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Costs associated with beef cow-calf production and particularly the high cost of meeting nutritional requirements of beef cows dictate efficient use of all available feeds. Crop residues can be an important and economical source of feed for beef cows in many South Dakota beef operations. Corn, milo, small grain and soybean residues are those most commonly available.

Crop residues are generally deficient in one or more of the essential nutrients and are not sufficient to maintain a beef cow year-round. In fact, they will normally be marginal in meeting maintenance requirements from weaning to near calving, a time when nutritional needs are at a minimum. For young stock and for lactating cows, crop residues should be supplemented with energy, protein, minerals and vitamin A. Therefore, the most practical use of crop residues appears to be for maintenance of dry, pregnant, mature cows.

Corn Residues

Definition of Terms

1. Corn refuse or corn residue: Material left after the shelled corn has been removed. This would be the stalk, leaves, cob and husk.

2. Corn stover: Material left after the ear (grain and cob) has been removed. This would be the stalk, leaves and husk.

3. Stalklage: Material harvested off the ground after grain harvesting machine has passed through the field. It is mostly stalks, leaves and husks with a small amount of grain and cobs; it is essentially the same as stover.

4. Husklage: Material discharged from rear of combine. This would be the husks, cobs and a small amount of grain.

Harvesting

There are four basic methods of harvesting corn residues; (1) grazing; (2) husklage dumps; (3) baling or stacking as dry stover or stalklage; (4) ensiled stover or stalklage.

Perhaps the most common method of utilizing corn residues has been grazing during the fall and early winter months. This method of utilization is acceptable

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in many areas and in many operations it is probably the only practical way of utilizing the residues. In Iowa it has been estimated that corn residue from a field yielding 100 bushels of grain per acre and a stocking rate of 2 acres/cow will provide grazing for 80-100 days, weather permitting. The major advantage of grazing is the low investment in labor and equipment.

There are some disadvantages to grazing compared to harvesting and feeding that should be recognized. Expected recovery of residue by grazing is only about 20% of the dry matter remaining in the field after harvest. As a component of corn residues, the remaining grain is highest in digestibility and protein content followed in descending order by the leaf, husk, stalk and cob. Grazing livestock will tend to select the more digestible plant parts and leave the less desirable parts. Toward the end of the grazing season, only the lower quality corn residue components remain. In years of heavy snow corn stalk field grazing can be quite limited with snow covering the husks and grain, the most nutritious plant parts. Apart from the selective grazing influence, nutritional quality of residue materials continues to decline as the winter season progresses. Grazing of stalk fields also limits any form of fall tillage.

Husklage Dumps

Husklage is composed of the husk, cob and any grain carried through the combine. It may also include a portion of the stalk and leaves. It is generally collected with a straw buncher similar to that used in collecting chaff and straw from small grain harvest.

Husklage dumps provide a convenient method for field storing reserve feed supplies. This allows field grazing during good weather and access to the husklage dumps during periods of snow cover. It should be remembered that if husklage is collected and removed from the field, quality of the remaining residue is reduced and cows have less of the more digestible forage to selectively graze.

Utilization of husklage dumps in Iowa studies was approximately 35-42% of the dry matter collected. Very little of the cob was consumed, while the husks were totally consumed. Generally, the cob accounts for 50% or more of the husklage collected. Chopping or grinding the husklage increases the utilization of the cob material and total utilization might well be 80-85% compared to the 35-42% utilization of unground husklage dumps.

As with any stored residue, access to the husklage dumps should be controlled to prevent excessive waste. Cattle should be forced to clean up as much of the husklage as possible before they are given access to more dumps.

Baling or Stacking

The use of stack building equipment and large package balers for harvesting crop residues has increased considerably in recent years.

When making large bales or stacks, moisture content should be between 25 and 30% to enhance storage and maximize consumption by beef cows. This will usually occur 3-4 days after grain harvest. However, length of the drying period will vary with weather conditions at harvest time. Quantity of material harvested will depend on grain yield, type of grain harvest (picker or combine) and the pattern of harvest.

