is long toe or hoof growth and severe lameness. Hand-picking corn would be the most effective solution, but may not be realistic for producers looking to get cows on traditional stalk fields for winter feed.

Strategies for using high-grain cornstalk fields include:

- graze yearling cattle or calves first, then follow with cows;
- graze cull cows destined for slaughter first, then follow with the main herd;
- short-term graze (only a few hours per day);
- increase the stocking rate to reduce grain intake per animal; and
- divide the field into strips with power fence using polywire and fiberglass posts, forcing cows to consume some husks and leaves along with the ears of corn. This will reduce founder potential.

The experience level of the cattle grazing a cornstalk field determines how efficiently they will glean a field for grain. Old cows with previous experience can pick up amazingly high amounts of corn, as can experienced yearling cattle. Inexperienced calves may have the least risk of founder or acidosis in high-grain cornstalk fields because they must first learn how to find corn so their grain intake increases gradually. Finally, in stalk fields that have excess ear-drop, consider filling cows with forage before allowing them access to the stalks. This will limit their corn intake and may help reduce founder or acidosis.

Grazing Crop Residue and Effect on Subsequent Grain Yield

Few experiments have evaluated the effect of winter grazing of crop residues on subsequent grain production. Three years of data from experiments conducted in Nebraska indicate that fall and winter grazing has no significant effects on crop yields compared to ungrazed areas. Neither corn, soybean nor grain sorghum yields were adversely affected following grazing. Residue cover was, however, significantly reduced from grazing compared to ungrazed plots. In no-till cropping systems, additional tillage was not required following fall and winter grazing.

In a ridge-till system, grazing of cornstalks did not adversely affect ridge integrity, but soil bulk density in the top (0-3 in.) depth was increased in the interrow, following grazing under muddy conditions. Other measurements showed that soil bulk density may increase in tracked areas following grazing. Spring grazing indicated a significant decrease in water infiltration rate compared to ungrazed areas. Spring grazing of stalks also showed a decrease in residue cover and increase in bulk density. Fifteen years of data indicated no negative effect on soybean or corn yields in grazed compared to ungrazed fields.

Time of Grazing and Crop Yield

Experiments were conducted during the fall and winter to evaluate performance of calves grazing cornstalks on conventional and ridge-till fields. In these crop residue grazing experiments, calf stocking rate was 1.2 head/acre for a 60-day grazing period from December to February. To determine grazing impact, yields were measured by machine harvest the following fall from grazed and ungrazed areas of each tillage method. The three-year yield averages for ridge-till and conventional systems show little difference between treatments.

Because no differences were observed due to winter grazing, spring grazing was evaluated to see how compaction impacted subsequent crop yield. When grazing caused surface compaction, we hypothesized that tillage would offset the compaction and maintain yield. Crop production was based on an annual corn-soybean rotation with one half of the field planted to each crop. Tillage treatments included ridge-tilling during the summer, no-tillage, fall tillage with a chisel followed by conventional tillage (disc) in the spring, or spring conventional tillage alone. All tillage treatments were conducted during the corn rotation with no tillage following the soybean crop.

This grazing trial was conducted with a calf stocking rate of 0.8 acres per calf for 60 days. This rate was based on average stocking rates to optimize animal performance. Soybean yields showed no difference between grazed and ungrazed treatments; spring and fall tillage treatments had no effect on soybean yield when compared to the no-till treatments. Corn yields two years post-grazing showed no significant differences due to grazing or tillage treatments.

Therefore, another grazing trial was conducted with stocking rate increased 2.5 times to 0.32 acres per calf for 60 days. Overall grazing improved soybean yields over ungrazed treatments and included significant improvement in yield in no-till-grazed over no-till-ungrazed treatments. Spring and fall tillage had no effect on soybean yield when compared to no-till treatments. There was no effect on corn yields the second year after grazing when compared to the ungrazed treatments.

Careful strategies should be considered when grazing crop residues in March, due to the high possibility of mud. In our research, we have observed no negative impacts when grazing cattle on crop residues in "normal" spring conditions.

