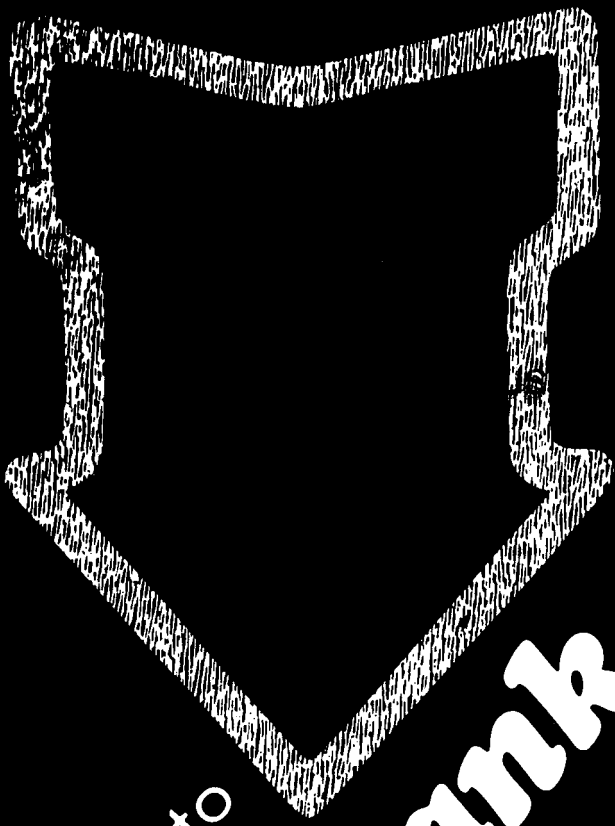

get to know your septic tank

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WHAT DOES AN ONSITE SEWAGE TREATMENT SYSTEM DO?

An "onsite" sewage treatment system completely treats sewage on the property where the sewage has originated.

This system has two parts: sewage tank and soil filter. The sewage tank separates out the large solids, and the soil filter removes the fine solids and destroys accompanying bacteria. The only maintenance required by a properly operating system is the occasional removal of accumulated solids from the sewage tank.

A sewage tank may be a septic tank or an aerobic tank (with an air agitator). In both, the large solids are separated and partially decomposed by bacteria. The liquid discharged from these sewage tanks is called effluent. This effluent contains disease-causing bacteria and nutrients. Minnesota law prohibits discharging this effluent onto the ground surface or into surface waters, except in rare instances when a permit must be granted by the Minnesota Pollution Control Agency (MPCA).

The Septic Tank

The most common type of sewage tank in Minnesota is the septic tank. Raw sewage flows into the septic tank where the solids separate from the liquid. Solids such as soap scum and fat float to the top and form a scum layer. Heavier solids settle to the bottom where they are partially decomposed by bacteria. The non-decomposed solids remain as the bottom sludge layer. The solids which are trapped in the septic tank must be removed by pumping before they build up to a level where they will wash out into the soil treatment system and plug the soil pores. The septic tank should be watertight, corrosion proof and constructed according to the dimensions in the figure. A shallow tank with adequate access is easy to maintain.

Except in the rare instances when a permit is granted by the MPCA for surface discharge, sewage tank effluent must be discharged into a soil filter—called the soil treatment system. Most soils are excellent filters, but some soils cannot perform this task.

TYPES OF SOIL TREATMENT SYSTEMS

Three types of soil treatment systems can be used:

1. Drainfield trenches—The most common soil treatment system uses drainfield trenches. This system does the best job of treating sewage. Drainfield trenches use evaporation and plant life to help treat the sewage in summer months. This system does not require extensive disturbance of terrain (a lawn and probably most of the trees can remain for the owner's enjoyment). Layout is flexible.

2. Seepage bed—This system does not require as large a lawn area as do drainfield trenches, but it has a smaller sidewall absorption area. It cannot be located on slopes greater than 6 percent, and it is susceptible to overloading from surface water. It is less efficient than a drainfield trench system. Also, contractors often smear or seal the bed bottom during construction, destroying the bed's ability to absorb the effluent.
3. Seepage pit (dry well)—This is the least desirable soil treatment system. The effluent is placed too deep for proper treatment, and there is no evaporation or use by plants. In addition, the system often contributes to water well contamination. Seepage pits are not allowed where the soil is suitable for drainfield trenches or a seepage bed. Deep soil borings are necessary to determine if the seepage pit will pollute ground water.

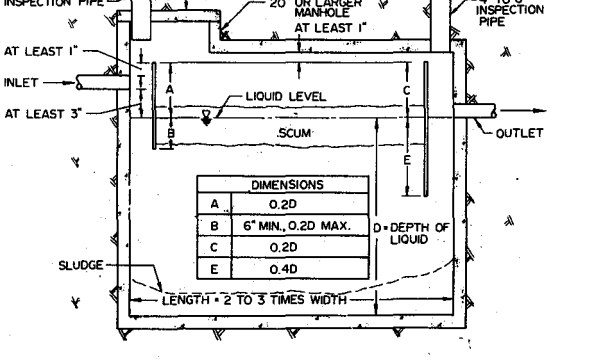
DRAINFIELD TRENCHES WITH DROP BOXES

A system of drainfield trenches connected with drop boxes is the most effective soil treatment system for sewage tank effluent. The drop boxes distribute the effluent to drainfield trenches in sequence, using only as much of the sewage treatment system as needed at the time.

Sewage tank effluent flows into the first drop box, which supplies effluent to the trench system. One outlet of this drop box is connected to the distribution pipe of the first trench. Another outlet carries the effluent to the drop box for the next trench when the first trench is being used at maximum capacity. The bottom of the outlet pipe leading to the drop box of the second trench should be at the same level as the top of the rock in the first trench.

A drop box must be installed at the head end of each trench. Drop boxes are usually concrete, 12 to 18 inches in diameter (or square) and about 18 inches deep.

The bottoms of the trenches must be level throughout their lengths, so they usually should follow ground contours. Trenches should not be dug close enough to trees to

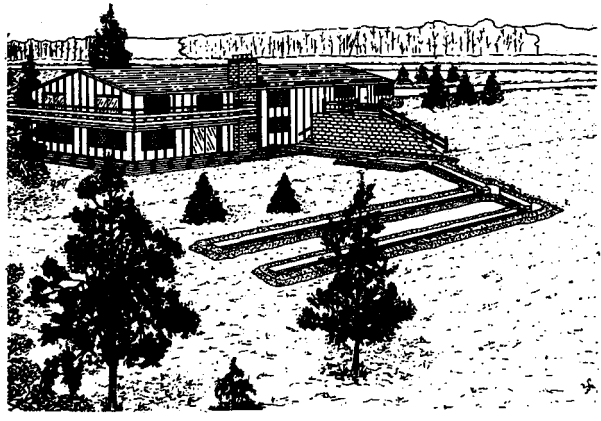


cause serious root damage. However, trees usually need not be removed from the drainfield. Tree roots will not plug the drainfield trenches, and trees will use the effluent.

Shallow trenches do a much better job of treating sewage than do deep ones. Six inches of soil backfill over the trench rock is enough to prevent freezing, even during Minnesota winters. However, you must have good grass cover and must allow snow to accumulate naturally. Snow cover compacted by pedestrians and snowmobiles may allow frost to penetrate to the drainfield trenches.

