Feeding and managing livestock during a feed shortage

Agriculture Canada

Minister
Agriculture Canada

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O T T A W A
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Dear Producer,

The drought of 1980 is now behind us. But the damage done to crops and pastures can still be felt. If you are among the livestockmen in the drought-affected area, you may have to find ways of maintaining your herds on scarce, inferior, or more expensive feed.

To help you cope with those problems, I have had my department's animal nutrition experts prepare this publication under the direction of a special western planning committee.

This information constitutes the best advice we can offer on overwintering cattle and sheep as economically as possible.

By using the information, along with your own management skills, you should be able to stretch local feed supplies, cut back on the need to import feeds, and avoid major reductions to herds and flocks.

This publication is just one part of the federal government's overall drought relief program, and complements our other efforts, such as the $13.4-million Fodder Procurement Program, the $41-million Herd Maintenance Assistance Program, and the $7-million Feed Transportation and Water Assistance Program.

I hope these measures help you overcome the challenge you face in maintaining your herds this winter.

Yours sincerely,

Eugene F. Whelan

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1. INTRODUCTION

The main purpose of this bulletin is to provide information on how to more effectively use common feeds and byproducts (residues) of crop production for the feeding of livestock. It gives procedures for combining various sources of ingredients, the processing and supplementing of forages, cereal straws and their chaff plus crop residues from many other sources (fababeans, sunflowers, etc.), along with many examples of practical application. Many of these materials, by themselves, are of little or no feeding value but when appropriately processed and supplemented, can be upgraded to very useful feeds. Complementary feeding and management techniques, such as the use of additives and pregnancy diagnosis to stretch feed supplies, are described.

While this information has general application to ruminant production, its application during periods of severe feed shortages (such as are occurring on the Prairies in 1980-81) is especially vital and can result in the following benefits:

Existing local feed supplies can be greatly extended;

The need to import feeds will be greatly reduced;

Less drastic cutbacks will be necessary in herds and flocks; and

Less government assistance will be needed to maintain a healthy livestock industry.

In addition to the information contained herein, the reader is advised to seek assistance from animal nutritionists at Agriculture Canada research stations, in provincial departments of agriculture, at universities and from industry (feed firms and private consultants).

2. MANAGEMENT TECHNIQUES FOR EFFICIENT FEED USE

a. *Feed Inventory and Feed Testing*

The first step in planning a winter feeding program is to take stock of available resources (feed, bedding, water) on the farm so that a decision can be made either to cull stock to the extent of available feed or to obtain additional resources. Quantities of forage (hay, silage, greenfeed), straw and grain on hand should be recorded. Since moisture content of feeds varies considerably, it would be advisable to determine moisture content so that the amount of dry matter actually available in the different feeds will be known. This is particularly important for silages.

Dry matter of feeds can be determined on the farm using either a conventional oven or a microwave oven, and a scale capable of weighing reasonably accurately to 100 grams. If using the kitchen oven, place 100 g of material on a cookie sheet or cake pan and spread evenly. Dry at 80°C (200°F) for 8 hours, let cool and weigh, replace in oven and reweigh at 2 hour intervals until loss in weight becomes negligible.

Example Feed Inventory Sheet

Feed	Est. amount	% D.M.	% T.D.N.	Pounds T.D.N.	Pounds D.M.	% Crude protein (DM)	Pounds crude protein
Barley	2,000 bu @ 46 lb	88	85	7,820	80,960	12.5	10,120
Br-alf hay	1,500 bales @ 50 lb	85	56	42,000	63,750	14.0	8,925
Oat silage	40,000 cu ft @ 40 lb	36	60	960,000	576,000	11.5	66,240
Oat hay	2,000 bales @ 40 lb	87	55	44,000	69,600	12.0	8,352
Barley straw	100 round bales @ 800 lb	90	44	35,200	72,000	3.5	2,520
Wheat straw (feed and/or bedding)	500 round bales @ 850 lb	90	38	161,500	382,500	3.0	11,475
Total				1,250,520			107,632

If a microwave oven is available, place 100 g of feed in the bottom of a paper bag which has been cut to leave a 2- to 3-in. side. Set at "high" and dry for 4 minutes. Remove, stir and replace for 1 to 2 minutes. Weigh after it cools. If high moisture material such as silage is involved, another 1-2 minutes drying period should be used. Remove, cool and weigh. The weight of dry material remaining (grams) equals the percent of dry matter.

Because there will be considerable variation in feed quality and because protein supplements may be required to properly balance rations, it is essential that the protein content of your feeds be known. Representative samples of individual feeds should be forwarded to your nearest feed-testing laboratory for analyses. In specific instances some special analysis may be required, such as for nitrates in cereal hays whose growth was suddenly arrested by frost or drought. For practical purposes, other important constituents of feeds can be estimated or possible deficiencies economically countered by providing sufficient vitamins and minerals in supplements or mineral mixes and vitamins by injection.

b. Water Requirements

Quantity and quality of water supply is particularly important in a dry year. Excessive evaporation and algae growth can seriously affect water quality. If in doubt, have water analyzed; contact lab for containers.

The amount of water consumed by livestock depends on kind and amount of ration (increasing as level of protein, mineral and dry matter intake increases), temperature of the air and water, quality of the water, kind and size of the animal, level of milk production and availability of water. Restricting water intake will reduce intake and efficiency of feed utilization and could lead to rumen impaction where large amounts of low-quality roughage are being fed. It may also lead to the development of urinary calculii (water belly) under some conditions.

Poor-quality water can cause problems ranging from death to impaired animal performance. Nitrate levels of 0.35% are toxic to cattle. The presence of alkali salts can interfere with mineral nutrition. Water containing more than 5000 parts per million of solids is inferior, especially for younger stock. Where algae are plentiful (as is often the case in a dry year), the water can be poisonous to livestock. Sloughs, dugouts and ponds can be treated with bluestone to control algae. Apply at the rate of 1 lb for 16,000 cu ft of water. (Place bluestone in a water-permeable bag, tie baling twine or light rope to each end of bag and work back and forth throughout dugout to assure even treatment. Measure dugout and bluestone carefully. Excessive bluestone can be injurious to stock.

The table below shows average water requirements for livestock. When assessing water supply be sure to allow for expected losses due to evaporation, seepage and freezing. If there is any likelihood of running short, take steps immediately to obtain more. (Some provincial governments have programs to help farmers pump water to dugouts).

Points to remember

—Keep water troughs clean.

—Allow free access to water at all times, or water frequently.

—Heat water in winter to 4 to 5°C (40°F) to prevent freezing and encourage consumption.

—Check water supply frequently (power failure, frozen line or stuck float could be important with automatic waterer—electric shorting out at the waterer can discourage or prevent consumption).

