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# EC98-278 Grazing Crop Residues

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# Grazing Crop Residues

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Nebraska has an abundance of crop residue available for late fall and winter grazing. However, several factors prevent the grazing of many fields, including the location of fields in relation to the cattle, the lack of shelter or appropriate fencing and water availability. Despite these limitations, residue grazing is an important resource to many cattle operations, primarily as either a winter feed resource for maintaining the breeding herd or putting weight on cull cows. Calves weaned in the fall can also be wintered on cornstalks if appropriate supplementation is used.

## Nutritional Value

*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.

**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 | 91 |
| Leaf | 76 | 6.2-7.5 | 7.0 | 41-65 | 58 |
| Husk | 55 | 2.6-3.8 | 2.8 | 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 |

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

**Cornstalks**

As shown in *Table I*, the corn cob and stalk are lowest in protein and energy, the leaf and husk are intermediate and the grain highest. Nutrient quality of a cornstalk field varies depending on whether or not the field was irrigated (*Table II*). In dryland corn fields, the grain, husk and leaf, cob and stalk generally equal to or greater in protein and energy content than 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 greater. More residue, however, is left in an irrigated corn field after harvest. Research from eastern Nebraska indicates about two times more residue is left in an irrigated field (over 5,000 pounds per acre) compared to a dryland field (2,500 pounds per acre). Although the proportion of grain left in the two fields may be similar, the total amount of grain left in an irrigated field is usually much greater. While 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, the average amount of grain left in the field is about 4.2 percent of the yield.

Research has shown cornstalk fields grazed shortly after harvest are higher in nutrient content than those grazed 60 days after harvest. This indicates loss of nutrients due to weathering. The greatest nutrient, primarily a loss in energy content, appears in the husk and leaf. Also, nutrient losses are greater in wet, humid areas due to increased decomposition and weathering.

**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.

### Grain Sorghum Stubble

Many of the above nutrient quality aspects apply 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; however, sorghum grain is not utilized as well 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.

### Soybean Stubble

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 likely due to the high lignin content, especially in the stalk. Lignin is an undigestible cell wall component of the plant.

## Grazing Characteristics

Weather can be the most important factor in successfully grazing crop residue. For example, snow cover can reduce or eliminate access; mud may make grazing difficult and may result in decreased animal performance and forage waste.

One Animal Unit Month (AUM) is the amount of forage required to sustain a 1,000 pound cow or equivalent for one month. One acre of irrigated corn stalks or grain sorghum stubble will provide approximately two AUM of grazing. Dryland stalks will have about one-half the carrying capacity of irrigated stalks. This number depends, though, on factors such as harvest conditions and subsequent weather conditions. For example, excellent harvest conditions would mean less grain left in the field, resulting in a lower total nutrient value and fewer grazing days prior to moving cattle to a new stalk field. Another way to calculate the number of grazing days is to assume 4 percent of the grain yield is down corn and amounts to 1.9 pounds of corn dry matter per day. If there is minimal mud and trampling, we could estimate 80 percent of the corn, leaves and husks can be consumed. This would provide .8 days of grazing for a calf or .4 days of grazing for a cow per bushel of corn produced (Ex: 150 bu corn/Ac x .4 days = 60 days of grazing per cow per acre).

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

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 "suckers", may be high in toxic prussic acid.* If "sucker" growth occurs, cattle should not graze the stubble until at least seven days following a hard freeze.

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 consumed could be very high in energy content (70 percent TDN) at first to very low (40 percent TDN) at the end of grazing. Also, as the stocking rate (number of cows per acre) increases, the nutrient content of the remaining residue declines more rapidly as the grain and husk are being removed at a much faster rate.