CARE AND FEEDING OF YOUR SEPTIC SYSTEM

- A "starter" is not needed for bacterial action to begin in a septic tank. Many bacteria are present in the materials deposited into the tank and will thrive under the growth conditions present.
- Additives should not be used, since they are of no benefit and some may do great harm. Additives that cause the accumulated sludge in the tank bottom to increase in volume will result in the sludge being flushed out into the drainfield, plugging soil pores. Other additives, particularly degreasers, may be carcinogens (cancer-causing) or suspected carcinogens that will flow directly into the ground water along with the treated sewage.
- Discharge all sewage wastes from the home into the septic tank. Don't run laundry wastes directly into the drainfield, since soap or detergent scums will quickly clog the soil pores, causing failure.
- Normal amounts of household detergents, bleaches, drain cleaners, toilet bowl deodorizers, and other household chemicals can be used and won't harm the bacterial action in the septic tank. Do not use excessive amounts of any household chemicals.



- Don't deposit coffee grounds, cooking fats, wet-strength towels, disposable diapers, facial tissues, cigarette butts, and similar nondecomposable materials into the house sewer. None of these materials will decompose, and they will cause a rapid accumulation of solids in the septic tank.
- Avoid dumping grease down the drain. It may plug sewer pipes or build up in the septic tank and plug the inlet. Keep a separate container for waste grease and throw it out with the trash.
- Remove the sludge and scum by pumping every 1 to 3 years for a 1,000-gallon tank serving a 3-bedroom home having 4 occupants (and with no garbage disposal).
- When your septic tank is cleaned, you must remove the manhole cover or the tank cover to facilitate cleaning and to be sure that all solids have been pumped out. A septic tank cannot be cleaned adequately by pumping out liquids through a 4-inch inspection pipe. This process usually results in the scum layer plugging the outlet baffle. So be sure that the tank is open when you have it cleaned. At this time, the baffles also can be inspected and replaced if necessary.
- If you must use a garbage disposal, you will need to remove septic tank solids every year or more often. Ground garbage frequently will find its way out of the septic tank and clog the soil treatment system. It is better to compost, incinerate, or throw out garbage with the trash.
- Use a good quality toilet tissue that breaks up easily when wet. To determine suitable quality toilet tissue, place a portion in a fruit jar half full of water. Shake the jar and if the tissue breaks up easily, the product is suitable. High wet-strength toilet tissues are less desirable. The color of the toilet tissue has no effect on the septic system.
- Each septic system has a certain capacity. When this capacity is reached or exceeded, there will be problems with the system accepting as much sewage as you want to discharge into it. When the sewage system approaches its daily capacity, be conservative with your use of water. Each gallon of water that flows into the drain must be treated and disposed. Repair all leaky plumbing fixtures and, if possible, reduce the amount of water used for bathing, doing laundry, and flushing the toilet.
- Reducing toilet wastes is the single most effective way to reduce sewage flows. The flush toilet accounts for about 40 percent of sewage wastes from an average home. Many flush toilets use 5 to 6 gallons per flush. Flush toilets that use less than a quart of water per flush are available.
- Routinely check the toilet float valve to be sure it isn't sticking and the water isn't running continuously. Be sure the toilet is not flushed unnecessarily. Don't use the toilet to dispose of housecleaning water or cigarette butts.

- Determine how much water your automatic washer uses per cycle. Front-loading washers and suds savers typically use less water than top-loading machines. If your sewage system is approaching its maximum capacity, try to spread the washing out during the week to avoid overloading the sewage system on a single day.
- Baths and showers can use appreciable amounts of water. Shower heads that limit the flow rate to 2 gallons of water per minute are available. Filling the tub not quite so full and limiting the length of showers could result in appreciable water savings.
- Keep a container of drinking water in the refrigerator. Then it will not be necessary to run the faucet for a period of time to obtain cold water.
- Water softener recharge wastes will not harm septic tank action, but the additional water must be treated and disposed of by the soil treatment system. If the softener wastewater creates an overload to the sewage system, the wastewater can be discharged to the ground surface, since it contains no pathogens. The wastewater should be discharged in a location where it does not cause a nuisance or damage valuable vegetation.
- Detergents can cause problems with septic systems. It is difficult to estimate the amount of cleaning power required for a load of laundry, so people usually use too much. Be wary of inexpensive washing products, which may contain excessive quantities of filler or carrier, some of which can be extremely detrimental to the sewage system. The best solution is to use liquid laundry detergents, since they are less likely to have carriers or fillers that are detrimental to a septic system.

Never go down into a septic tank. The gases present may poison or asphyxiate you. Only trained professionals should enter a septic tank.

Before buying a lot

Before you buy a lot, know exactly where the boundaries are. Then determine the most desirable location for your home and the best place for the soil treatment system. Remember that steep slopes, ponds, and marshy areas will cause construction and drainage problems.

Make soil borings at the proposed sites for the house and soil treatment system. Be particularly concerned about evidence of a high seasonal water table in the soil. In the spring, the water table can be observed in the boring holes. In the fall, the only evidence of a high seasonal water table may be mottled (spotted or streaked) soil that is colored several shades of red and grey. For help in evaluating the soil suitability for a building site and

sewage treatment system, contact your local office of the Soil Conservation Service. Before finalizing any purchase contract, check with the local zoning office to see whether you can get a building permit, including a permit to install an onsite sewage treatment system.

You **cannot** install a soil treatment unit where seasonally saturated soil would be closer than 3 feet to the bottom of the proposed soil treatment system. If such a possibility exists on the entire lot, it will be necessary to haul in fill and construct an elevated system. You will need a lift pump in a tank located beyond the septic tank if the location of the soil treatment system is higher than the sewage tank outlet.

Extremely coarse soil, such as sand and gravel, cannot filter out the fine solids and bacteria from sewage tank effluent. Finer soil usually is present in the surface layers of soil, or it can be hauled to the site.

Extremely fine soil, such as clay, is an excellent filter, but it may be too tight to allow much sewage to pass through it. In addition, clay soils frequently have high seasonal water tables and therefore are not suitable for a soil treatment system. The most economical sewage treatment system is one in which the sewage can flow by gravity through the sewage tank and into a soil treatment system that is located where the soil is suitable for adequate treatment.

Don't end up with a wet basement

You can install a basement where a high seasonal water table exists in the soil on a building site. Your basement will be wet, however, unless you follow special construction practices. For example, you will have to install drain tile around the **outside** of the foundation footing, and you will have to waterproof the outside of the basement walls.

The proper time to provide for a dry basement is during construction of the house foundation. It is improper procedure to install drain tile inside of the foundation footing after the house has been constructed. It is the contractor's responsibility to construct a house that will have a dry basement. The technology for doing it is available, and the cost is minimal if proper procedures are followed during house construction. Refer to Minnesota Extension Service HE-BU-1369, *Correcting Basement Moisture Problems*.

If the drain tile used around the outside of the foundation footing cannot obtain a gravity outlet, you will have to install a lift pump. The drain tile must never be connected to the sewage system. Drainage water will overload the sewage treatment system, causing sewage to back up in your basement.

If you own the lot

The cost of making a poor lot adequate for an onsite sewage treatment system may exceed the purchase price of a more suitable lot. Even then, the poor lot will never have the

suitability that a lot with proper soils would have. If a lot does not have suitable soil for a sewage treatment system and if suitable soil cannot be hauled to the lot, the only alternative may be hauling away the collected sewage. At a cost of 5¢ a gallon, this is an expense of $4,000 per year for a typical 3-bedroom home. At an annual hauling cost of $4,000, you will soon pay for a suitable lot, but you still won't own one. Your zoning administrator will do you a favor by denying a permit to build on such a lot.