—Beef cows can use snow to meet water requirements but this should be considered a last resort (thawing snow requires energy!).

c. Pregnancy Testing and Culling

With feed supply short or expensive and prices for cattle relatively good, it may be wise to cull all low-producing breeding stock and perhaps even younger stock under some conditions. Efficient cow-calf operators routinely test all breeding females for pregnancy and cull all

Class of stock	Est. consumption, gal/day (1 gal = 10 lb)	
Dairy cow (milking)	35	depending on milk production
500 lb steer (maintenance)	6-8	depending on temperature
800 lb steer (finishing)	8-10	
1100 lb steer	10-15	
1100 lb pregnant beef cow	8-12	
Mature sheep, dry ration	0.5-1.5	varies with availability of snow, moisture content of feed and temperature
Lambs, 65 lb (ground dry ration)	0.5-1.0	
Sheep, lush pasture or silage	very little	

that have failed to become pregnant following the breeding season. The average beef calf crop in herds on the prairies appears to be about 70%. Thus approximately 30% of beef cows in any 1 year produce no calf. If these are eliminated from the prairie herd, the calf crop remains the same and the total amount of feed for cow wintering is reduced by almost one-third. This represents a significant increase in efficiency of beef production by decreasing the average cost of producing a calf. Pregnancy testing can be rapidly and accurately carried out by experienced veterinarians or artificial insemination technicians. Cull stock (non-breeders, those of poor conformation, or poor mothers) as soon as possible and send to the packing plant to ensure they don't end up in another breeding herd.

d. Early Weaning

Under most management systems on the prairies the growth rate of the calf is obtained at the expense of the cow after August, and is much lower than earlier in the grazing season. With early weaning the cow goes into the winter feeding period in better condition and will have lower feed requirements during the winter. If calves are retained, it also allows them to get over the stress of weaning and to adopt to new feed and environmental conditions before the onset of cold weather; this reduces the likelihood of shipping fever and pneumonia. Also, a preconditioning period for calves intended for sale will improve appearance and they may bring a better price.

e. Fall Grazing

If weather conditions permit, *consider grazing* stubble fields, regrowth on hay, pasture and forage seed production fields, slough, bush and roadside areas. This will reduce the winter feeding period and dependence on stored feed. Even if some supplemental feeding on these areas is required, it will allow good use of material that would otherwise be wasted. If grazing oat regrowth, be aware that nitrate levels can become dangerous following a frost; see section 7b. The need for temporary (electric) fencing and water may restrict use of some areas.

Cows grazing Alberta wild ryegrass in late fall. Extending the grazing season cuts winter feed requirements.

Late-seeded oats provide productive summer-fall pasture.

Judgement must be exercised in grazing perennial pasture and hay stands. Grazing newly established stands or established forage stands too closely will prevent buildup of root reserves, cause winter killing and reduce subsequent production. In some areas the ability of pasture regrowth to hold snow can also affect winter survival and spring moisture supply, affecting forage available for spring grazing. The producer therefore must assess the advantages of perennial pasture grazing in fall is relation to the grazing situation next spring.

f. Protecting Feed Supply

Don't put up hay and straw at higher than recommended *moisture levels* or it may mold.

Stack feed on *well-drained areas* to minimize spoilage on the bottom.

Line up rectangular stacks *in a north-south direction* away from buildings and shelterbelts. This allows better exposure of the stack to sunlight and to the wind, and speeds drying following a rain.

If possible, store feed in sheds or cover stacks with tarpaulins, plastic sheeting, or a layer of straw bales to keep out the rain. If stacked material contains over 10% moisture, provide for some air movement through the top of the stack (ducts between bales), otherwise moisture will gather under the plastic and lead to spoilage.

g. Avoiding Wastage

Avoid wastage of feed at all stages of harvesting, transporting and feeding.

If feeding round or square bales on the ground, don't put out any more than can be cleaned up within an hour or two. Otherwise it may be fouled. Feeding on the ground can result in feed losses of up to 50%.

If using self-feeders, be sure they are properly designed and managed to avoid wastage or bridging. (Plans for various types of feeders are available from federal and provincial departments of agriculture.)

If a feeding gate is used, it may be advisable to limit the amount of hay accessible at any on time so that all feed will be consumed and buildup of spoiled feed will be prevented. The high cost or scarcity of feed may justify the additional labor involved. Similarly, if bunk feeding, silage amounts should be controlled to prevent a carry-over in the trough which could freeze or spoil.

Avoid over and under feeding. Check on the condition of livestock frequently and make adjustments in level and quality of feeding in accordance with production goals. When growing replacement heifers and steers, a choice may have to be made between feeding fewer cattle for faster gains or most of your cattle at slightly above maintenance levels in order to have them on hand for placing on pasture or in the feedlot next spring. Don't under feed to the point of stunting. For some producers, avoiding overfeeding may be as important as ensuring adequate nutrition. Cows carrying too much condition can have problem at calving time.

h. Protecting Livestock from Weather

Protection from wet and windy conditions during the winter can reduce feed requirements of cattle and sheep by 20% or more and reduce the incidence of shipping fever and pneumonia. Efficient and inexpensive shelters and 8 to 10 ft high 20% porosity fences should be provided when practical. (Plans available from the Canada Plan Service, Agriculture Canada, Sir John Carling Building, Ottawa). Tree bluffs and snow fences can be used to advantage if available. Provide well-drained, adequately bedded areas. Access to a shed is desirable to keep rain and snow off livestock but avoid the use of poorly ventilated sheds.

Stacking wagons can produce reasonably weather-resistant "packages" of mechanically stacked hay, provided the operator can achieve a well-rounded, uniformly sloping top. Depressions on the top funnel rainfall and melting snow into the stack, causing spoilage.

Protecting the straw supply. If straw is to be carried over into the next year or will be subjected to considerable precipitation it may pay to protect it with well-tied-down tarpaulin or plastic sheet. Be certain to cover it day after stacking.

i. Herd Health

Many management and environmental factors can create undue stress which can lower the animal's resistance to disease. If possible, such operations as weaning and castrating should not be carried out simultaneously nor should they be done under adverse weather conditions. Proper facilities should be available to permit handling of livestock with minimal stress to both animal and man.

Livestock should be protected from disease by following recommended vaccination procedures for such diseases as blackleg, malignant edema and any other diseases prevalent in the area.

Parasites such as warbles and lice should be controlled by timely applications of the appropriate treatment, following recommended procedures.

When transporting cattle, provide adequate protection from the weather, cover the floor with sand or fine gravel to give the stock adequate footing, and do not overcrowd.

When ration changes are planned, make gradual changes, particularly when increasing the grain allowance or changing from a grass to a high-quality legume hay. Performance can be seriously affected when animals scour, bloat or go off feed. Watch closely for symptoms of bloat (swelling on left side), impaction and diarrhea.

