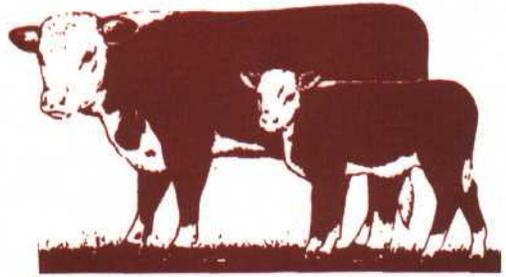




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Crop Residues for Beef Cattle

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As production costs increase, cattlemen are becoming more interested in crop residues as an economical source of feed, especially for brood cows. Corn, milo and soybean residues are most commonly used.

The energy yield per acre of corn can be maximized by harvesting the entire crop as silage in the 30-40 percent matter range. However, because the time span for making good silage is limited, varying amounts of the crop must be harvested as grain. If 1 T. of residue were gleaned from each of the 2.5 million acres of corn grain harvested annually in Michigan, the yield of dry matter would winter nearly one million beef cows. That is five times as many as the state normally maintains.

Unsupplemented or untreated corn crop residue alone will not maintain a brood cow year-round. In fact, it will barely maintain her during early pregnancy when her nutrient requirements are at a minimum, although properly made high-moisture corn stover silage comes very close to getting the job done. For young stock and lactating cows, crop residues must be supplemented with energy, protein and minerals. This bulletin is primarily concerned with the requirements of the dry, mature pregnant cow.

Table 1 shows how dry matter is distributed in corn, soybean and milo residues. Even though the stalk contains the highest level of moisture, it nevertheless makes up 1/2 of the dry weight of corn residue, 2/3 of milo residue, and 7/8 of soybean residue.

The relative nutritive values and yields of the various residues and their components are given in Table 2. The leaves and husks of the corn plant are less fibrous and higher in energy than the stalks and cobs. The only residue components that contain a significant level of crude protein are corn and milo leaves and soybean pods. Corn and milo stover silage made immediately after grain harvest also contain a reasonable level of

Table 1. Distribution of Dry Matter in Crop Residues.

Item	% DM	% Harvested Residue DM
Corn residue:		
Grain	72	---
Stalk	27	49.3
Leaf	78	20.6
Cob	50	19.1
Husk	52	11.0
Soybean residue:		
Bean	90	4.5
Stalk	82	87.0
Pod	88	8.5
Milo residue:		
Grain	80	---
Stalk	19	66.7
Leaf	78	33.3
Head (residue)	76	---

Table 3. Composition of Crop Residues vs. 1100-lb. Dry Cow's Requirements (Mid Pregnancy).

Item	Corn Stover	Soy Stover	Milo Stover	Corn Stover Silage	1100-lb. Dry Cow Requir.
Estimated TDN, %	45	40	42	50	52
Crude Protein, %	4.0	4.3	4.7	5.0	5.9
Calcium, %	.30	.90	.49	.35	.18
Phosphorus, %	.12	.10	.13	.14	.18
Vitamin A, IU/lb.	0	0	0	0	1270

crude protein (5-7%). Corn and milo residue out-yield soybean residue by two or three-fold.

In Table 3, the nutrient requirements of the dry, mature 1,100-lb. pregnant cow are compared with the average composition of dry stacked corn, soy and milo stalkage and high quality corn stover silage. The latter

Table 2. Composition and Yield of Harvested Crop Residues.