The high cost of a holding tank can be kept down by conserving water. Prospective purchasers of your property may not want to do this, however, and the resale price will be sharply reduced because of the holding tank.

ADDITIONAL INFORMATION

More information is contained in the following Minnesota Extension Service publications. They are available from your county extension office or by writing to Distribution, 3 Coffey Hall, 1420 Eckles Avenue, University of Minnesota, St. Paul, MN 55108.

- AG-BU-1360—*Town and Country Sewage Treatment*
- AG-FO-0583—*How to Run a Percolation Test*
- CD-FO-0797—*Locating On-Site Home Sewage Treatment Systems*
- AG-FO-0817—*Evaluating Soil Texture for a House Site*

For price information, call the Distribution Center, Minnesota Extension Service: 612/625-8173.

Other sources of information include:

- Minnesota Pollution Control Agency
- Your county extension director
- Your county zoning administrator
- Extension agricultural engineers at the University of Minnesota
- Your local office of the Soil Conservation Service
- Minnesota On-site Sewage Treatment Contractors Association
- Minnesota Department of Natural Resources
- Minnesota Department of Health

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Strategies for Feeding the Ewe Flock

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PHOTOS:

Front cover: **The ground makes an inexpensive feed bunk when a good fence keeps the sheep from walking on the feed.**

Back cover, top: **If the feed is handy to the bunk, a scoop shovel can be an efficient way to feed sheep—and keep you warm at the same time.**

Back cover, bottom: **A self-unloading feed mixer is an efficient way to feed grain along the front of a simple, but well-engineered fence line bunk.**

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Strategies for Feeding the Ewe Flock

Robert M. Jordan, extension animal scientist

Aspects to consider and problems likely to be encountered

FEEDSTUFFS

Feed costs of the ewe and her lambs constitutes 60-70 percent of total lamb production costs. The ewes' yearly feed represents about two-thirds of those costs or 50 percent of all costs of production. Producers can do little about feed costs per ton, but several practices can reduce daily ewe feed costs. Ewe cost per day and feed costs per ton are related, but they are not the same.

Feed bulk or density affects feed transport costs, wind loss, bunk capacity, mixing ease, and feeding methods. Lack of bulk or dry matter often results in excess salt and mineral intake, wood chewing, and eating wool off one another. Feed storage problems, handling costs, and feed spoilage in storage or in the bunk are other considerations when selecting feeds. Obviously, the nutrient content of feedstuffs, palatability, toxicity, and possible adverse physiological effects should receive major attention.

In short, solutions to some feeding problems shouldn't create others. The ideal sheep feed is low-cost, palatable, nontoxic, and nutrient rich; it satisfies the ewe, minimizes handling and feed bunk problems, and maximizes lamb and wool production.

FEEDING EQUIPMENT

Low cost, convenient, easily maintained equipment that accommodates the feeding of large flocks with a minimum of labor should be the goal. Feed bunks that reduce feed wastage will pay for themselves in 1- or 2-years' time. Basically, feed bunks don't cost more than $1-3 per ewe and last 15- 20 years. Feed bunks should be suitable for hay, silage, or grain; easy to clean; and easy to move from snow, mud, and manure piles.

The total cost of a silo unloader, augers, and feed bunks is considerable and may amount to $10-$12 per ewe. Thus, your feeding system should maximize the use of the automatic feeding equipment.

You can reduce your capital investment in feeding equipment per ewe by feeding multiple groups of ewes per day in the same bunk. During gestation and summer dry periods, feeding on alternate days or three times per week works well and minimizes labor and equipment. This is particularly feasible if you are mechanically feeding with a belt feeder or auger system. Moving hungry ewes with their lambs through gates without injuring the lambs is the major problem in feeding multiple groups of ewes per day in the same feed bunks or on alternate days and should not be attempted.

If a ewe needed the same kind and amount of feed every day it would be easy to devise a feeding system, feed bunks, and ration to accommodate her. Actually, 8 months out of 12 the ewe wants to eat far more feed than she needs. To economize on feed costs and to feed the ewe no more than she can profitably utilize necessitates three approaches: a) hand feeding a specified amount each day (which entails considerable labor); b) changing the nutrient concentration of the ration according to her needs (very bulky or high-grain); or c) limiting the amount of time that she has to eat. With a high-energy ration, this might be 20 minutes during early gestation, 30 minutes during late gestation, and 1 hour twice a day during lactation.

Be conscious of the amount of labor required to feed sheep. For example, cornstalks are an inexpensive source of nutrients, but they are very bulky and entail considerable labor to feed. If they are ground to minimize waste and facilitate handling, the cost almost doubles by the time they reach the bunk. If they are not ground, there are the problems of feed refusal, frequent cleaning out of the bunk, and an accumulation of refused stalks around the bunk or, worse, in the barn. Ewes can utilize corn stalks in the field at a minimum cost but harvesting them increases the cost of nutrients tremendously.

To summarize, other factors in addition to how much the ration costs per ton have a direct bearing on how to best facilitate the feeding of large numbers of sheep with a minimum of labor. The number one problem in American farm flock production is devising a scheme that enables maintenance of a large flock with a minimum of labor while maintaining maximum lamb production.

PRODUCERS' ATTITUDES

To surmount some of the physical problems of feeding 100-500 ewes, to economize on the equipment and labor, and to understand the factors that affect the amount, kind, and cost of feeding a ewe daily, requires applying knowledge to the problem. If all sheep weighed 100 pounds, if they were always fed equal parts of grain and hay, if the hay were always alfalfa with 15 percent protein, and if the grain were always corn, it would be quite easy to devise not only the equipment but the ration for sheep. However, that is seldom the case.

While sheep producers feed their sheep by the bale or tractor scoop and feed according to the ewes' condition, they should acquire knowledge as to the nutrient composition of the feeds being fed. Weighing a typical bale of hay or scoop full of silage or grain once a month and knowing whether oats provide enough protein for ewes and whether corn silage is high or low in calcium will prevent feeding mistakes. Overfeeding didn't affect profits when feeds were low-priced, as it does now with $60-80 per ton of hay.

REDUCING COSTS OF FEEDING EWES

The costs of feeding ewes for 6-7 months can be most effectively reduced by:

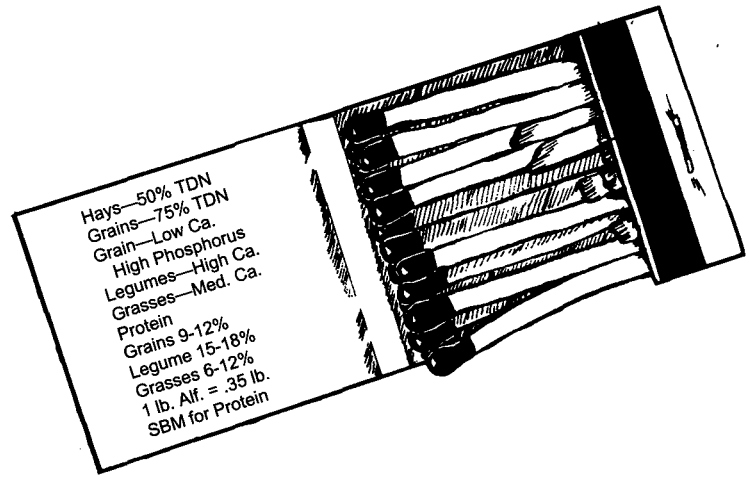
1. reducing feed waste with
    a) bunks that prevent ewes from walking on feed, and
    b) feeding the correct amount, and thus avoiding overfeeding. Usually, if feed is being wasted too much feed is being offered.