Watch for conditions such as foot rot, pinkeye and ringworm and treat promptly. Foot rot usually is cleared up within a day or so by the prompt injection of penicillin. Dusts and sprays are available for treating pinkeye, and ringworm. If caught early, they can be controlled by covering the affected area with grease to exclude air.

Storing round bales. Though not recommended in high rainfall areas, "pyramid" storage does save space.

Providing well-ventilated sheds when wintering cows reduces feed and bedding requirements and permits early calving (with aid of infrared heaters to dry newborn calves).

3. NUTRITIONAL REQUIREMENTS OF RUMINANT LIVESTOCK

Ruminants are able, through the activities of the bacteria in the rumen (paunch), to digest fibrous materials such as hays and straws, which cannot be digested by other animals. In addition, ruminants can use simple forms of nitrogen such as urea to produce bacterial protein which then can be used to meet the animals' protein needs. The ability of ruminants to survive and produce on relatively "poor" quality feeds depends on the activities of the rumen bacteria.

While the rumen bacteria give the ruminant an important advantage in using fibrous materials, some restrictions on feeding result. The bacterial population does not respond quickly to changes in feeds and thus changes must be made gradually. Also, to maintain body condition, provide adequate gut fill, meet nutrient requirements, and maintain rumen function. Proper balances of roughages and concentrates must be maintained.

For desired performance, adjustments in rations may be required as the animals progress through the winter, depending on temperature, age and condition of the animals, and stage of pregnancy. A livestock scale to weigh animals at 2-week intervals is of considerable value in assessing the adequacy of rations.

Nutrient requirements of the pregnant animal increase as parturition approaches, and during lactation nutrient requirements are considerably higher than during early pregnancy (see Tables 1 and 2). Over the winter feeding period it is therefore advisable to use lower quality roughages first and save higher quality feeds until the last month of pregnancy. The provision of adequate levels of protein, calcium, and phosphorus during late pregnancy is important in establishing the milk flow of the lactating dam and also appears to increase rebreeding success.

In Table 1, note that TDN does not increase during late pregnancy of the cow, and decreases slightly for yearling pregnant heifers during late pregnancy to reduce

Table 1 Daily Nutrient Allowances for Wintering Beef Cattle

	Average daily gain (lb)	Feed/ day (lb)	TDN		Crude protein (%)		Ca (%)	P (%)	Vit A (IU)
			%	lb	Total	Digestible			
Cows, early pregnancy	0.5	20-22	50	10	8	4.5	0.25	0.25	50,000
Cows, late pregnancy	1.0	20-22	50	10	10	6	0.35	0.35	50,000
Yearling pregnant heifers*	1.0	20-22	55	11	8.5	5.5	0.30	0.30	50,000
Replacement heifer calves	1.7	15	60	9	12	9	0.48	0.32	15,000
Lactation	0	28-32	58	16	10	6	0.34	0.32	65,000

* During early pregnancy. During late pregnancy use same requirements for cows, late pregnancy. From Milligan (1973).

calving difficulties. Requirements for protein, calcium and phosphorus are increased during late pregnancy. Daily lactation requirements for TDN are at least 50% higher than those for pregnancy, and those of the other nutrients are also increased considerably when increased daily intake is considered.

The nutrient requirements of ewes increase greatly in late pregnancy and during lactation, and must be met to avoid pregnancy toxemia near parturition, as well as to allow for high rates of lamb growth during lactation. The TDN content of the ration of the ewe is higher than that of the beef cow in Table 1, since sheep have a relatively smaller digestive capacity than cattle. The late pregnancy-lactation period of the ewe is also more intense than that of the beef cow in terms of lamb growth and lactation.

Nutrient requirements of dairy cattle are difficult to present in tables such as done for the ewe and beef cow since the daily requirements for nutrients depend largely upon the level of milk production. As a general rule, 2% of the cow's body weight in high-quality roughage, for example, will be required, as well as a relatively high level of grain. A cow producing 50 lb of milk per day will require about 25 lb of alfalfa plus 20 lb of grain, as well as supplements of minerals and vitamin A, D and E.

During the overwintering period on the prairies there is likely to be considerable cold stress on beef cattle and sheep at times, which increases the animals' requirements for energy (TDN). At temperatures below −20°C the requirement for TDN may increase to as much as 14 lb per day. Therefore considerably greater quantities of roughage must be supplied or extra grain fed. Particularly when large quantities of low-quality roughages such as cereal straw are fed, the provision of extra grain during cold weather will be necessary to prevent impaction.

Vitamin A should be given to all classes of animals at the levels shown in the tables. This will be of considerable importance where low quality roughages form the major portion of the diet since these materials usually are low in Vitamin A.

Slough hay, harvested at the right stage, can go a long way towards meeting the nutritional requirements of the wintering beef cow.

4. FEEDS AND HOW TO USE THEM

Only feeds that are likely to be available in quantity will be discussed here. If you have some local feedstuff available or a plant-derived product or byproduct which you feel might have potential as a feed, consult your nearest animal nutritionist for advice.

a. Perennial Hays

Grass-legume hay of good quality is the forage of choice for dairy cows. It will more than meet the requirements of wintering beef cows and thus is usually fed as a supplement to low-quality forages or straw. It can be used to provide the nutritional requirements for growing steers and heifers when fed with 2-5 pounds of grain per head daily. Quality of grass-legume hays is determined by the stage of maturity at which the crop is cut, the amount of legume present and the extent of nutrient losses suffered during handling, storage, processing and feeding. If beef cattle producers are fortunate enough to have even

Table 2 Daily Nutrient Allowance for Wintering Sheep

	Average daily gain (lb)	Feed/ day (lb)	TDN		Crude protein (%)		Ca (%)	P (%)	Vit A (IU)
			%	lb	Total	Digestible			
Pregnant ewe (1-15 weeks)	0.07	3.0	55	1.65	9.0	4.9	0.35	0.35	4,000
Pregnant ewe (last 6 weeks)	0.40	4.6	58	2.67	9.3	5.2	0.35	0.35	6,000
Lactation	−0.1	5.8	65	3.77	10.5	6.3	0.48	0.34	6,000
Replacement lambs	0.18	3.3	58	1.91	8.9	5.0	0.42	0.25	4,000

Modified from NRC (1975)

a limited quantity of good-quality grass-legume or legume hay available, it can be most effectively used (in order of priority) to:

1. supplement a straw-grain based ration for breeding cows following calving;

2. provide a portion, ⅓ to ½, of the ration for growing replacement heifers;

3. supplement a straw-grain based ration for pregnant cows.

Grass hays such as bromegrass or crested wheatgrass are generally of lower nutritional value than grass-legume hays and thus may not be as useful as grass-legume hays in supplementary roles. These grass hays may however make up a large proportion of the diet of the growing animal and in some cases be the entire diet of the mature animal with supplements of minerals and vitamin A added.