## Meeting Nutritional Needs

Nutrient (protein, energy, minerals, vitamins) requirements for cattle increase as their stage of production moves from mid-gestation; dramatically increasing after calving due to lactation. For a 1,200 pound mature cow producing 18 pounds of milk, the percent of protein in the ration should be 7.0 percent in mid-gestation and 8 and 9.5 percent for cows in late gestation and after calving, respectively. Restated in pounds, cows would require 1.4 pounds of crude protein daily in mid-gestation, 1.7 pounds of crude protein in late-gestation and 2.1 pounds during lactation. Likewise, energy (TDN) needs increase from gestation to lactation. Percent TDN needed in the ration daily is 49 percent (9.5 pounds TDN), 54 percent (11.2 pounds TDN), and 56 percent (12.1 pounds TDN) for mid-gestation, late gestation and lactation, respectively. For the first-calf-heifer, the pounds of crude protein and TDN needed on a daily basis are similar to the mature cow described above. However, the protein percentage needed for the first-calf-heifer is much different. Percent of the ration needing to be crude protein is 8.1 percent, 8.5 percent, and 10.4 percent for first-calf-heifers in mid- and late gestation and after calving. Likewise, the percent of the ration that needs to be TDN is 55 percent, 57 percent, and 63 percent for first-calf-heifers in mid- and late gestation and after calving. The reason for the higher percentage required: is the first-calf-heifers have less rumen capacity and their rations must be more nutrient dense because they can't eat as much as mature cows.

### Cows and First-Calf-Heifers

As long as cattle have grain to select in a cornstalk field, they will consume a diet that is probably above 7 percent crude protein and as high as 70 percent TDN (*Table II*). This will exceed the protein and energy needs of a 1,100 to 1,200 pound cow in mid-gestation. Spring-calving cows, which are at mid- to late gestation during fall and early winter, have nutrient requirements well matched to crop residue grazing programs. However, as the stalk grazing season progress, nutrient quality of the stalks decreases.

Periodically, producers should check what is available in the residue field. If corn is visible in the manure of gestating cows grazing corn residue, supplementation with other than vitamins and minerals is probably unnecessary. However, after most of the grain has been consumed, protein supplementation is needed. *Cows in mid- to late gestation, or after calving, 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 to 6 using the scale 1 = very thin to 9 = obese).

Heifers in late gestation should not be allowed to graze cornstalk fields, or milo stubble especially after the grain has been consumed, unless supplemented with energy. Heifers have a high protein and energy requirement and the remaining residue does not meet their requirements.

Lactating cows, such as fall-calving cows, grazing crop residue also must be managed carefully. As long as lactating cows have grain to select in the field, their energy needs should be met. If the breed type has a high milk potential, however, protein supplementation is necessary even if the cattle have grain to eat.

### Calves

Forage bulk may cause lower performance for young cattle, as their rumen capacity per unit of body weight is less than that of mature cows. Protein supplementation appears necessary for calves grazing cornstalks; even then gain may not exceed 1 pound per day. This may be adequate if a producer is wintering calves for low rates of gain and plans to summer them on grass. Supplementing the calf with energy may, however, provide greater gains and still be economical.

## Grazing Strategies

The producer who grazes livestock on crop residue must 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. Do not be in a hurry to provide supplemental feed or cattle will become lazy and not graze.

Ordinarily, dry cows will at least maintain body weight, and may gain .5-1 pound per head daily, on corn and grain sorghum residue grazing programs where grain, husks and leaves are available.

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 stripped grazed versus whole-field grazing. However, if residue fields are strip-grazed and it happens to snow, some of the best feed may be lost 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 gleaned from the field. To keep cows gaining or maintaining weight using unsupplemented crop residue, move them to a fresh field when all grain has been consumed.

Fall-calving cows may utilize crop residue for fall-winter grazing if fresh fields are made available at 2-4 week intervals. If the amount of ear drop is low, it may be advantageous to early wean fall calves at 90-120 days of age. Weaning calves would lower the nutrient needs of the cow, and grain and higher quality roughage can be fed directly to the calf and the cow could be maintained on crop residue. On the other hand, if the fall calving cow is pregnant with her next calf, it may not be necessary to wean. These cows, grazing crop residues and suckling a calf, may loose body condition; however, they will likely regain condition on summer pasture before fall calving. In this situation, pay close attention to first-calf-heifers.

Also, cows will substantially 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 stalk, there is little energy in this residue.