2. reducing the number of winter feeding days by extending the fall grazing period with brassicas (rape or turnips), corn stalks, or fertilized grass.
3. economizing on the amount and/or quality of feed stuffs fed during periods that have minor effects on production (summer dry or early gestation period).

Figure 1 illustrates this principle.

4. utilizing feedstuffs that cost less per ewe daily to provide adequate nutrition. Corn silage is the lowest cost feed available. More producers should include it in their feeding program.

   A 3:1 hay to corn or a 2:1 hay to corn ratio fed at 75 percent or 70 percent, respectively, of the weight of hay fed, results in equal ewe production; but the 25-30 percent less total feed fed reduces costs accordingly.
5. feeding ewes on alternate days, with the exception of the lactation period (when lambs are small), thereby reducing labor costs considerably.
6. condition scoring your ewes. Ewes that are fat in the fall can be fed less during midgestation, with a saving of 10-20 percent, without affecting lamb and wool production.



Useful feed composition data

The data on feed composition in table 1 is presented as reference information. The feedstuffs have been grouped according to type. First appreciate that these are average values and a specific bale of alfalfa hay could have more or less total digestible nutrients (TDN), protein, or minerals than the values shown.

Table 1. Composition of typical sheep feeds[1]

Feedstuffs	Typical dry matter content %[2]	Based on 90% dry matter content: Energy TDN %	Energy DE Mcal	Protein Total %	Fiber %	Calcium %	Phosphorus %	Vitamin A equivalent I.U./lb.[3]
Grains								
Oats	88	69.3	1.39	12.0	11.2	.10	.34	—
Corn	88	78.3	1.57	9.0	2.1	.02	.31	500
Barley	88	77.4	1.55	12.2	5.0	.08	.41	—
Wheat	90	78.3	1.57	14.4	2.7	.05	.37	—
Rye	90	76.5	1.53	12.4	2.0	.06	.34	—
Sorghum	90	79.2	1.58	11.2	2.0	.04	.32	—
By-products								
Beet pulp	90	65	1.30	9.0	18.8	.68	.10	—
Beet molasses	77	68	1.36	7.6	—	.16	.03	—
Cane molasses	75	66	1.32	5.2	—	.89	.08	—
Wheat bran	90	64	1.28	15.4	10.1	.14	1.18	—
Protein supplements								
Soybean meal	90	79.2	1.58	44.8	6.0	.32	.68	—
Linseed meal	90	71.6	1.43	34.5	8.9	.40	.82	—
Brewers grains	90	63.0	1.26	26.5	14.7	.26	.49	—
Cottonseed meal	90	63.9	1.38	40.7	11.9	.15	1.18	—
Sunflower Meal	90	68.4	1.37	46.3	11.4	.41	.91	—
Roughages								
Hay—alfalfa	88	51.3	1.02	15.4	27.8	1.20	.20	7,500
timothy	88	49.0	.98	8.2	29.8	.36	.17	4,000
bromegrass	88	49.0	.98	8.7	30.4	.35	.18	3,000
orchard grass	88	49.0	.98	10.1	31.0	.40	.22	7,500
canary grass	88	49.0	.98	9.4	31.7	.30	.22	7,500
alsike clover	88	51.0	1.02	13.2	26.5	1.20	.22	25,000
red clover	88	51.0	1.02	14.4	26.5	1.30	.20	8,000
Alfalfa-brome haylage	46	50.0	1.00	14.4	31.0	.54	.18	18,000
Corn silage	40	63.0	1.26	7.3	22.0	.24	.18	—
Corn stover	88	50.0	1.00	5.6	33.4	.44	.08	—

[1]Values are from NRC feed composition tables.

[2]For most feeds, the "as-fed basis" will provide nutrients similar to those presented here. To convert the exceptions, high moisture feeds, silage, haylage, molasses, etc., to an "as-fed basis," divide the values given by 90% to put them on a 100% DM basis and then multiply that answer by the dry matter content of the feeds in question, i.e., corn silage $\frac{7.3\% \text{ protein}}{90\%}$ = 8.1% X 40% = 3.2% on as-fed basis.

[3]Values calculated on basis of 1 mg. carotene equal to 400 I.U. of Vitamin A.

Secondly, these values are on a 90 percent dry matter (DM) basis. A forkful of silage doesn't contain 63 percent TDN. Actually, it is 70 percent TDN content on 100 percent DM basis, X the DM content of the silage (30-40 percent), i.e., .70 TDN X .35 DM = 24.5 percent TDN on an as-fed basis. Most grains and dry forages are 85-90 percent DM so the values in table 1 are quite comparable to the as-fed basis. For example, corn with 87 percent TDN on a DM basis contains 78 percent TDN on a 90 percent DM basis. Oats with 78 percent TDN on DM basis is equivalent to 70 percent TDN at 90 percent DM.

Thirdly, don't try to master all the feeds, only those you are apt to use.

As "rules of thumb" we have written some basic information about feeds on a match clip which will help you make better feeding decisions under pressure.

Quality factors are not covered in table 1 nor discussed in the feeds section. Quality of the forage is affected by: a) maturity at harvesting; b) deterioration during harvesting (hay rained upon and loss of leaves from shattering during raking and windrowing); and c) deterioration during storage (mold growth and heat damage or browning reaction [Mallard's reaction]). Quality factors are extremely crucial to a sound sheep feeding program. Minnesota research indicates the protein in heat-damaged hay was 43.0 percent digestible compared to 70.8 percent for undamaged hay. Heat damage reduced the digestibility of hay dry matter from 61 percent to 52 percent. Forage color (green) and leafiness are two good visual ways to estimate quality. Have your forage tested for acid detergent fiber (an indicator of digestibility) and neutral detergent fiber (good indicator of feed intake) so you know if it is adequate in nutrients.

Characteristics of feedstuffs for sheep

LEGUME HAYS—ALFALFA, ALSIKE, AND RED CLOVER

With the exception of young growing/finishing lambs and lactating ewes, legume hays provide about 50 percent more protein than sheep require. Legumes' high protein (15-18 percent), calcium (1.25 percent), and carotene (50-100 mg/lb) content make them ideal for correcting those deficiencies that occur when you are feeding corn silage, corn stalks, low-quality grass hay, and straw rations. Sheep particularly like legumes. They are highly digestible and a good source of most trace minerals and vitamins. Regardless of what kind of sheep are being fed, nutrient deficiencies are unlikely to occur if legume hays constitute about 50 percent of the ration. As a source of energy (50-53 percent TDN on a 90 percent DM basis) they don't have a great advantage over non-legume forages. Their superiority, in comparison to other feeds, hinges on their high content of protein, minerals, vitamins and high palatability.

GRASS HAYS

Grass hays include bromegrass, orchard grass, canary grass, timothy, bluegrass, and a variety of native grasses. Grass hays normally contain about 90 percent DM; on that basis they contain 48-50 percent TDN. Thus, they have almost as much energy value as legumes. The difference is that they have 50-75 percent less protein (6-10 percent) and only about 25 percent as much calcium (.20 percent) as legumes. Furthermore, the quality of grass hays varies more than that of legumes. There is a tendency to put off harvesting grass hay. Delaying cutting by 10 days can reduce the protein content of grass hays 3 or 4 percent and decrease the digestibility of the nutrients by 30-40 percent. Therefore, grass hays are often not as palatable to sheep as are legumes. Because of their lower protein content, and particularly lower calcium content, they cannot be used to correct the deficiencies of protein and calcium in corn silage or corn stalks rations. Ewes need about 10 percent protein in their total ration during gestation. A ration consisting only of grass hays would likely be deficient in protein. Like most forages, grass hays are rather low in phosphorus, containing .17-.22 percent. Sheep need a ration that provides about .25 percent phosphorus. Thus, supplemental phosphorus must be fed the ewe. Grass hay does have adequate carotene if it has good color and has not been stored for long periods.