Slough hays (sedges, red top, reed canarygrass) are usually coarse and relatively low in quality, because maturity is normally advanced before harvesting is possible. In dry years, however, it is possible to harvest slough grasses at an earlier stage of development when feed quality and physical characteristics compare well with that of other grass hays. At any stage slough grass is useful for feeding to livestock, particularly to wintering cows, and should be superior to mature cereal straw. If stemmy, it can be ground to encourage consumption without waste, but grinding such hay is more difficult and requires more power than grinding alfalfa or bromegrass. Supplementation with protein and energy may be necessary and additional vitamin A and minerals *will* be required for any class of stock.

Roadside hay. Much forage goes to waste annually along prairie roadways. Quality will depend on the forage species present, contamination with weeds, when harvested and amount of weathering. Hazards include presence of glass and metal debris in bales. Care should be exercised by both the hay maker and the feeder. Such debris can cause hardware disease and can also do considerable damage to processing equipment (see section 7e).

b. Green Feed (Cereal Hays)

Cereal crops cut in the early dough stage and handled as a hay crop provide a very nutritious forage which can equal good-quality grass-legume hay in feeding value, particularly for beef cattle. At this stage the leaves and stems are green and of good feeding value. As the crop ripens, the feeding value of the plant as a whole decreases, although ripe cereal crops if properly harvested can still be very useful feeds. Oats, barley and wheat hays are usually ranked in that order, other conditions being equal. Fall rye is good but should be harvested by early dough stage to optimize feeding value. If buying

Stack silo can be used to store surplus feed when conventional silos are full or not available. When properly packed and covered to exclude air, silage quality can be excellent.

cereal hay, look for a good green color, lots of leaf material and freedom from spoilage. If the quality is good, cereal hays can make up the bulk of the forage component of the ration for beef and dairy cows, growing steers and heifer calves, and sheep. However, since the protein content will generally be less than for good quality grass-legume hays, it may be necessary to supplement the ration with additional protein, particularly for dairy cows. If lower quality cereal hays are available as the main feed supply it may be advisable to chop or grind (½ in. screen) the material to achieve optimum levels of intake, particularly for sheep and growing steers and heifers. (It will also help to crack ripe kernels of grain, improving utilization.)

c. Silages

Silage can be made from almost any crop grown in western Canada. Sweet-clover, brome-alfalfa, cereal crops, corn and fababean are often used, and mixtures (oat-pea, barley-fababean, alfalfa-corn) are often used to provide a feed with a better energy:protein ratio. Properly sealed silage can be stored for several years.

"Shorter-season" corn varieties are extending field corn growing northward from conventional growing areas. Yields of silage can be excellent but higher moisture at ensiling is often a problem in more northerly regions.

Feeding value depends on crop, stage at which crop is cut, moisture content, and proper ensiling techniques (packing, speed of operation and protection from air).

Silage at 30% dry matter can be substituted for hay of comparable quality at the ratio of 3:1. Silage is bulkier than hay and some classes of livestock may not be able to eat enough to meet their nutritional requirements. Wintering beef cows may be able to more than meet their nutritional requirements when full-fed silage. However, the level of silage may have to be restricted in the case of high-producing dairy cows, pregnant ewes, growing calves and finishing steers to permit feeding of enough higher energy feeds to provide the required level of nutrients. Silage is useful in getting cattle onto feed and as part of the ration for most other classes of ruminant livestock. For further information on silage, see the Saskatchewan Department of Agriculture bulletin *Silage,* available form Animal Industry Branch, Saskatchewan Department of Agriculture, Administration Building, Regina.

d. Cereal Crop Residue

Cereal Straws are frequently used for feeding the wintering beef herd. While oat straw is usually the most nutritious and palatable, barley and wheat straws can also be effectively used. Cereal straw is bulky, low in protein, has little or no vitamin A, and is low in available minerals. However, it can supply useful energy and can be treated to improve its feeding value (see section 8a). Considerable variations in feeding value exist, both within and between cereal crop varieties. For example, large differences in straw of barley varieties have been observed with the feeding value of two-row barleys tending to be higher than that of six-row varieties. When feeding straw-based rations, it is imperative that the animal receive supplemental vitamin A (either by injection or in the concentrate portion of the ration), minerals (including cobalt-iodized trace mineralized salt, calcium and phosphorus) and additional protein (rapeseed meal, alfalfa hay, dehydrated alfalfa pellets, or a commercial supplement). Animals also must have free access to good-quality water at all times to reduce the possibility of rumen impaction. Grinding straw (½ in. screen) will permit increased intake of straw which may be desirable when feeding sheep (since sheep don't take well to long straw) or for growing steers and heifers. However, adequate supplementation of the straw is imperative to prevent rumen impaction. Straw can be used to a limited extent in dairy rations but use should be limited to 8-10 lb/day or less.

When cereal crops are needed for pasture but fencing and water supply pose problems, they may be field chopped and fed to stock on pasture. Extra cost may be offset by more efficient use of heavy stands.

Grazing cereal crop stubble reduces dependance on perennial pasture and stored feed.

If buying cereal straw, look for color (greener the better), leaf material, unthreshed grain kernels and freedom from weeds and spoilage. Some straws may contain sweetclover or other forage used for a companion crop; however, the forage component often deteriorates during swathing and threshing of the cereal.

Chaff is quite variable in composition, depending upon the proportions of grain and/or weed seeds present, and can range in nutritive value from somewhat better than straw to the equivalent of a low-quality hay. Chaff responds very well to ammoniation (see section 8a). Animal intake of chaff is higher than for straw since the chaff is less bulky than straw. Chaff may be collected and stored for use as a winter feed for confined animals, or it may be left in the stubble fields as piles which the animals can use while grazing.

Supplementary protein, minerals and vitamin A will be required when chaff is used as a major ration component.

e. Cereal Grains

Usually barley, oats and wheat are the grains considered as potential livestock feeds on the prairies, although there may be some corn available also. In

Round baling cereal straw. In times of hay shortage, cereal straw supplemented with grain, protein, minerals and vitamin A can provide a satisfactory ration for beef cattle.

feeding of both cattle and sheep it is important to realize that the different feed grains can be substituted readily for each other *on an energy basis*, but *not* on a weight or bushel basis. As a general working rule 5 lb oats = 4 lb barley = 3.5 wheat, corn or rye. Substitutions should be made on this basis.

Cereal grains also supply phosphorus and protein to the ration, but protein adequacy is variable depending upon the grain used (see crude protein content of grains, section 6).