Grazing Genetically Modified Corn

Recent concerns with changes in animal performance due to genetically modified corn residues have also been evaluated. Steer calves grazing four different fields of corn residue (Bt-corn rootworm protected, nonBt, Roundup Ready® (RR) and non-Roundup Ready) stocked at equal stocking density (1.06 acre/steer/60 days) were used to evaluate genetic enhancement on animal performance. Steer performance was not different between Bt-corn rootworm protected or Roundup Ready hybrids and their parental controls following the 60-day grazing period. The animal performance demonstrates that the feeding value of corn residue doesn't differ between genetically enhanced corn hybrids and their non-genetically enhanced parent hybrid. Similar research at the University of Nebraska also showed no difference in steer performance due to the incorporation of the Bt trait for corn borer protection. There was also no preference between Bt and non-Bt hybrids. During the grazing period, 47.5 percent of the steers were observed grazing Bt residue, and 52.5 percent of the steers were observed grazing nonBt residue.

To determine how grazing crop residues for Bt-corn hybrids affected performance of pregnant beef cows, one non-Bt-corn hybrid and three Bt-corn hybrids were compared. Rates of change in the concentrations of digestible dry matter and crude protein over winter were not significantly affected by corn hybrids. Mean amounts of hay required to maintain body condition score of cows maintained in a dry-lot were greater than for cows grazing crop residues (3,199 vs 825 lb/cow DM) but did not differ between corn hybrids.

The data from these experiments suggests genetic enhancement has no effect on corn residue utilization by grazing beef cattle. Producers can take advantage of increased yields and reduced herbicide/pesticide use with Bt corn rootworm protected or RR hybrids without adverse effects on corn residue grazing performance.

What Are Crop Residues Worth?

There are several ways to assign a value to crop residue. The owner of the corn field can consider what is being sacrificed — the nutrients and organic matter removed from the field, along with the costs of waiting to begin post-harvest field operations and scattering weed seeds. On the other hand, pasturing corn stalks produces three benefits:

- it can reduce volunteer corn problems next year;
- it eliminates the need to shred stalks; and
- most nutrients are returned to the soil in the manure.

The user of the cornstalk field may have feed savings and additional weight gains from utilizing the field, but may incur additional costs in moving the livestock and providing water and fencing.

Several of the advantages and disadvantages of pasturing crop residue are difficult to value. A crop owner may think that nutrients are being removed when cattle are grazing a cornstalk field. If cows maintain weight while grazing a stalk field, by definition, no nutrients are lost. Cows grazing a cornstalk field eat about 30 percent of the residue and digest about half, so about 15 percent of the organic matter is potentially lost, and some weathering and residue will be lost to wind.

With this in mind, generally assume that essentially no organic losses can be attributed to cows grazing the residue. This concept is supported by many years of cornstalk grazing and measuring subsequent corn yield and finding no difference between grazed and ungrazed fields. If calves graze corn stalk residue and are supplemented, more nutrients may be added to the field than removed due to grazing.

Estimate the feed value of crop residue based on daily consumption and price of feed saved, usually the largest benefit of using crop residue. Corn and grain sorghum residue are comparable in nutritional value to grass hay (7 percent protein and 52-56 percent TDN). Additional savings may be realized in reduced wear-and-tear of dry-lot facilities, reduced equipment operating costs, labor reduction for feeding and manure removal, and compliance with the Nebraska Department of Environmental Quality (NDEQ) for feeding animals in confinement.

New Animal Feeding Operation (AFO) guidelines have recently been established in Nebraska in regard to "dry-lotting" animals. Livestock maintained for 45 days in an area where vegetation cannot be maintained may be considered being in an AFO. This should trigger the request for an inspection from NDEQ, for which there is a fee. The smaller the number of cows to be fed in a dry-lot situation, the less likely is the dry-lot to be permitted. However, in some scenarios for livestock managers, it is either dry-lot and feed cows harvested forages during the winter or have them graze crop residue for a portion of the winter. Therefore cattle will be dry-lotted for more than 45 days. These savings usually more than offset the additional costs of supplying water and fencing, moving cattle and inspecting the grazing cattle.