HAYLAGE

Normally haylage is made from alfalfa-brome forage. Its value in relation to hay is determined by when it is cut and its moisture content. Typical haylage contains 40-50 percent DM but may drop down to 38-40 percent DM. When that occurs it is an entirely different feed, on an as-fed basis. Eight pounds of alfalfa-brome haylage that contains 45 percent DM provides the ewe with 3.6 pounds DM. This 3.6 pounds DM contains about 55 percent TDN; thus the ewe consumes 1.98 pounds of TDN. However, if haylage contains only 40 percent DM, then 8 pounds of haylage would provide 3.2 pounds DM or 1.76 pounds of TDN. A 5 percent change in haylage DM content changes the TDN intake by twice that, or 10-12 percent. Failure to recognize a change in DM often leads to ewes receiving less energy than intended. Aside from problems with DM fluctuation, alfalfa-brome haylage normally is put up in less time and

Table 2. Daily nutrient requirements —154 lb. ewe (moisture free)

Production	Gain	Protein		TDN		Calcium		Phosphorus		Vitamin A	Vitamin E
Stage	lb.	lb.	%	lb.	%	gm	%	gm	%	I.U.	I.U.
1	0-.02	.25	9.4	1.5	55	2.5	.27	2.4	.25	3300	18
2	.04-.07	.29	9.3	1.7	55	3.5	.23	2.9	.21	3300	21
3	.40-.50	.44	10.7	2.7	60	6.2	.21	5.6	.20	6000	28
4	-.06	.80	13.0	3.8	65	10.0	.48	7.5	.34	6000	40
5	.13	.60	11.0	2.8	60	9.3	.30	7.0	.25	6000	40
6	.3-.4	.36	9.1	2.7	60	5.7	.27	3.2	.25	3300	27
7	.5-.7	.3-.4	16-18	1-2	78	5-6	.60	2-3	.30	1000	15-20

1. Maintenance—summer dry period
2. Dry—1st 15 weeks gestation
3. Last 4-6 weeks gestation
4. First 8 weeks lactation
5. Last 8 weeks lactation
6. Flushing
7. Early weaned lamb (6 weeks old, 25-40 lb.)

thus, on a DM basis, may be higher in protein and minerals, and possibly carotene, than hay.

CORN SILAGE

Corn silage is a major winter feed for beef cows in the corn belt but is seldom used for wintering ewes. The reluctance to feed ewes corn silage is based on several factors. 1. Often the flocks are small and the labor entailed in feeding corn silage is too great. 2. The fact that many producers have no feed bunks precludes its use. 3. Also, it has a bad reputation, only part of which is based on fact. Many producers believe that ewes wintered on high corn silage rations do not produce strong lambs or as much milk and that the lambs are lighter at weaning time. This is more myth than fact. It is true that poorly harvested corn silage (corn silage that is cut too coarse, is too dry, and is poorly packed) does harbor the bacteria, lysteria, that causes listerosis or circling disease. There is no cure for this disease. Corn silage produces more energy per acre and more sheep can be maintained utilizing corn silage than any other harvested feed. If you have a flock of 100 to 300 ewes, seriously consider corn silage as a major component in your rations. It will reduce production costs.

On an as-fed basis, typical corn silage that contains 35-40 percent DM contains approximately 26 percent TDN, 3.0-3.2 percent total protein, .11 percent calcium, and .08 percent phosphorus. A typical 150 pound ewe would have no difficulty eating 8 pounds of corn silage during early gestation. Compare her requirements according to the figures given in table 2. Eight pounds of corn silage provide 2.2 pounds TDN, which is .5 pounds more than the ewe needs during early gestation, and .24 pounds protein, which isn't enough. Actually, the ewe would have to eat 9 pounds of corn silage to meet her protein requirements. It's extravagant to use corn silage as the only source of protein because in so doing the ewe eats approximately 30 percent more energy than is required during early gestation.

Would 8 pounds of silage meet the calcium and phosphorus requirements? According to the requirements during early gestation for 150 pound ewes, 8 pounds of silage would provide .008 pound calcium and .006 pound of phosphorus. This is enough calcium but a bit low on phosphorus. A corn silage ration would be particularly lacking in both calcium and phosphorus during late gestation, and tremendously lacking during lactation. Thus, decide which is the most economical—to overfeed the ewe corn silage in order to provide protein, or to reduce the amount of corn silage fed and provide a better source of protein than corn silage. If you reduce the amount of corn silage from 8 pounds to 6 pounds and replace it with a drier feed, that feed must not only be higher in protein but also provide somewhat more calcium and phosphorus than the 2 pounds of corn silage contained. A good substitute that would meet all of those requirements (protein, calcium, and phosphorus) would be 1 pound of alfalfa hay.

CORN STOVER

If sheep are going to be a viable part of the corn belt farm enterprise they must utilize more crop wastage than is now the case. With equipment that enables crop residue to be efficiently harvested, the crop residue that appears to offer great promise is corn stover (stalks and leaves left after the corn has been combined). Corn stover is a reasonably good source of dry matter. Corn stover primarily contributes bulk to the ration and some gross energy. The problem with corn stover is that it's

Super simple feeding equipment and inexpensive sheep feed (corn stalks) have vices as well as virtues. A ewe cannot eat enough corn stalks to meet her requirements. Guard against high ewe and lamb mortality with additional protein, vitamin, and energy supplements. Don't economize on feeding equipment to the extent that savings are lost in increased labor and wasted feed.

variable in quality, ranging in protein from 3-6 percent and in fiber from 32-38 percent, lacks palatability, and requires more labor to feed. Corn stover is a good example of a feed that costs little initially, but by the time it is put into the feed bunk a sizeable cost has been incurred. In our studies it cost about $10-15 per ton to grind. Grinding alleviates the problem of refused feed and normally ewes will eat 10-15 percent more ground corn stalks. However, regardless of whether corn stalks are ground or not ground, there will be a 25-35 percent refusal.

Columbia ewes weighing 180-200 pounds consumed only 2 pounds of corn stalks per ewe daily along with 1 pound of alfalfa hay or .4-.5 pound of soybean meal. Obviously 2 pounds of corn stalks and 1 pound of alfalfa hay is not enough energy for a ewe of that size. Nevertheless, corn stalks can be used as a source of energy to a greater degree than they are being used now. They offer opportunities to reduce the cost of feeding ewes during early gestation. To utilize corn stover, supplement with either a protein and mineral supplement, or about half of the DM must be provided as alfalfa hay.

BY-PRODUCTS

Beet pulp is generally offered as pelleted beet pulp. Aside from phosphorus, if you fed sheep nothing but beet pulp pellets they would do quite well. They have on an as fed basis (usually 90 percent DM) 9 percent protein, 19 percent fiber, .68 percent calcium, and .10 percent phosphorus. They are not as high in energy as oats, with 65 percent TDN. The pellets are easy to handle, an ideal feed for starting commercial feeder lambs on feed. During periods when hay is scarce and high priced, the high fiber content of beet pulp helps extend short hay supplies.