For cattle feeding, the grain should be broken by either grinding or rolling. With sheep there does not appear to be any advantage to processing grain. Wheat can be fed at high levels in steer-finishing rations (80-85%) provided care has been exercised in getting the animals gradually up to this level. The finishing ration should contain at least 10% ground cereal straw to provide some bulk.

Saving cereal crop chaff. Unthreshed grain, broken kernels and weed seeds and fine particles of leaf and seed hulls have a higher feeding value than straw; these can provide a significant portion of the ration for maintaining the beef cow.

f. Screenings

Screenings consist of broken or shrunken seeds, particles of chaff, weed seeds, and other extraneous matter left over after the grain or seed is cleaned for market. Screenings are a highly variable product ranging in value from that of the "parent" crop to that of straw or less. Because of this, it is important to have a representative sample of the lot being purchased analyzed, at least for crude protein content, and preferably for digestibility. If they are relatively free of soil and grit, weight per bushel is a convenient measure of feeding value compared to grain. Where screenings contain a significant amount of small weed seeds, it would be advisable to grind them. Otherwise they may pass through the digestive tract intact and pose a serious weed problem on manured land.

Screenings can be useful in rations for beef cattle and sheep. Unprocessed rapeseed screenings have been self-fed to finishing steers with good results, when obtained at a very low cost. Processing would lead to more nutritional efficient use. Some rapeseed screenings contain large amounts of wild oats.

Screenings from legumes such as alfalfa, clover, peas and fababeans can be high in protein and can be used as a protein supplement in ruminant rations if unit cost of protein compares favorably with that of rapeseed meal or dehydrated alfalfa meal, for example.

g. Other Crop Residues

In areas where forage seed is produced it may be possible to obtain forage straw. The feeding value will depend on the kind of crop, stage of maturity at harvest, and the losses incurred during the threshing processes. Bromegrass and crested wheatgrass straws can be quite palatable. Fababean residue has been found to be quite palatable and suitable as the main roughage for wintering beef cows, provided the leaf and pod material is retained in the residue. Where the product contains mostly stems, it is not palatable and must be supplemented with other feeds to increase consumption. Sunflower residue also has potential as a feed for wintering beef cows. Field pea residue may be useful but has not compared well with good wheat straw in recent tests. Where plant residues are coarse or stemmy, chopping and coarse grinding may be advisable to ensure complete consumption and avoid waste.

5. FEED SUPPLEMENTS FOR BALANCING ROUGHAGE-BASED RATIONS

When formulating rations based on farm-grown feeds it is almost always necessary to supplement with vitamins and minerals and in many cases with protein and energy. The following supplements are available on the market and can be useful in meeting specific nutritional deficiencies in rations to improve animal performance.

a. Energy Supplements

Cereal grains Wheat, barley, oats and corn are excellent sources of energy to use when supplementing rations based on hay, silage or straw. (See nutrient composition, section 6). The use of high-protein wheat can reduce the requirement for purchased protein supplements. Avoid replacing too much good hay with grain in dairy rations or butterfat content of milk will be less. Always introduce grain into rations gradually or problems ("grain poisoning" overload, bloat or other digestive disturbance) may occur. Avoid feeding grain rations that contain 40-60% ground, good-quality alfalfa, as bloat may result. Grain should be cracked, rolled or coarsely ground for best results. Sheep, particularly finishing lambs, do not tolerate high grain rations as well as beef cattle do.

Tallow Add to complete rations at 2-3% to increase energy level and reduce dustiness. Levels in excess of 5% may interfere with rumen function.

Tallow is not recommended for cold weather mixing. When fed to finishing steers at 3% in a ground good quality hay ration, it can be worth up to eight times as much per pound as hay.

Acidulated fatty acids (A.F.A.) This byproduct of the manufacture of canola oil is similar in feeding value to tallow (9.4 kcal/g) but mixes more easily with other ration components. It improves performance of growing-finishing beef cattle on either grain or ground forage rations and reduces dustiness (worth up to seven times the price of grain or 10 times the price of hay/lb when fed at 3% of ration).

Molasses Molasses is useful when fed at a level of 3 to 5% of the ration, in improving palatability of low-quality roughages. Mix with hot water (in equal amounts by volume) and sprinkle over feed at rate of 1 lb/head/day for cattle or add to complete ground ration at 3% by weight. Not recommended for mixing into rations during cold weather. As an energy source molasses is worth about 70 to 80% as much as grain per pound.

b. Protein Supplements

Commercial supplements Most commercially prepared protein supplements are formulated to contain 32% crude protein equivalent. These supplements may be available as either dry pellets or in liquid form. They can be economical sources of protein and contain substantial levels of minerals and vitamins also. The liquid form of the 32% protein supplement appears to be of particular value under feeding regimes where self-feeding is of great advantage, such as during fall grazing. Canola meal can be used effectively as a protein supplement, although there are some practical restrictions on its use in dairy rations. Dehydrated alfalfa (pellets or meal) is an excellent protein source, but is often not economical to use.

Soybean meal May be preferred by dairymen, but likely costs more than canola meal.

Dehydrated alfalfa pellets Supplies carotene and other nutrients in addition to protein. Excellent supplement when feeding unprocessed roughage. Little loss due to wind if fed in open. Check cost against nutrient content.

High protein crops Ground field peas, fababeans and canola (rapeseed) may be used as protein supplements when formulating cattle, sheep or swine rations on the farm (See section 6). The economics of using them will depend on their market value relative to more conventional protein supplements such as canola meal or soybean meal. Excessive levels of canola in dairy cattle rations should be avoided.

c. Minerals

Cobalt-iodized salt Recommended for all ruminant livestock. Feed at 0.5% in complete feeds and feed free choice (usually in block form), *and* in combination (1:2) with calcium phosphate supplement, free choice (keep fresh).

Calcium-phosphorus supplements Required in high-roughage rations. Use a supplement with approximately 1:1 ratio of Ca:P.

Limestone Good source of calcium (38%) if phosphorus not required. (Largely used in high grain rations).

Trace minerals Recommended for all classes of livestock, particularly when feeding low-quality roughages and corn silage. NOTE: Trace mineral supplements formulated for cattle should not be used for sheep since sheep are sensitive to high levels of trace minerals, particularly Cu.

d. Vitamin Supplements

Vitamin A D E (granulated) Used where complete rations are fed or where a grain and/or protein concentrate is fed daily along with roughages (10,000 IU vitamins A/g).

Vitamin A D E (injectible) Product of choice when feeding unprocessed forages. Guarantees each animal gets its share. Use according to directions on package. When using this method of vitamin supplementation, the animal should be reinjected at about 60 days intervals.

e. Miscellaneous Growth Promotants and Additives

These are not recommended for breeding stock or replacement heifers.

Implants

Synovex S & H Recommended for growing-finishing steers and heifers, respectively.