Item	Percent DM	Percent In vitro Dig. DM	Percent Lignin	Percent CP	Percent Ca	Percent P	DM Recovery Tons
Corn plant:							
Grain	73	91	---	10.0	.02	.35	---
Husk	55	68	6.7	2.8	.19	.08	---
Cob	58	60	7.4	2.8	.04	.06	---
Leaf	76	58	5.1	7.0	.80	.18	---
Stalk	31	51	10.5	3.7	.28	.11	---
Stalklage (Hesston)	66	56	8.8	4.2	.30	.12	1.0-2.0
Stalklage (Flail)	55	51	---	3.8	.27	.16	0.5-1.5
Husklage (Foster)	78	65	---	3.7	.16	.08	---
Stover silage	40	67	---	5.0	.35	.14	1.0-2.0
Soybean residue:							
Stalk	88	35	18.4	4.0	.73	.09	---
Pod	88	51	8.7	6.1	1.02	.17	---
Stalklage (Hesston)	87	40	15.6	4.3	.10	.10	0.5-1.0
Milo Plant:							
Grain	74	90	---	10.5	.02	.38	---
Leaf	66	56	7.3	10.0	.64	.19	---
Stalk	25	57	10.1	3.6	.29	.08	---
Stover silage	32	53	---	6.8	.50	.12	1.0-2.0
Stalklage (Hesston)	40	54	9.3	4.7	.49	.13	1.0-2.0

meets the cow's energy needs but falls short in protein, phosphorus and vitamin A, as do all other dry residues, which lack energy as well. Calcium does not appear to be a problem, but some analyses have shown certain residue samples to be marginal in this element. Although not shown here, vitamin E is low in most crop residues.

There are three basic methods of harvesting crop residues: (1) Grazing; (2) stacking as dry residue; and (3) ensiling as high-moisture residue. These systems are discussed below, using the corn plant as an example. In discussing corn residue, several terms are used. Generally speaking, *stalklage* is material harvested from the ground after a corn harvesting machine has gone through the field. It is mostly stalks, leaves and husks with a small amount of grain and cob. Depending on the harvest season, the amount of grain and cob can reach significant levels. *Stover silage* is stalklage that is ensiled instead of being harvested as dry residue. *Husklage* is material discharged from the rear of a corn combine; i.e., husks, cobs and a small amount of grain.

GRAZING CORN STALKS

1. One acre can carry one cow for 40-50 days (assuming 100 bu./A. grain yield).
2. Two acres can carry one cow for 80-100 days (assuming 100 bu./A. grain yield).
3. Cows will selectively graze the more palatable portions of the plant first: (1) Grain; (2) leaves and husks; and (3) cobs and stalks.
4. Expected recovery of residue by grazing is about 15-30%. If the potential yield of residue DM is 1.5-3.0 T./A., the recovery would be 0.2-0.9 T./A.

5. Extremely thin cows should not graze corn stalks for more than 30 days.
6. For first 30 days, a mineral supplement is adequate. For example, 40% T.M. salt, 40% dicalcium phosphate, and 20% vitamin A premix (5,000 I.U./gm).
7. After 30 days, supplemental protein and energy should be considered. Here are possibilities:
 - a. Lick tank placed well away from water source to avoid over-consumption (1-2 lb. of 40% CP supplement is adequate).
 - b. 5-10 lb. of hay, depending on condition of cows and amount of stalks in field.
 - c. 3-6 lb. of corn, depending on condition of cows and amount of stalks left in field.
 - d. Combination of the above.
8. Over-feeding of supplemental energy will discourage cows from grazing.

DRY CORN RESIDUE

1. There are three main systems of harvesting dry corn residue:
 - a. The "Hesston Stakhand" which is an operation separate from the grain harvest. A Hesston "30" stack contains 3,000 to 4,000 lb. stalklage DM. Recovery with this machine average about 65%. If potential yield is 1.5-3.0 T./A., recovery would be 1.0-2.0 T./A.
 - b. The "Foster Harvest Master" husklage dump wagon, which trails behind the grain combine. Each dump contains about 1,000 lb. of husklage DM. Recovery with this machine averages about 65%. If potential yield is 1.5-3.0 T./A., recovery

would be 1.0-2.0 T./A.

- c. The large round baler. This involves windrowing the stalks and baling them with a large "Vermeer"-type machine. Recovery with this method is about 50%.
2. To stack or bale corn residue, moisture content must be below 40% or spoilage may occur. Below 30% is preferred.
3. There are several ways of feeding corn residue stacks:
 - a. Self-fed with feeding panels in drylot.
 - b. Self-fed with feeding panels in stalk field. Cows may graze corn stalks and feed on stacks if snow covers the ground.
 - c. Re-cut and mixed with other ingredients such as corn and supplement and fed as a complete ration.
4. Residue dry matter intake ranges from 12-20 lb. per cow per day, with an average of about 16 lb.
5. Dry residue stacks alone will not normally maintain a cow's weight. There are several possibilities for supplementing them:
 - a. Supplement with hay daily or alternate with hay stacks every other day.
 - b. Put out a lick tank.
 - c. Select a supplement program from Table 4.