If cattle are to be self-fed from stacks, carefully controlled access to the stacks will be required. Allowing free access to stacks results in a high percentage of wasted feed (up to 50%) as the cattle tend to trample and bed down on the material. Observations at Purdue University indicate an electric wire is not satisfactory for feeding residue stacks because it requires too much attention and reduces intake.

Utilization of corn residue stacks will normally be 65-85% of harvested material depending on harvesting and feeding management conditions.

Ensiled Corn Residue

Ensiled corn residue offers several advantages in harvesting, storing and feeding. Some benefits of this method are: (1) maximum recovery of residue materials; (2) less feed loss; (3) maximum retention of feed quality and palatability; and (4) allows efficient mechanized forage handling.

Specialized equipment designed for harvest of stalklage minimizes pick up of dirt and allows recovery of up to 90% of the crop residue when harvested early. Purchase, depreciation, maintenance and operating costs of equipment need to be considered in relation to value of crop residues harvested. Harvesting costs per ton of stalklage might be quite high because of the relatively low per-acre yield.

If corn residue silage is properly harvested immediately following grain harvest, fine-chopped and packed well (bunker or pit), dry matter intake and digestibility are higher than that of dry residue stacks. When properly chopped and packed in a bunker silo, spoilage is very little more than that of corn silage.

Experience in several corn-belt states provide the following suggestions for harvesting and storing corn residue silage:

1. Harvest as soon as possible (within 2-3 days) after grain harvest.

2. Harvest early in the season to maximize nutrient recovery.

3. Maintain moisture content of silage above 50%. The following table shows the expected moisture range of corn residue silage at various harvest times.

Time of harvest	Moisture range, %
Following high moisture ear corn silage	65 - 78
Following high moisture shelled corn harvest	60 - 73
Following combine, picker sheller with 18-20% moisture grain	50 - 65

If corn residue silage is harvested with less than 50% moisture, water should be added to insure compaction and ensiling.

4. Chop fine. Consider equipping forage harvester with recutter screen or putting a recutter attachment on blower.

5. Bunker or trench silos are adequate for storage of corn residue silage. However, silage should be well packed and silo covered to reduce storage losses.

Grain Sorghum (Milo) Residues

Management considerations for grain sorghum residue utilization are somewhat different from those of corn residue. Livestock can readily graze milo stubble because it tends to remain in an upright position after harvest. Leaves are readily available although beef cows will often graze the upper stalk leaving the lower leaves until later in the grazing season.

Grain and chaff that fall behind the combine are generally unavailable to the grazing animal unless the straw spreader is removed. Beef cows have been observed to graze the discharged material when it is allowed to fall directly to the ground. However, both utilization and nutrient quality can be substantially increased by collecting the material directly from the combine.

If grain harvest occurs before the first killing frost, sorghum plants will often remain green and actually continue some growth if moisture permits. New shoots containing prussic acid at levels potentially harmful to grazing animals may occur until the first killing frost. The new shoots can be safely grazed 4-6 days after a killing frost.

In general, protein content is higher in grain sorghum residues, but dry matter yields and digestibility values are lower than in corn. Experience has shown that if given a choice, beef cows prefer corn over grain sorghum residues. Residues of grain sorghum make up a lower percentage of the total plant dry matter than corn. Forty to fifty percent of the total plant dry matter of corn is residue compared to 40% or less for grain sorghum.

Soybean Residues

The potential for soybean residues would appear to be less than corn or grain sorghum residues because of restricted acreage and the relatively low yield of residue materials.

At maturity the beans constitute 46-52% of the total plant dry matter. The stems and pods which are the refuse normally available for feeding after harvest are in the approximate ration of 2:1. Thus pods and bean tailings together would probably yield no more than 1/4 ton per acre.