Beet molasses. Many producers believe that this is a very high energy feed. Actually, on an as-fed basis (77 percent DM), it contains about 68 percent TDN, which is less than oats or corn, and about 7.6 percent protein. It is an excellent feed to enhance the palatability of feeds such as corn stalks. It quiets the dust but it should not be thought of as a magic feed, a preventer of pregnancy disease, or maker of a lot of milk. It's been used as a carrier for some mineral supplements and for urea-type supplements offered sheep free choice. If it can be bought competitively with other energy and protein sources, molasses has a place. It is a more difficult product to handle than grains.

Super simple feeding equipment and inexpensive sheep feed (corn stalks) have vices as well as virtues. A ewe cannot eat enough corn stalks to meet her requirements. Guard against high ewe and lamb mortality with additional protein, vitamin, and energy supplements. Don't economize on feeding equipment to the extent that savings are lost in increased labor and wasted feed.

Sunflower hulls. Pelleted sunflower hulls are a uniform product, higher in fiber (51 percent), low in protein (5 percent), and low in energy (35 percent TDN). View them primarily as a source of dry matter to satiate the ewe's appetite and to prevent wool picking. As a source of nutrients, expect them to contribute little. They serve as a good carrier for molasses.

Wheat bran is a very bulky but palatable feed. On an as fed basis it contains 64 percent TDN and 16 percent protein and is high in phosphorus (1.2 percent). Therefore, it is a good additive to a ration a little low in phosphorus for ewes or lambs. Because it's often produced from Dakota and Montana grown wheat, it's higher in selenium. In a selenium-deficient area, the addition of 10-20 percent wheat bran to the grain ration would contribute needed selenium.

PROTEIN SUPPLEMENTS

Soybean meal tops this list. It has 79 percent TDN and 45 percent protein (table 1). While not as rich in phosphorus (.68 percent) as cottonseed meal (1.2 percent) or wheat bran, it is much higher in phosphorus than the other grains. It is very palatable and, therefore, a good addition to creep rations. Soybean meal usually is the least costly source of protein in Minnesota.

Linseed meal usually contains 72 percent TDN and 35 percent protein. It is considerably lower in both energy and protein than soybean meal. For the most part it is solvent extracted so it is not higher in fat than typical soybean meal. While it's an excellent source of protein and very palatable to sheep, it normally is higher priced per pound of protein than soybean meal.

SUNFLOWER MEAL

Sunflower meal containing 68% TDN and 28-38 percent protein can be used in the same manner as soybean meal for sheep, and, when fed at the same protein level, comparable results have been obtained.

UREA

Urea is the main source of non-protein nitrogen used in ruminant rations. Sheep producers usually buy it as a component of a commercial supplement that often contains added vitamins A and D and minerals. However, it is available and can be mixed by the producer. Basically a mixture of 12 percent urea and 88 percent corn results in a supplement with an approximate 45 percent protein equivalent. Corn silage, corn stalks, and grass hay are deficient in both calcium and phosphorus. The addition of 5 percent dicalcium phosphate to the above described corn and urea mixture results in a supplement containing 42 percent protein and 1.2 percent of both calcium and phosphorus. Feeding .2 pound of the supplement per ewe daily would provide from 10-15 percent of her total calcium and phosphorus requirements.

MINERAL SUPPLEMENTS

Calcium and phosphorus are the major components of bonemeal and dicalcium phosphate (dical). Dical is a more uniform product and its calcium and phosphorus is just as available as that in bonemeal. Dical contains 25 percent calcium and 18.5 percent phosphorus whereas bonemeal contains 24 percent calcium and 12 percent phosphorus. Sodium phosphate contains 22 percent phosphorus and no calcium, so it is used only when additional phosphorus is needed. Feed-grade limestone (38 percent calcium and no phosphorus) is used in high-grain rations. None of these supplements are palatable. Mixing them with 60 percent trace mineral salt containing 90 to 100 ppm selenium in the summer and 50 percent salt in the winter will assure intake.

Pastures

Sheep are efficient grazers and will readily consume a wide variety of forages, forbs, and weeds. However, both the pasture and the sheep must be managed to maximize land returns. Pasture management must include renovation, fertility maintenance, and productive forage species. Sheep management for optimum lamb production and a vigorous forage stand includes: a) avoiding grazing too early in the spring or too late in the fall (poaching); b) rotational grazing, which permits legumes to remain vigorous; c) uniform grazing; d) parasite

control; and e) grazing the class of sheep that will respond to nutritious forage.

Applying these principles, pasture should provide the least-cost ration and the simplest management. Conversely, unproductive, parasite-infested pasture will reduce gross returns by 30-40 percent. University of Minnesota experiments indicate that well managed pastures can produce 400-500 pounds of lambs per acre and average daily gains of .35-.46 pound per lamb. Conversely, ill-managed pasture may result in only 3-4 pounds gain/lamb per month.

FORAGE SPECIES

Legumes (alfalfa, clovers, and birdsfoot trefoil) resulted in more gain and finish and more pounds of lamb per acre than any other forage species tested at the University of Minnesota. But they also have faults. In some areas legumes cause a great deal of bloat and may become unusable. At St. Paul and Rosemount, legume pastures cause very little bloat. Legumes won't stand abuse, i.e., constant grazing will kill a stand of alfalfa or clover in 1 year. Grazing too early (prior to May 5-10) or too late in the fall (after September 5-15), reduces plant vigor and will shorten the life of the stand appreciably. Mixture of alfalfa and brome or orchard grass will provide a better turf and an earlier pasture with greater flexibility of use and fewer bloat problems.

GRASSES

Orchard grass isn't as early or as hardy as brome, but it provides more palatable and nutritious forage in July and August and greater overall tonnage than bromegrass. It also responds well to fertilizer.

Bromegrass is much more productive than bluegrass or timothy, equally hardy, and remains palatable longer into the summer months than fescues, wheat grasses, bluegrass, or timothy. However, it is not ideal as it, like all cool season grasses, becomes dormant during the hot and dry weather of summer.

Reed canary grass produces more forage per acre, is as early a spring producer and as hardy as any grass grown in Minnesota. But in hot weather it produces a toxic alkaloid that causes severe scouring, reduces forage intake, and consequently causes weight gains hiatus. Don't use it for lambs you are attempting to grow and fatten; rather, utilize it for non-lactating ewes. There are now varieties that are much lower in alkaloids and may be used for growing lambs. Low alkaloid canary grass may be superior to all other cool season grasses grown in Minnesota.

ANNUAL PASTURES

If your alfalfa killed out and your permanent pasture is inadequate, what should you use as a supplement? Many producers utilize sudan grass or sorghum-sudan hybrids. Unquestionably they provide lots of forage during late June, July, and August. Sudan is planted in late May and early June and is very sensitive to cold weather. It is a 60-day pasture only. Managing sheep on sudan is difficult. They tend to eat it into the ground in one area and permit it to grow to 5-foot heights in another. Very heavy stocking rates and rotational grazing will minimize the problem.

Small grains and rape. Planting rape or turnips with oats early in the spring will provide excellent feed by late May. Sheep initially dislike rape and will graze exclusively on the oats. By mid-June, when the oats is flowering and heading, the rape will be 4 to 10 inches high. With a reduced oats intake, the rape will provide excellent forage (barring a drought and an insect invasion) until freeze-up. In sheep grazing studies, rape has produced the fastest gains among suckling or early weaned lambs (.4-.5 pound daily) and with feeder lambs in the fall (September to November), a gain of .5 pound daily has been consistently obtained. There has been no bloat whether the rape was frozen or not. Rape is very succulent and lambs may scour, so be careful of fly strike or maggots.