Ralgro Recommended for growing-finishing steers and heifers (NOTE: check with someone familiar with implanting techniques as location of implant is important).

Rumensin

Not recommended for on-the-farm mixing due to requirements for precise levels and thorough mixing. If included in custom mixes for feedlot cattle it may improve feed efficiency by an average of 10% depending on kind of ration and other factors (NOTE: rations containing rumensin are highly toxic to horses).

Antibiotics

Supplemental antibiotics fed at low levels may be useful when fed during stress periods, to beef calves following weaning, and to steers for a few weeks following placing in feedlot. For steers, recommended level is between 70 to 100 mg active ingredient (aureomycin or terramycin for example) per head per day in a complete ration or in the grain portion of the ration if hand fed.

6. COMPOSITION OF FEEDSTUFFS USED IN RUMINANT RATIONS

The values for TDN and crude protein shown in Table 3 are based on averages determined from a large number of samples. Forages (hays, silages) and some crop residues may deviate widely from these values and therefore, wherever possible, representative samples of these feedstuffs should be forwarded to the appropriate provincial feed analysis service for analysis. Cereal grains and protein supplements are much less variable in their composition and cereals should be analysed if kernels are severely affected by frost or drought. Only by utilizing this service can accurate decisions be made regarding efficient use of available feeds.

Taking samples of baled hay. Representative samples of all major feeds available should be forwarded to the nearest feed testing laboratory for analyses to facilitate their efficient use in formulating rations.

Table 3 Average Nutrient Content of Commonly Used Feeds (D.M. basis[1])

Feedstuff	TDN (%)	Crude protein (%)
Energy supplying feeds		
Barley	81	12.0
Oats	73	11.5
Wheat	88	15.3
Corn	88	9.0
Tallow	200	—
Acidulated fatty acids	200	—
Molasses	84	7.7
Protein feeds		
Canola (rapeseed) meal	72	41
Soybean meal	85	49
Linseed meal	77	37
Dehy pellets	62	19
Field peas	85	25
Fababeans	78	28
Canola (rapeseed)	130	22
Hays		
Alfalfa	59	16.2
Alfalfa-brome	56	13.2
Sweet clover	59	14.7
Slough hay	48	9.1
Brome	53	9.3
Crested wheatgrass	53	8.5
Green feed	55	9.5
Silages		
Alfalfa	59	15.4
Sweet clover	58	14.7
Cereal	64	9.5
Corn	68	8.3
Fababeans	68	15.0
Crop residues		
Cereal straw		
—Wheat	38	3.5
—Oats	45	4.0
—Barley	44	3.8
Fababeans	44	6.0
Chaff	45	4.7
Ammoniated straw[2]	51	8.5
Ammoniated chaff[2]	56	11.1

[1] See section on Feed Inventory and Testing for methods of determining dry matter.

[2] Neepawa wheat straw and chaff.

CAUTION: As stated earlier, these data are average values which have been compiled by the Saskatchewan Feed Testing Services as well as from research data. Individual feeds can vary considerably from these values. *Make use of provincial feed analysis services.*

7. POTENTIAL FEEDING PROBLEMS

With any change in the feeding management of the ruminant, problems may arise, particularly when using alternative feeds. A description of some of the more common problems follows.

a. Rumen Impaction

Cattle and sheep forced to subsist on unsupplemented or improperly supplemented rations based on low-quality hay or straw tend to overeat in an effort to meet nutrient requirements. The situation is aggravated during cold weather or when water intake may be inadequate. Under such conditions, the digestive tract or portions of it become overloaded and feed ceases to move. This most commonly occurs in the rumen and/or the omasum, although the abomasum may also become "plugged".

The problem can be largely avoided by feeding recommended levels of grain, protein supplement, minerals and vitamin A and by assuring access to a good water supply (amount and quality) at all times. In especially cold weather, extra grain or good-quality hay will help to keep the consumption of straw to a safe level. Normally the beef cow will consume up to 12 to 14 lb of cereal straw per day which may be considered a practical limit to the amount of unprocessed straw which should be offered.

While grinding roughages for beef cows is not recommended where sufficient quantities of roughage are consumed to meet requirements, there may be a case for grinding straw in times of feed shortage, in order to increase nutrient intake without adding excessive bulk. Supplementation with adequate amounts of deficient nutrients is essential as is the provision of adequate water. Grind as coarsely as possible to assure that consumption under self-feeding conditions is not excessive. If grinding through a ½ in. screen to ensure minimal separation of ingredients such as grain, it is advisable to limit the amounts fed, once or twice daily, to that required to sustain the level of animal performance desired.

b. Nitrate Poisoning

Frost, drought, weed sprays and other factors which cause cessation of plant growth, can result in buildup of nitrates to toxic levels. Peak levels of nitrates are usually reached about 3 days following the growth alteration. In the animal, nitrates may intefere with the respiration process and cause death by asphyxiation (symptom—difficulty in breathing). When high levels of N fertilizer have been used, the situation is aggravated. While deaths have occurred at nitrate levels below 1%, steers grazing oat pasture containing an excess of 2% have shown no adverse effects. Factors such as rate of intake and amount of supplemental feeding may have a bearing on the toxic level. Crops most affected by this phenomenon are cereals (particularly oats) and some of the grasses. The danger of nitrate poisoning on oat pastures is often exaggerated and may unduly deter the livestock producer from using oats for pasture. Good judgement and management must be exercised when grazing oat pastures. If in doubt, have a representative sample analyzed, remove cattle or provide additional feed on pasture to dilute nitrate level.

Oat hay should be analyzed for nitrate content if conditions at harvest time were conducive to nitrate buildup. If high levels of nitrate are present the feed should be diluted with other feeds to bring the average level of nitrate to less then 1%. It is also recommended that vitamin A levels be increased as high levels of nitrate interfere with carotene utilization. Where a problem is anticipated, the farmer may wish to have a treatment available. However, the treatment must be administered quickly after symptoms appear. Treatment consists of an intravenous (into the vein) injection of a 4% solution of methylene blue at the rate of 100 cc for each 100 lb body weight.

c. Sweetclover Disease

When sweetclover hay or silage becomes moldy, a compound (dicoumarol) is formed which interferes with the ability of blood to clot. As a result, animals fed moldy sweetclover may show soft swelling beneath the skin, and may bleed excessively as the result of an injury or operation such as dehorning, castrating, etc. To prevent this problem, sweetclover, if put up as hay, should be baled at less than 20% moisture and stored under a roof or tarp to prevent moisture from entering the bale. Round or square bales left outside will likely mold if any appreciable precipitation occurs. Sweetclover silage may mold if not properly packed to exclude oxygen or if not properly protected from air during storage.