Soybean pods are the most nutritious plant part except for the bean. Because of the high nutritional value of the pods (58-63% digestible) and high protein content of the bean tailings, this discharged material from the combine might be a valuable feed source. If the combine can be economically equipped to collect the

pods and tailings, collection of this material may be a good investment, particularly at present protein prices. Beef cattle response to the pods is not well known. Some processing such as grinding may be necessary because of the stiff characteristics of the pod.

Small Grain Residues

Straw and chaff from small grain crops can be a significant part of the wintering rations for mature beef cows. They are not considered appropriate ration components for replacement heifers or growing steer calves since they are too low in energy and other nutrients.

From an operational standpoint, straw is that material that comes over the combine straw walker and would include primarily small grain stems and weeds from the field. Chaff is that material coming over the combine shoe which includes the glumes, many of the leaves, broken bits of stem, cracked and light grain and weed seeds.

Straw is high in fiber and lignin. Both are associated with low digestibility. It is also low in protein, phosphorus and vitamin A. Oats and wheat straw are higher in energy yield (TDN) than barley straw. Oats straw contains a somewhat higher level of digestible protein than either wheat or barley straw (see Table 3). The chief value of straw is in the energy provided for maintenance and the heat increment produced as it is digested. This heat helps keep the animal's body warm but does not provide energy for gain.

The value of chaff is very difficult to determine. It depends largely on the amount of grain, weed seeds and other material such as pigeon grass leaves that go through the combine. Chaff is generally higher in energy (TDN) than straw, and normally contains about twice as much protein.

Wintering Cows on Straw (North Dakota)

Studies have been conducted for several years at the Dickinson, North Dakota Experiment Station evaluating the use of wheat straw in the wintering ration of beef cows.

Each year dry pregnant cows were randomly allotted to receive either a hay ration or a hay and straw ration (Table 1). The hay fed cows were allowed 20 lb. of crested wheatgrass - bromegrass hay daily and the straw-hay group was fed seven lb. of the same type hay, one lb. of soybean oil meal and wheat straw free choice. Each group was fed a mineral mixture of one part dicalcium phosphate and two parts plain salt, free-choice. Because of waste, the straw was chopped and self-fed after the first year.

Table 1. Wintering Cows on Hay or Straw and Hay -- Rations Fed (North Dakota)

Feeds	Daily Ration, lb.	
	Hay Group	Straw & Hay Group
Crested - brome hay	20	7
S.B.O.M.	0	1
Wheat straw	0	Free Choice*

* Average daily consumption varied by years from 8.3 lb. to 13.0 lb., with an overall average of 10.5 lb.

Table 2. Four Year Summary of Beef Cow Performance When Wintered on Hay or Straw and Hay (North Dakota)

	Hay	Straw & Hay
No. cows	186	186
December wt., lb.	1065	1060
May wt., lb.	998	968
Winter wt. change, lb.	- 67	- 92
Next October wt., lb.	1118	1101
Summer gain, lb.	120	132
Av. calf birth wt., lb.	72.3	71.3
Av. calf weaning wt., lb.	378.1	376.7
Conception rate (3 years):		
1st cycle, %	56.6	54.8
2nd cycle, %	24.5	19.9
3rd cycle, or later %	7.7	7.5

Wintering costs of the two feeding programs were similar for the four years. The value placed on straw obviously influences the comparative costs of the two wintering programs. If straw is utilized in a winter ration it actually amounts to a cash income from the straw.

Average calf birth weights and weaning weights did not appear to be affected by the rations since they were essentially the same in both groups (Table 2). The straw-hay ration apparently had no adverse affect on subsequent reproductive performance. Approximately the same percentage of cows conceived during the first cycle in each of the groups. Conception rate during the second cycle was slightly lower for the straw-hay group.

Results of this study indicate that up to two-thirds of the hay in the wintering ration of mature beef cows can be replaced by straw, if properly supplemented with protein, minerals and vitamin A, without adversely affecting production of the cow or growth rate of the calf. Some weight loss is not considered detrimental if cows are in good condition going in to the wintering period.