An example for estimating crop residue value is presented in *Table III*. The budget assumes 1 AUM per acre

Table III. Example budget estimating the value of grazing crop residue
60 Cows Grazing 160 Acres of Crop Residue for 120 Days

Net benefit to livestock enterprise	
Feed savings[1] (60 head @ $.90 per day for 80 days)	$ 4,320.00
Dry-lot savings[2]	$ 1,137.00
Value of additional weight gain (loss)[3]	0
Less crop residue grazing costs[4]	$ -3,387.00
Net livestock benefit	$ 2,070.00
per acre = $2,070/(160 acres) =	$ 12.94
per head day = $2,070 / (60 head x 120 days)=	$ 0.29
Net benefit to crop enterprise	
Saving shredding stalks 160 acres @ $3.50/acre[5]	$ 560.00
Manure credit less nutrient and organic matter consumed[6]	0
Net crop benefit	$ 560.00
Per acre	$ 3.50

[1]Example feed savings based on 80 days at 30 lb grass hay per head per day at $60 per ton. May need to be adjusted for supplemental feed needed while grazing crop residue.
[2]Electricity cost for pumping 25 gallons water per head per day at 5¢ per 1,000 gallons. Depreciation and interest for water tank and tank heater of $32 per annum. Fuel cost for tank heater based on 1 gallon per day for 60 days. Lot cleaning and repairs of $100 per year. Labor for feeding and oversight of 1 hour per day. NDEQ fees, maintenance of buffer strips, etc. $5.00 per cow.
[3]Add value of any additional weight gain expected from crop residue grazing (or subtract loss in value). Example assumed to be zero.
[4]Moving cattle 5 miles at 45 cents per mile equipment charge plus 12 hours labor. Water costs as described above plus hauling 2 miles at 45 cents per mile equipment charge and 2 hours of labor per day. A total of $250 per year for depreciation and interest on fencing materials, battery charger and labor for installation and teardown. Additional oversight costs of 10 pickup miles per day at 48 cents per mile, plus 30 minutes labor time per day.
[5]Fuel, repairs and labor cost.
[6]The manure produced may contain more nutrients than the stalks removed, but nitrogen losses are possible, making it difficult to estimate a net manure credit.

actual grazing (60 head at one animal unit per head for 80 days for a total of 4,800 animal days or 160 AUMs). The example considers an additional 40 days on a 160-acre crop residue pasture but with snow cover requiring supplemental feed. For illustration, additional weight gain is assumed to be zero and manure credit is ignored. The primary savings in manure may likely be the reduced cost in removing and spreading the manure from the dry-lot facilities.

Estimate the value of the crop residue on an acre or head-per-day basis. Weather variability may make rental value of crop residue grazing on a per-acre basis uncertain, but renting crop residue on a per-day basis can reduce that uncertainty, if the rental period can be adjusted with weather conditions. Livestock producers grazing their own crop residue would realize the benefit from both sides as estimated in *Table III*. Livestock producers renting crop residue could consider the net cost of their next best alternative (for example, supplementation on dormant pasture or feeding in dry-lot) as the maximum rental value of the crop residue.

Landlords could consider any livestock costs covered by the landlord, minus the net benefit to the crop enterprise, as the minimum rental value of the crop residue. Both the maximum rental value the cattle could realize ($12.94/acre, *Table III*) and the minimum rental value the crop must cover ($3.50 per acre, *Table III*) should be adjusted based on factors discussed earlier. The remaining range in rental values provides a basis for negotiating a rental rate.

Summary

In summary, grazing cattle on crop residue is a valuable feed asset for livestock producers to consider. This Extension Circular reviews many aspects of grazing residues from nutrient content of residue, supplementation strategies based on desired performance, calculating stocking rates, and strategies to manage around founder. Allowing cattle to harvest their needs is a management strategy to reduce feed costs. Know what your expectations are for your operation, your cattle, and your crops.

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