CORN STOVER SILAGE

1. Harvesting and storage tips:
 - a. Harvest as soon as possible after grain harvest (within 2-3 days).
 - b. Harvest early in season to maximize nutrient recovery.
 - c. Maintain moisture above 50%; 60-70% is better. Add water if necessary.
 - d. Chop fine. Equip forage harvester with recutter screen or put a recutter attachment on blower.
 - e. Pack well to reduce storage losses.
2. Recovery of dry matter per acre varies from 0.5-2.0 T., depending on stover yield and harvesting efficiency.
3. There are three primary ways in which residue silage is harvested:
 - a. Forage harvester with a flail pickup, which recovers about 30-50% of the stover.
 - b. The "Foster" attachment for collecting husklage from the rear of a corn combine. This system leaves the stalks in the field.
 - c. The "John Deere Stalker," a row-crop attachment for forage harvesters, designed to follow after the grain harvest and more efficiently gather the residue that remains. Recovery is about 65%.
4. If stover silage is properly harvested immediately following the grain harvest, dry matter intake and digestibility is slightly higher than that of dry stover stacks:

Table 4. Supplementing Dry Corn Residue (1100-lb. Dry Mature Cow in Mid Pregnancy).

Item	TDN lb.	CP lb.	Ca gm.	P gm.	Vit. A IU
Required by cow daily	8.6	1.0	13	13	20,000
Supplied by 16# residue DM ¹	7.2	.64	22	9	0
Daily deficit	-1.4	-.36	--	-4	-20,000
Possible supplements: ²					
4# mixed hay	2.0	.44	15	4	20,000
4# corn	3.2	.38	0	6	2,800
2# hay + 1.5# corn	2.2	.36	8	4	11,000

¹ Assuming 45% TDN, 4% CP, .30% Ca, and .12% P in residue DM

² P and vitamin A should be furnished when supplements are inadequate.

Table 5. Supplementing Corn Stover Silage (1100-lb. Dry Mature Cow in Mid Pregnancy).

Item	TDN lb.	CP lb.	Ca gm.	P gm.	Vit. A IU
Required by cow daily	8.6	1.0	13	13	20,000
Supplied by 18# silage DM ¹	9.0	.90	29	11	0
Daily deficit	---	-.10	---	-2	-20,000
Possible supplements: ²					
2# mixed hay	1.0	.22	7	2	10,000
1.5# corn	1.2	.13	0	2	1,000
1# hay + 1# corn	1.3	.20	4	3	5,700

¹ Assuming 50% TDN, 5.0% CP, 0.35% Ca, and 0.14% P in dry matter.

² P and vitamin A should be furnished when supplements are inadequate.

- a. Daily DM intake - 18 lb. per cow vs. 16 lb. for dry stacked residue.
- b. Estimated TDN - 50% vs. 45% for dry stacked residue.
5. Corn stover silage is deficient in protein, phosphorus and vitamin A. for the mature cow in mid pregnancy. Refer to Table 5 for supplementation alternatives.

LEASING OR PURCHASING STALKS

In many areas, cow herd owners may lease picked corn fields from neighbors or purchase the refuse and harvest it in large packages. Based on different hay prices, researchers at Purdue University developed Table 6 to serve as a guide to the maximum value of corn refuse for either grazing or machine harvesting

Table 6. Maximum Price to Pay for Corn Stalks.

Value of Hay \$per ton	Grazing \$/cow/mo. ¹	Harvested Stacks, \$/ton DM ²
\$30	\$6.80	\$14.00
\$40	\$9.50	\$18.70
\$50	\$12.20	\$23.35
\$60	\$14.90	\$28.00

¹ Grazing values based on alternative ration of 18 lb. dry hay per cow per day. Assuming a supplement cost of 10¢ per cow per day after 30 days of grazing.