Feeding Crop Residues

Nutrient Composition

Most crop residues will be deficient in one or more of the basic nutrients, even for wintering mature pregnant beef cows. They will be greatly deficient in meeting requirements of growing calves, young cows and lactating beef cows, and probably should not make up a major part of the ration for these classes. Table 3 shows the approximate nutrient requirements (percent composition of ration dry matter) for mature, dry pregnant beef cows and the approximate nutrient content of some common crop residue materials. Vitamin E is low in most crop residues and all crop residues should be considered devoid of vitamin A.

Table 3. Approximate Nutrient Requirements (Ration Dry Matter Composition) for Dry, Pregnant Beef Cows & Nutrient Content of Crop Residues.

	TDN	Crude Protein	Digestible Protein	Calcium	Phosphorus
	%	%	%	%	%
Beef cow requirements	50	5.9	2.8	.16	.16
Nutrient content, dry matter basis:					
Dry corn stalklage	45	4.2	1.6	.40	.11
Corn stalklage silage	48	5.0	1.9	.42	.12
Soybean stover	40	4.4	1.7	.90	.10
Milo stover	42	4.6	1.6	.48	.12
Oat straw	46	4.4	1.4	.33	.10
Wheat straw	44	3.6	0.4	.17	.08
Barley straw	40	4.1	0.5	.34	.09

Supplementing Corn and Sorghum Stalk Grazing

Since beef cows will selectively graze the more palatable and nutritious portions of the plant first, a mineral and vitamin supplement will probably be adequate for the first 30 days. After 30 days of field grazing, supplemental protein and, depending on weather, condition of cows and amount of stalks left in the field, some supplemental energy should be considered.

The following are suggested as possible supplements for field stalk grazing by dry, pregnant mature beef cows:

1. 1 - 1/2 lb. of 40% protein supplement or 1 1/2 - 2 lb. of 32% supplement.

2. 5 - 8 lb. prairie hay, depending on condition of cows and amount of stalks left in the field.

3. 4 - 5 lb. oats.

4. 5 - 6 lb. alfalfa hay.

Natural protein supplements may be fed alternate days or every third day, provided adequate daily allowances are met. It should be remembered that overfeeding of supplemental energy will discourage cows from grazing. Salt should be provided at all times and a mineral mixture containing 8 - 10% phosphorus should be provided free-choice. Trace mineral salt in the mixture would be desirable. Vitamin A requirements can be met with a vitamin injection or feeding a supplement fortified with vitamin A to provide 20,000 I.U. per head daily. Vitamin A supplements will generally also contain vitamin E. Supplementation will need to be increased for thin cows and during adverse winter weather.

Supplementing Harvested Crop Residues

Harvested crop residues may be lower in nutrient value than early grazing but will be substantially higher in value than late field grazing. Most harvested crop residues will be marginal for maintenances of mature cows, especially for protein. The following are suggested as possible supplements for harvested crop residues (corn or sorghum residue and small grain straw):

Corn or Sorghum Residue

1. 1 lb. of 32% protein supplement and 4-5 lb. prairie hay

2. 4 - 5 lb. oats

3. 5 - 6 lb. alfalfa hay

Small Grain Straw

1. 1 lb. of 40% protein supplement and 6 - 8 lb. prairie hay

2. 5 - 6 lb. oats

3. 7 - 8 lb. alfalfa hay

Natural protein supplements may be fed alternate days or every third day, provided adequate daily allowances are met. Mineral and vitamin supplementation is vital. See recommendations for supplementing field stalk grazing above.

Summary of Nutritional Characteristics of Crop Residues

1. Energy is near adequate for maintenance of mature beef cows but substantially deficient for growing-finishing cattle and lactating cows.

2. Crude protein may be slightly deficient for mature cows and is extremely deficient for growing-finishing cattle.

3. Calcium appears to be adequate for most classes of cattle but may be added as a safety factor, especially for young stock because of variability of crop residues. Note: most commercial phosphorus supplements will also contain calcium.

4. Phosphorus is deficient for all classes of cattle.

5. Vitamins A and E should either be added to the crop residue diet or provided through intramuscular injection.