Mineral deficiencies and toxicities

SALT

Typical consumption of idodized salt is .03-.06 pound per ewe daily depending upon season, lactation and salt content in the water and feed eaten. Inadequate dry matter intake may increase salt and mineral intake to .10-.20 pounds daily. This level isn't toxic, provided adequate water is available. Salt is an excellent carrier for sources of calcium and phosphorus.

CALCIUM AND PHOSPHORUS

Ewes fed primarily hay are not apt to be deficient in calcium, but most forage rations, including alfalfa hay, are low in phosphorus. Corn silage is deficient in both calcium and phosphorus. Calcium deficiency will exist with non-legume hays, grain rations (very low in calcium), and corn silage. A salt-limestone mix of 50-60 percent salt and the balance limestone fed as the only source of salt will encourage ewes to consume approximately 2.5g calcium, which is 50-60 percent of their total needs during gestation and about 25 percent of their requirement during peak lactation. Deficiencies of either calcium or phosphorus will retard growth before resulting in abnormal bone development, tetany, and depraved appetite.

MAGNESIUM

The magnesium requirement is .12-.20 percent. Sheep do develop hypocalcemia and grass tetany, both of which will respond to treatment with magnesium. If grass tetany is a problem, salt-mineral mix containing 10 percent magnesium salts (chlorine, carbonate) would be beneficial.

POTASSIUM

The potassium requirement is .5-.8 percent of the diet. Very high-grain diets could be low in potassium; forages usually have two to five times that level. Inadequate potassium reduces feed intake.

SULFUR

Wool is high in sulfur; the sulfur requirement is about .15-.25 percent of the diet dry matter. Rations containing less than half forage are apt to be deficient in sulfur. Trace-mineralized salt contains supplemental sulfur and beet molasses, linseed meal, and soybean meal are relatively rich in sulfur. The Ohio Agricultural Experiment Station reports improved feed intake and heavier lambs were produced at 30-40 days when ewes were fed corn silage fortified with .5-1.0 percent sulfur at the time of ensiling. Furthermore, the sulfur helps control listeria growth in the silage, thus reducing problems with circling disease.

IODINE

When trace mineral salt containing iodine is provided, problems with goiter are eliminated. The requirement is .10-.80 ppm. Salt without iodine will precipitate goiter problems.

IRON

Normally no iron deficiency occurs in sheep. However, in lambs raised on slatted wood floors, a deficiency may occur. Intramuscular injections of iron-dextran will prevent the problem. The requirement is 30-50 ppm.

COPPER

Several severe copper toxicity incidents have occurred in Minnesota in the last 5 years following an error in mixing feed. An analysis of several types of Minnesota feeds indicate a content of 10-20 ppm copper, which is well in excess of the requirement of 7-11 ppm. Toxicity has occurred with diets containing 40-50 ppm. Diets containing in excess of 30 ppm should be viewed with suspicion. If the molybdenum content is low (less than .2 ppm), copper toxicity may occur with diets containing as little as 15-20 ppm copper. Molybdenum is now added to most TM salt in Minnesota.

COBALT, MANGANESE, AND ZINC

When trace mineral salt is available, cobalt deficiency doesn't occur in Minnesota. Deficiencies of cobalt cause lack of appetite and thrift, low fertility, and decreased lamb and wool production. The requirement is .10-.20 ppm.

Manganese deficiencies have occurred among lambs fed purified diets containing 1 ppm. Most feeds contain adequate levels. The requirement is 20-40 ppm.

Zinc deficiencies are unheard of in Minnesota. Diets containing less than 20 ppm depress growth and reproduction. Supplementation is usually not necessary though zinc is usually a component in trace mineral salts.

SELENIUM

This trace mineral causes the most concern among Minnesota sheep producers because selenium deficient areas exist. Feeds should contain .1 ppm selenium. Grains contain about half as much selenium as forage grown on the same soil. The western half of Minnesota normally produces feeds containing .1-.4 ppm and Dakota feedstuffs are even higher. Therefore, feedstuffs produced in western Minnesota, the Dakotas, and Montana (flax [linseed meal], sunflower meal, and wheat bran) contain considerable selenium. It is permissible to add .2 ppm selenium to the total ration or 90 ppm to the salt.

NITRATE POISONING AND UREA TOXICITY

Heavily fertilized fields, accompanied by an arrest in growth from drought, are conditions that may result in an accumulation of nitrate in forage and corn plants. Just what the lethal level is depends on the protein and energy level and rate of intake. Sheep fed a complete ration containing 12.8 percent potassium nitrate showed no symptoms, whereas lambs fed low-quality hay plus .5 gm KNO_3 per Kg showed severe symptoms.

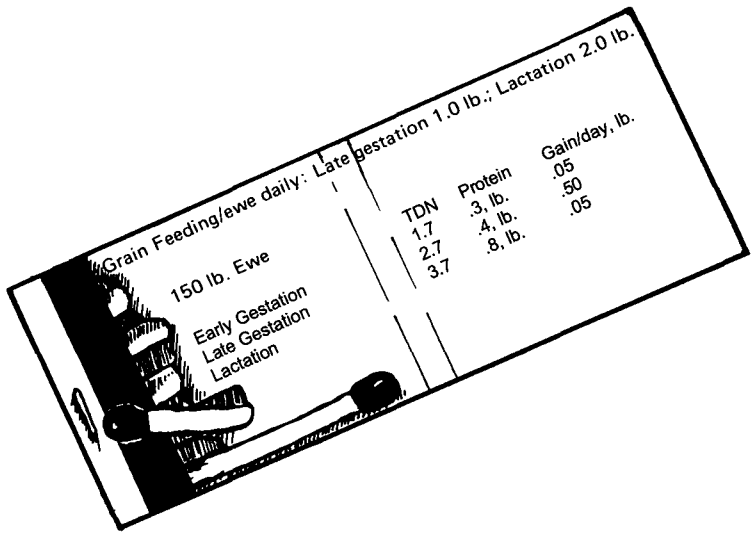
If your feed contains 1-3 percent KNO_3, dilute it with other feeds, feed corn with it, and be certain protein is adequate. Corn silage can also contain toxic levels of nitrate, though ensiling reduces it somewhat.

Urea toxicity is not apt to occur when urea is added to silage at 1-2 percent, when supplied from a commercial supplement, or when mixed well and fed with high energy rations. Problems occur when hungry sheep are fed poorly mixed urea supplements in which urea is providing 40-50 percent of the protein equivalent. Mixing urea with salt is another lethal procedure.

Feeding the ewe

Now let's talk about feeding the sheep. The daily requirements for sheep at several stages of production are presented in table 2. Don't let the mass of figures confuse you. Zero in on the basics. On another match clip note the feed requirements of ewes. These aren't exact, but close enough and easy to remember.

You can also remember TDN requirements as 1.0, 1.8, and 2.5 percent of ewe's body weight during early and late gestation and lactation, respectively.



The information given about various feeds and the requirements of ewes at various stages of production have been used to formulate the example rations presented in table 3. Remember, no one single ration is always best. Certainly, changing costs and availability of certain feedstuffs suggest that sheep producers must be able to formulate rations that will be low cost yet nutritionally adequate from a variety of feeds.

When you begin formulating a ration, realize that the daily nutrient requirements of a typical 150-pound ewe should be contained in 3.5-4.0 pounds of feed. If she is not pregnant or lactating, she requires somewhat less than 3.5-4.0 pounds of hay and if she is, she needs somewhat more than 3.5-4.0 pounds of hay.

