Ammoniation of Low Quality Roughages

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When good or medium quality hay is not available, livestock producers may consider feeding ammoniated low quality hays or crop residues. Ammoniation can double or triple crude protein levels in crop residues such as straw and corn stalks and increase digestibility 10 to 30%, making them equivalent to prairie hay in feed value. Ammoniation can also boost consumption of those feeds by 15 to 20%. Phosphorus, trace minerals and vitamin A should be added to the diet whenever ammoniated residues are fed. Residues treated with anhydrous ammonia may not work well if cows are in thin condition, but as a general rule, cows receiving ammoniated residues will maintain weight and condition during gestation until 50 days prior to calving (Table 1). Additional supplementation will be required immediately prior to calving and during lactation.

Table 1. Effect of ammonia treatment of wheat straw on performance of gestating beef cows.

Treatment	*Daily Straw Intake (lb)*	*Daily weight change (lb)*
Straw + 7 lb alfalfa	14.8	-0.27
Ammoniated straw + 7 lb alfalfa	19.7	0.40
Ammoniated straw	26.1	0.10

Ward et al., 1982

Ammoniation works best on low quality forages including wheat, barley, and oat straws, corn stover, and very mature, low quality grass hay. Forages with less than 6% crude protein and 48% TDN (dry matter basis) are candidates for ammoniation. Treatment of medium- to high-quality forages with anhydrous ammonia results in only small changes in digestibility and intake, and may cause toxicity problems when fed. Ammoniation of small grain hay may cause cattle to become nervous, irritable, and to have convulsions.

The moisture content of the forage to be ammoniated is also important. Ammonia combines with the moisture in the forage before causing the increase in digestibility. Best results are achieved when the forage has greater than 10% moisture, with 15 to 20% ideal. Molds will not grow on ammoniated forages; ammonia is an excellent fungicide.

Ammoniation is relatively simple and easy to accomplish. Forage stacks must be covered completely and sealed with plastic to make an airtight environment. The following are simple steps used routinely to ensure successful treatment.

1. Determine the approximate weight of residue or forage to be treated in each stack, and the availability of plastic. Most farm supply stores and lumberyards sell various sizes of plastic, with the largest being 40 × 100 ft. If possible, locate stacks in an area with some protection from strong winds, good drainage, and near where it will be fed.
2. Disk the area to loosen the top few inches of soil for anchoring the plastic cover. If 40 × 100 ft-plastic is used, blade an area about 15 × 80 ft to provide a surface for the bales and loose soil to later cover and seal the plastic.
3. Stack residue to be treated on the smooth area. If big round bales are used, stack them in a 3- or 6-bale pyramid. Size of the bales and plastic dictates the stacking method. Eleven to 13 bales in length will fit under 40 × 100 ft plastic. Leave about 2 inches between bales to allow for

maximum exposure to ammonia.

4. Cover stacked residue with new 6 or 8 millimeter black plastic and seal the edge with excess loose soil. Leave a small space to insert a pipe for adding anhydrous at the midpoint of the stack.
5. Insert a pipe 6 to 10 ft in length on the ground and seal plastic with loose soil around the pipe. Connect the pipe to the anhydrous tank hose with an adapter; usually obtained from the anhydrous supplier. A shut-off valve on the pipe eliminates backflow of anhydrous when disconnecting after application is completed.
6. Add 60 lb of anhydrous per ton of dry forage (3%). Either purchase the amount of anhydrous needed or calculate the pounds of anhydrous per percentage unit on the tank gauge based on net weight of anhydrous in the tank and percentage of fullness on the tank gauge.
7. Turn on anhydrous slowly, until the plastic balloons slightly, then shut anhydrous off. Check around the stack for tears in the plastic or leaks around the edge. Seal tears with duct tape. Slowly add the remainder of the anhydrous; do not balloon the plastic. Total time for addition of the anhydrous will be 8 to 10 minutes per ton of residue; a 30 ton stack requires about 5 hours.
8. After treatment is complete, turn off the valve, remove the pipe, and seal the area of the sealed pipe.
9. Temperature affects the time needed for the best results (Table 2). The cooler the temperature, the longer the residue needs to remain sealed.
10. Open one end of the stack 3 to 5 days prior to feeding to let the excess ammonia gas exhaust.

Table 2. Length of time forage needs to be sealed

Temperature	*Minimum time to be sealed*
above 86°F	1 week
59 to 86°F	1 to 4 weeks
below 59°F	4 to 8 weeks

Safety Precautions

Anhydrous ammonia is very dangerous. It will burn skin, eyes or throat, can explode and burn, and is maintained under pressure. Suggested safety precautions include:

- Check valves, hoses, tanks, and plastic cover over stack for leaks.
- Wear goggles, rubber gloves, respirator, and protective clothing.
- Work upwind when releasing anhydrous ammonia.
- Have fresh water available to wash off any anhydrous ammonia on skin.
- **Do not** smoke near anhydrous ammonia.
- Keep children away from treatment area.
- Remember, anhydrous ammonia is corrosive to most metals – do not treat near barns or equipment.

Cost of Ammoniation

Cost of anhydrous ammonia and plastic; quality, availability, and cost of low quality forage; and labor need to be considered when evaluating ammoniation of low-quality forages. Estimated cost to treat one ton of forage are $24 to $27 for anhydrous ammonia (based on $800 to $900/ton of ammonia) and $6 to $10 for plastic ($200 for 6 mil., 40 × 100 ft), for a total of $30 to $37/ton. If wheat straw costs $100/ton, total cost of ammoniated wheat straw would be $130 to $134/ton.

Ammoniation of forages should be considered when prices of medium or high quality roughages are

high. Assume medium quality (51% TDN) grass hay is $160/ton and untreated wheat straw is 40% TDN. Ammoniation increases digestibility or TDN 15%; therefore, treated wheat straw would be 46% TDN. Treated wheat straw would be 90.2% the value of the hay (46% TDN ÷ 51% TDN) and break even for the treated straw would be $144 ($160/ton × 90.2%). In this scenario, if a producer could buy and ammoniate wheat straw for less than $144/ton, this management practice should be considered to supply TDN to the cow herd.