² Values include harvesting costs. Subtract \$10 to \$15 per ton if you are going to purchase someone else's stalks and harvest them yourself.

purposes. In most cases, these values are higher than the real asking price because the owner of the corn stalks seldom has an alternative use except for fertilizer, which is about \$5-\$8 per ton, or \$5-\$16 per acre depending on the estimated yield of dry matter.

FEEDING CORN RESIDUE TO FEEDLOT CATTLE

1. Growing-finishing cattle need a ration that will average at least 70% TDN and 10-14% crude protein over the course of the feeding period. Corn residue obviously falls far short of this.
2. To bring the energy level of the ration DM up to 70%, corn residue (45% TDN) and shelled corn (90% TDN) must be fed in approximately equal proportions on a dry weight basis. This should give performance that approaches an all corn silage diet.
3. In a two-phase feeding program, the proportion of corn residue and corn grain could be about 2/3 residue DM to 1/3 shelled corn DM during the backgrounding phase. During the finishing phase, they could be about 1/3 residue DM and 2/3 shelled corn DM.
4. Because of the low protein content of these residue-grain mixtures (6-8%), adequate supplement must be added to the ration to bring it up to 10-14% crude protein on a dry matter basis.
5. Calcium, phosphorus and vitamin A also must be added in supplemental form to bring the ration up to about 0.4%, 0.3% and 1,000 IU/lb., respectively.

These residue-corn mixtures will average about 0.2% Ca, 0.2% P and 500 IU vit. A per lb. of DM.

SUMMARY OF NUTRITIONAL CHARACTERISTICS OF CORN RESIDUES

1. Energy is marginally deficient for mature brood cows (45 vs. 50% TDN) and extremely deficient for growing-finishing cattle (45 vs. 70% TDN).
2. Crude protein is somewhat deficient for dry mature brood cows (4% vs. 6%) and extremely deficient for growing-finishing cattle (4% vs. 10-14% CP).
3. Calcium appears to be nearly adequate for most classes of cattle but, because of the variability of corn residue, should be added as a safety factor, especially for young stock.
4. Phosphorus is deficient for all classes of cattle (.12% vs. .16-.30%).
5. Vitamins A and E should either be added to the corn residue diet or injected intramuscularly.

OTHER CROP RESIDUES

A few other crop residues are listed in Table 7. Very seldom can these feedstuffs be the sole ingredient in the diet for extremely long periods of time or poor performance may result.

Treating fibrous residues such as barley, oat and wheat straw with hydroxides and/or ammonia shows promise of improving their digestibility. Future research may produce practical methods of making such treatments economically feasible.

Table 7. Composition of other Crop Residues vs. Cattle Requirements.

Item	Percent of Dry Matter				Precautions
	% TDN	% CP	% CA	% P	
Requirements:					
1100-lb. dry cow	52	5.9	.18	.18	---
800-lb. steer	78	11	.34	.26	---
Apple pomace (25% rice hulls)	54	4.5	.13	.11	Consumption may be a problem
Barley straw	41	4.1	.30	.05	---
Beet Molasses (Mich.)	78	9-10	.12	.03	---
Beet pulp (Mich.)	68-72	8-9	.60	.08	---
Beet top silage	54	12.7	1.0	.22	Tends to be laxative. Must be mixed with other roughages
Brewers grains	68-83	30	.30	.54	---
Corn cobs	47	2.8	.12	.04	---
Corn screenings	70-90	8-10	.03	.25	May be moldy in wet years
Cull navy beans	83	25	.17	.63	Not over 20-25% of ration or scouring may occur
Cull potatoes	79-89	8-10	.04	.22	---
French fries	90	5.5	.03	.14	---
Navy bean residue	50	7.7	.85	.11	---
Oat silage	59	9.7	.37	.30	---
Oat straw	47	4.4	.30	.10	---
Wheat straw	43	3.5	.17	.08	---
Wood residues	0-40	0-2	High	0	---