The third point, ewes bearing twins or triplets, especially if they are a bit fat, are quite susceptible to ketosis or lambing paralysis. Mortality from ketosis is usually 100 percent. Prevention can be 100 percent successful if, during the last 4 to 5 weeks, the ewe is fed so she gains weight (8-15 pounds) during that period. Don't waste money by feeding to prevent pregnancy disease during the first 3 months of gestation; it never occurs then. Regardless of what you are feeding or how much you are feeding, increase the energy intake the last 4 weeks before the first lamb is due by feeding .50-1.0 pound of grain per ewe daily.

Ewes need energy, protein, calcium, phosphorus, and vitamins if they are to produce 3.0-5.0 pounds of milk daily so as to produce 1.0 pound of lamb gain daily. All of the requirements

for milk production are provided when quality forage and grain are fed in adequate amounts (5.0 pounds of hay and 1 to 2.0 pounds of grain equivalent).

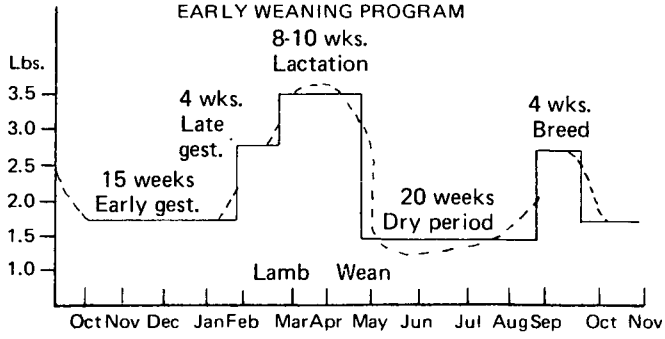
It's hard to starve a ewe that's full-fed hay, but she may starve her lambs because she can't eat enough hay to produce enough milk. Feed at a level that makes money.

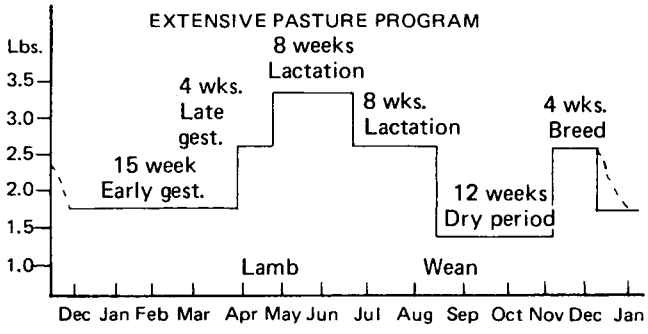
Nutrient requirement of the ewe

The amount and kind of feed that should be fed the farm flock ewe depends on several things, which, if not considered, will result in reduced production and/or excessive production cost.

1. **The age of the ewe.** Old ewes, possibly with poor teeth, may need a higher energy ground ration. Yearling ewes (lambed at 12-14 months) suckling one or two lambs need a far higher level of nutrients than a mature ewe to accommodate lactation requirements plus their growth needs. Failure to recognize this will result in low conception and a disappointing lamb crop as 2-year olds.

Figure 1. Daily TDN requirement year round of 154 pound ewe





2. **Size of the ewe.** Basically, the nutrient requirements of the ewe are in relation to size. A 110-pound ewe requires considerably less feed to maintain than a 190-pound ewe.

3. **Production stage.** A ewe's production stage determines how much and what kind of feed should be fed. The two critical periods, when the required amount of nutrients must be supplied to avoid disaster, are during very late gestation and during lactation. Figure 1 illustrates the magnitude of the difference in nutrient requirements and the proportion of the year that constitutes critical and non-critical periods.

4. **Production level desired.** If you are satisfied with a lamb crop of 110 percent and lambs that gain .25 pound per day for 8-9 months, the ewe would not need to be fed milk-stimulating rations nor would her lambs need a high intake of energy daily. Under some circumstances, prolonging the feeding period and utilizing low-cost, low-energy feed, coupled with the possibility of marketing lambs at high prices, may actually be profitable. However, the most profit usually is made by those who feed for optimum production.

5. **Current conditions.** There is a saying, "Fat ewes in the fall are like money in the bank." In short, a ewe in good flesh can be kept healthy while developing a fetus even though she may lose a little weight during early gestation and gain only a moderate amount during late gestation. Conversely, a ewe that is rather thin in the fall must gain much more weight during gestation and thus must be fed well. Experiments at the University of Minnesota have shown that rather fleshy ewes in the fall that gained 30-40 pounds during gestation produced no heavier lambs at 30-60 days of age than equally fleshy ewes that gained only 5 or 10 pounds during gestation. Conversely, thin ewes carrying one or two lambs that gain only 5 or 10 pounds during gestation actually would be much thinner at lambing time, very apt to produce lightweight lambs and far less milk, and might not be strong enough to respond to adequate feed post-lambing.

6. **Previous nutrition status.** Previous nutrition status affects condition and, equally important, affects stores of various nutrients. An example is the ewe's vitamin A status. Ewes that came off green forage and were fed dry hay containing virtually no vitamin A (carotene) could conceivably go through the entire winter without suffering from vitamin A deficiency. Conversely, ewes that had been eating dry brown forage most of the summer and were fed hay with little or no vitamin A would become vitamin A-deficient long before the winter was over.

7. **Condition score.** Condition of the ewe has a very significant bearing on what to feed ewes. Ewes that are fat at breeding can lose 5-10 percent of their weight during mid-gestation. Conversely, thin ewes must be fed so as to gain weight.

8. **Environment.** Wind, wet conditions, and cold weather definitely increase the ewe's energy requirements. Furthermore, if the ewe must travel long distances to procure feed, that too increases her energy requirements 20-30 percent in some cases.

9. **Diseases and parasites.** The effect of diseases and parasites on nutrient requirements is not well understood. Inadequate intake of protein and phosphorus, in particular, make sheep more susceptible to parasitism and bacterial infection. In addition, a heavy parasite load reduces feed intake and therefore energy and protein intake.

Summary

A ewe's nutrient intake during the critical stages of production (breeding, late gestation, and lactation) largely determines her level of lamb and wool production.

A sheep producer's willingness to apply what feeding know-how he has to his flock largely determines its profitability.

Knowledge about sheep feeds and how to feed sheep to your greatest advantage is not a complicated subject. To master the subject, reread this publication; apply the information to your own sheep; then teach your sons and daughters; and laugh all the way to the bank.

Table 3. Rations appropriate at various stages of production (per ewe daily)

Maintenance	Hay lb.	Corn silage lb.	Haylage lb.	Straw	Corn stalks	Grain lb.	Soybean meal lb.
1.	3.0						
2.		6.0					.2
3.			6.0				
4.				3.0			.4
Gestation early							
1.	3.5						
2.	2.0					1.0	
3.	1.8					.6	.2
4.		8.0					.2
5.			7.0			.2	
6.	2.0				2.0	.5	
7.	1.0				2.0	.5	.3
Gestation late	Add .5-1.0 lb. grain per ewe daily to any of the above rations.						
Lactation	4.0					2.0-3.0	—
		10.0				1.5	.25
	1.0	8.0				1.5	.2
			8.0			2.0-3.0	

Grain Feeding/ewe daily: Late gestation 1.0 lb.; Lactation 2.0 lb.

150 lb. Ewe

	TDN	Protein	Gain/day, lb.
Early Gestation	1.7	.3, lb.	.05
Late Gestation	2.7	.4, lb.	.50
Lactation	3.7	.8, lb.	.05