When sweetclover poisoning is recognized in one or more animals, either discontinue feeding the forage in question or alternate its feeding with a better quality hay such as alfalfa or a good grass hay. For acute cases treatment by a veterinarian (administering vitamin K or partial transfusion with blood from a healthy animal) may be necessary.

d. Other Moldy Feeds and Ergot

Because of adverse weather at harvesting or during storage, forages and roughages may be put up at too high a moisture content or may be penetrated by moisture during rainy periods. This can lead to the development of mold and reduce palatability and feeding value. Horses and sheep should not be fed moldy hay, but beef cattle are rarely affected by feed that is slightly molded or spoiled. Where large amounts of molded feed are encountered this should be discarded as there is always some risk in feeding moldy feed.

Moldy cereal grains have reduced palatability and feeding value but are rarely toxic to beef cattle. It may be

advisable to reduce moldiness by running the affected grain through a cleaner (using a good volume of air) and/or to feed it along with other grain to dilute the product (Avoid inhaling mold dust). Should animals become ill on moldy feed, call a veterinarian and replace moldy feed. Some high moisture grass hays, particularly in round bales, may appear to be molded but may in fact have undergone a caramelization process. This material has a sweet smell much different from moldy hay, and is quite palatable to cattle.

Grain containing *ergot* can cause serious problems if fed to livestock. Ergot causes muscular contractions in the uterus and intestinal tract and interferes with the circulation of the blood particularly to the extremities (ears, tail, feet and legs). Symptoms include nervousness, muscular tremors, uncoordinated movement and convulsions and death may result.

Grain containing ergot should not be fed to pregnant or lactating stock. For other stock the tolerance level is considered to be 0.1% ergot (1 g of ergot in 1000 g of grain, or roughly 1 ergot body in 1000 kernels of grain or about 42 ergot bodies in 1 L; a milk carton can be used to measure). It is important to obtain a representative grain sample for inspection.

e. Hardware Disease

Livestock may inadvertently consume nails, pieces of wire and other foreign objects that may lodge in the rumen, puncture the rumen wall, or enter the body cavity or the thoracic area where they may pierce the heart or a lung and cause the death of the animal. Symptoms include going off feed, stiff movement and slightly arched back, standing alone with elbows out or front feet elevated, a rise in body temperature, pneumonia and sudden death.

Prevention is achieved by installing powerful magnets on feed harvesting, conveying and processing equipment. This also saves damage to the processing equipment, particularly grinders and pelleters. A magnet may also be placed in the rumen of the animal to hold foreign objects and prevent penetration of the gut. In times of feed shortages feeds, particularly hay, may be harvested from areas or fields not noramlly used for hay production (roadside ditches, sloughs, pastures, etc.) where debris may have accumulated. Careful checking of feed from such areas would be advisable.

f. Awns

Cereal crops including barley, wheat and durum wheat may have awns which are irritating to the animal. Wild barley also possesses this characteristic. As well as the irritation aspect, which reduces palatability, there may be some danger from awn penetrating the tongue or mouth and producing absesses, lumpjaw or "wooden tongue" in the animals. This may be a problem associated with chaff use more so than with straw.

g. Pesticide Residues

Crops treated with some pesticides (both herbicides and insecticides) require a waiting period before they can be used as livestock feed. It is advisable to check with suppliers of cereal hays and straws to determine which pesticides, if any, were used in their cropping program and whether appropriate label precautions were respected. This would be especially important with feed for dairy cattle, but is also significant in beef production. A few examples of precautions that should be taken:

Do not graze fields treated with Hoegrass for at least 21 days after application.

Do not use manure from animals fed straw from a crop treated with Tordon 202-C on fields used to grow sensitive crops, such as sunflowers, beans, peas, potatoes, tomatoes, alfalfa and sugar beets.

Do not graze or feed crops treated with Sencor, Lexone to livestock within 30 days of application.

Do not feed crops treated with Mecoprop, Compitox, Mecoturf to livestock.

8. INCREASING THE VALUE OF FEEDS

Feeding value of roughages can be increased by chemical, physical and nutritional means. Ammoniation of cereal straws, low-quality forages and crop residues has been found to improve digestibility, nitrogen content and voluntary intake. Chopping and grinding of hay increases intake, rate of gain and feed conversion efficiency, especially when hay is of low quality. Supplementation with deficient nutrients or the use of special feed additives can also improve efficiency of feed utilization.

a. Ammoniation

Ammoniation of cereal straw, chaff, and a number of other crop residues has been shown to increase their digestibility, nitrogen content, and voluntary intake by

Treating baled straw stacks with ammonia to increase feeding value.

ruminant animals. In many cases, large improvements in nutritional value of crop residues have occurred enabling these materials to be incorporated in diets for sheep and beef cattle at much higher levels than recommended for the untreated materials (see section 10). The use of ammonia as a treatment method has been developed into a farm-scale operation by Kernan *et al.* (1977). A number of restrictions upon the method have come to light and should be outlined.

1. A reaction requires a mimimum time of 3 weeks during early fall when temperature is relatively high (above 10°C). Late in the year when the temperature is much lower there is uncertainty as to the length of time required and the extent of the reaction, although reaction will undoubtedly be reduced.
2. The straw should contain a minimum of 12% moisture for the reaction, although increases in nutritive value are larger at higher moisture levels.
3. To carry out the process, specialized equipment is required. In particular, pressure couplers and steel pipe are needed for application of the ammonia. The availability of this equipment is limited. For plans on construction of pipes and appropriate couplers refer to Kernan *et al.* (1977).
4. Ammonia can be hazardous to the operator unless handled by qualified personnel such as a dealer of anhydrous ammonia fertilizer.

Costs of ammoniation appear to be close to $20/ton which would provide a roughage with nutritive value close to that of a medium-quality grass hay. It must be pointed out, however, that quality improvement may vary depending on the type and quality of material to be treated and the reaction conditions.

Ammoniation of chaff increases its nutritive value even more than that of straw and has the additional advantage of destroying the viability of seeds in the chaff. The economic importance of this is unclear, but may be relevant in light of present trends toward minimum tillage.

Ammoniation of high moisture, (35%) high-quality alfalfa hay with 2% ammonia by weight (with the polyethylene cover left in place for 21 days) has been found to completely inhibit molding. Losses of TDN were 20% less than for the untreated high moisture control and 9% less than for the untreated low moisture control. TDN intake and daily gains of sheep were superior to that of sheep fed the low moisture control hay. This treatment may well have a place in preserving high-quality hay during unfavorable harvesting weather.

For detailed procedures for ammoniation of cereal straw refer to publication #329 of the University of Saskatchewan, which may be obtained from Mr. J. Kernan or Dr. E. Coxworth, Saskatchewan Research Council, 30 Campus Drive, Saskatoon, Saskathewan.