## Supplementation Strategies for Cattle Grazing Crop Residues

Salt, phosphorus, calcium and vitamin A supplements are recommended for all cattle grazing dormant winter range and crop residues. These supplements can be supplied free-choice.

When protein supplementation is required, natural protein sources provide a better response than protein sources containing large amounts of nonprotein nitrogen, such as urea or biuret. Three-year-old cows grazing cornstalks from mid-November to February 1, supplemented with .4 pounds of crude protein equivalent per head per day in the form of either soybean meal, 7.2 percent urea supplement or 9.2 percent biuret, gained .99, .76, and .83 pounds per day, respectively, indicating that if cows have only husk and leaves to consume in a cornstalk field, an all-natural protein source is recommended. This could be in the form of a good quality alfalfa or a concentrated natural protein supplement. Protein supplements containing protein sources such as sunflower meal, canola meal, feather meal, corn gluten feed and distillers grain tend to be cheaper per unit of protein than protein supplements containing soybean or cottonseed meal.

### Cornstalk Grazing Supplementation

Do not force cattle to eat the cobs and stalks. Even with protein supplementation-cows will lose weight and body condition. Heifers in late gestation should not graze cornstalk residues, especially if there is no grain available, unless provided an energy supplement.

If supplemented with protein, mature cows can graze stalk fields after the grain has been consumed and the husk and leaf remain. It appears the TDN (*Table I*) is adequate, but protein on the average is slightly below requirements. If protein needs are not met, the energy in the leaf and husk is not used efficiently.

If we assume the average crude protein composition of a diet of leaf and husk is 5.5 percent crude protein, and the cow is in mid- to late gestation, she is protein-deficient. To stimulate intake, and for efficient utilization of the energy in the leaf and husk, protein must be supplemented. If the cows are 1,200 pound and in average body condition, they would be approximately .51 pounds deficient in protein. This protein deficiency could be made up by feeding 3.2 pounds of alfalfa (18 percent CP, 88 percent D.M.) per head per day or 1.7 pounds of a 32 percent range cube per head per day.

When supplementing protein to beef cows, it is essential all cows get their share. Feeding the protein source every other day or every third day means larger quantities are fed and timid and young cows are more likely to get their share compared to daily feedings.

Calves grazing cornstalks also need escape protein supplementation. An escape protein is a protein source that is not digested in the rumen but rather is digested and absorbed in the small intestine. Grain is a good source of escape protein, but as the grain is gleaned from the field the calf's escape protein decreases. Research indicates a protein supplement with at least .36 pounds of escape protein per head is needed. However, supplementing escape protein is expensive. Total protein supplementation may need to be as high as .9 pound per head per day and even then average daily gain for calves grazing cornstalks may not exceed 1 pound per day. Non-protein nitrogen will meet the rumen bacteria needs and minimize cost, but have safety and palatability problems. Alfalfa, corn gluten and protein cubes containing soybean meal or cottonseed meal may be the most economical feed sources.

### Milo Stubble Supplementation

On average, the energy and protein in the leaves of milo stubble appear 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 may be .45 pounds deficient in protein and need to be supplemented similar to that described above (*Table I*). Remember, because of the milo's hard outer coat, it is not utilized by the cow.

## Grazing Strategies for Cornstalk Fields with Excess Grain

Excess grain (more than 8-12 bushels per acre) left in the field can cause both acidosis and founder in cattle. Founder, a severe foot or hoof 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. While hand-picking corn would be the most effective solution, it may not be realistic for producers looking to get cows on traditional stalk fields for winter feed.

Strategies for using high-grain cornstalk fields would be: 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; 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, thus reducing the potential of founder.

The experience level of the cattle grazing a cornstalk field determines how efficiently they will glean a field for grain. Old cows with pervious experience in cornstalk fields can pick up amazingly high amounts of corn, as can experienced yearling cattle, so 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.

Another technique to reduce risk of acidosis or founder might be to feed some ear-corn 7-10 days before cattle are turned out to help them adapt to a high-grain field.

**Estimating the Ear Drop**

Estimating the amount of corn down in a field helps producers determine a grazing strategy. An 8-inch ear of corn contains about .50 pound of corn grain, therefore 112, 8-inch ears would equal to 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 8-12 bushels per acre will require a well-planned grazing strategy.

**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 pounds of grain, and about 400 milo heads would equal 1 bushel of milo (1 bushel = 56 pounds). As fields approach 10-15 bushels down in the field, producers need to implement well-planned grazing strategies to avoid founder.

## Effect of Grazing Crop Residue 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 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 the ridge-till system, grazing of cornstalks did not adversely affect the integrity of the ridges, but soil bulk density in the top (0-3 inches) depth was increased in the inter-row following grazing under muddy conditions. Other measurements showed 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.

These data indicate cattle should not be allowed to graze crop residues in March, due to the high possibility of mud. Otherwise, it appears little compaction occurs in fields due to grazing.

## 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, the cost of waiting to begin post-harvest field operations and scattering weed seeds. On the other hand, pasturing corn stalks can reduce volunteer corn problems next year and eliminate the need to shred stalks and some 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. Grazing your own cornstalks with your own livestock may provide a different perspective from renting due to the difficulty in controlling weed seeds brought in by a renter's cattle and hay.

Several of the advantages and disadvantages of pasturing crop residue are difficult to value, including the cost of delaying field operations; the loss from removing nutrients and organic matter; and the benefit from reducing volunteer corn and getting cattle out of a confined lot. It is also difficult to place a value on the risk in moving cattle and the additional risks of overseeing cattle further from home.

The feed value of crop residue can be estimated based on daily consumption and price of feed saved, which is usually the largest benefit of using crop residue. As long as the cattle have grain and leaves to select, corn and grain sorghum residue are comparable in nutritional value to good quality grass hay (8 percent protein and 52-58 percent TDN). Additional savings may be realized in reduced wear-and-tear of drylot facilities, reduced equipment operating costs and labor reduction for feeding and manure removal, although these savings may be more than offset by the additional costs of supplying water and fencing, moving cattle and inspecting the grazing cattle. Evaluating cornstalk fields with considerable amounts of fallen grain may require an estimation of the grain and the level of expected utilization. Renting fields based on the weight gain realized would reflect the feed value of the crop residue.

An example for estimating crop residue value is presented in *Table III*. The budget assumes 1 AUM per acre actual grazing (60 head at one animal unit per head for 80 days for a total of 4,800 animal days or 160 AUM's). 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. Manure credit is also ignored, as little detailed information is available on the net gain or loss in converting crop residue to manure. The primary savings in manure may likely be the reduced cost in removing the manure from the drylot facilities and not having to spread the manure.

The value of the crop residue can be estimated on an acre or head-per-day basis. Due to weather variability, the rental value of crop residue grazing on a per acre basis is uncertain. Renting crop residue on a per day basis can reduce renter's 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 drylot) 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 ($10.09, *Table III*) and the minimum rental value the crop must cover ($2.50, *Table III*) should be adjusted based on factors discussed earlier. The remaining range in rental values provides a basis for negotiating a rental rate.

| **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 @ $.65 per day for 80 days | $3,120 |
| | | |

| | | |
|---|---|---|
| Drylot savings[2] | | 837 |
| Value of additional weight gain (loss)[3] | | 0 |
| Less crop residue grazing costs[4] | | -2,343 |
| | Net livestock benefit | $1,614 |
| | per acre = $1,614 , 160 acres = | $10.09 |
| | per head day = $1,614 , (60 head x 120 days)= | $.224 |
| Net benefit to crop enterprise | | |
| Saving shredding stalks 160 acres @ $2.50/acre[5] | | $400 |
| Manure credit less nutrient and organic matter consumed[6] | | 0 |
| | Net crop benefit | $400 |
| | Per acre | $2.50 |

1. Example feed savings based on 80 days at 26 pounds grass hay per head per day at $50 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.
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 30 cents per mile equipment charge plus 12 hours labor. Water costs as described above plus hauling 1 mile at 25 cents per mile equipment charge and 2 hours of labor per day. A total of $154 per year for depreciation and interest on fencing materials, battery charges and labor for installation and tear down. Additional oversight costs of 10 pickup miles per day at 25 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.

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