Hay and straw can be ground with a tub-grinder to increase consumption of self-fed roughage. Supplemental feed can be fed daily as required.

b. Chopping and Grinding Forages and Straw

When ruminant livestock cannot consume enough dry hay or roughage to meet nutritional requirements, intake can be increased by chopping or grinding. This way be particularly important when there is an abundant supply of roughage and grain is scarce or high priced. When roughage supply is limited it may also be necessary to ensure complete consumption of coarse stems, moldy portions, etc. Grinding prevents selective consumption and helps to mix and thus dilute portions of the ration which by themselves are unpalatable or possibly toxic. Experiments have shown that grinding stemmy sweetclover hay (11.3% crude protein) through a 1/2 in screen increased the feed intake of wintering steer calves fed an all-hay ration by 50%, doubled the rate of gain, and increased feed conversion efficiency by approximately 25%. Wintering heifer calves have been fed ground (1/2 in. screen) rations containing up to 52% ground wheat straw supplemented with grain, canola meal, minerals and vitamin A. Gains have averaged close to 1 1/2 lb per head/day over 255 days.

Processing baled hay through a grinder-mixer permits proper mixing of supplements and grain and increases rate of gain, particularly for growing stock fed low-quality hay.

A ground (½ in. screen) good-quality brome alfalfa finishing ration. Grinding forage for growing-finishing steers and heifers increases rate of gain and improves feed efficiency.

In general, grinding poorer quality forages produces the greatest percentage improvement in animal performance. Grinding does not in itself make the feed any more nutritious; in fact it reduces the digestibility of the feed slightly, but because animals can consume more, a larger proportion of the feed intake is available for production (growth), and a smaller proportion is used for maintenance. Grinding exposes more forage surface area to the action of microorganisms and enzymes and reduces the "protective" effect of lignin which in some feedstuffs surrounds digestible crude fiber and other nutrients. Grinding also increases the ratio of propionic acid: acetic acid in the rumen which improves feed efficiency in beef cattle but reduces butterfat content of milk. For this reason grinding (and pelleting) of roughage is not generally recommended for dairy cattle although part of the roughage could be so processed and used providing it is fod with some long, good-quality hay or silage.

Guidelines

Don't grind forage for any class of ruminant livestock when the animal is capable of consuming amounts adequate to meet nutritional requirements. Grinding palatable rations for beef cows results in either overfeeding (wastage of feed) or the need to limit feeding (labor is wasted and cows have unsatisfied appetites).

Grind through 1/2 in. screen. Courser grinding may be all right for good-quality hay when self-fed "as is". However, coarser ground material will allow other ration ingredients to settle out during handling and in self feeders, and may lead to bridging in the mixer and self feeder. Finer grinding may be better for very low quality roughage but costs are too high.

Efficient grinding requires a high capacity grinder and a tractor large enough (100 hp or more) to handle it. Power requirements increase considerably as the moisture content of the hay increases. That is why it is important to put hay and straw up in a dry condition (less than 20% moisture) and to protect it from taking on moisture. Also grinding damp hay leads to bridging and may promote heating in large self feeders if left too long before feeding. Where complete rations are to be processed, use a grindermixer. If forage is to be self-fed and supplementary feed hand fed, a tub grinder may be used. (If roughage is in the form of round bales, a tub grinder will have to be used.)

For growing-finishing cattle avoid the use of rations made up of 40-60% ground alfalfa or other "bloat-prone" legume hays, fed with grain. If gradually moving from a high forage to a high grain ration, use lower quality hay or dilute with ground straw over this range. Otherwise, bloat may occur.

Consider adding acidulated fatty acids (or tallow) at 3% to ground forage rations to reduce dust and increase energy.

When using high levels of poor-quality roughage in the diet, proper supplementation is essential to avoid impaction.

Since many livestock producers will be using unfamiliar feeds or rations during periods of feed showtage, they should keep a close watch over animal performance and adjust rations as necessary to meet production requirements. A livestock scale would be a real asset in checking animal performance at regular intervals (2 weeks).

c. Using Supplements, Additives, Implants

Feeds lacking specific nutritional factors are inefficiently utilized. Making up deficiencies in energy, protein, minerals and vitamins can markedly increase rate of gain, feed conversion efficiency or milk production and enable the efficient use of low-quality feeds and coopresidues. The use of growth promoting implants (for heifers and steers destined for slaughter) normally increases rate of gain by 10% or more and improves feed efficiency under full feeding conditions on pasture or drylot. The use of additives such as monensin which alter fermentation in the rumen can increase feed efficiency by 10% but should be used under carefully controlled conditions and only for feedlot finishing of beef cattle.

9. BEDDING REQUIREMENTS

Bedding is required in most livestock operations except slatted floor facilities. Quantity required per head will depend on the kind of ration (more when high-forage rather than high-grain rations are fed), drainage (slope and soil type), humidity, temperature, precipitation, kind of shelter, type of bedding and density of stocking. Commonly used bedding materials (with pounds required to absorb 100 lb of water) are wheat straw (45), oat straw (35), chopped straw (20-30), soft wood shavings (25), and sawdust (25).

The table below gives estimated bedding requirements in pounds per animal per day (tons per year assuming a 200 day winter period).

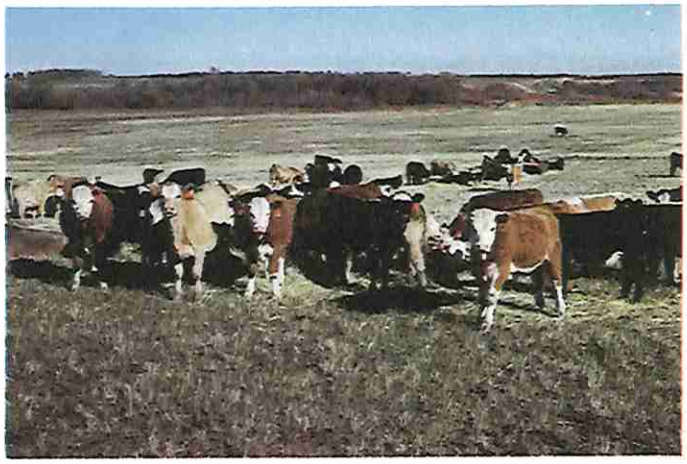
10. PRACTICAL FEEDING SYSTEMS FOR WINTERING BEEF CATTLE AND SHEEP

There are many possibilities for combining feedstuffs into adequate rations for beef cattle and sheep. In this section a number of rations which have been used successfully are presented. For all situations shown, cobalt-iodized salt and dicalcium phosphate (18% Ca, 20.5% P) should be mixed in a 2:1 ratio and supplied on a free-choice basis, with additional cobalt-iodized salt blocks available. In many areas there may be a requirement for certain trace minerals also, and therefore it is recommended that the dicalcium phosphate be obtained as a trace mineralized product.

NOTE: In these rations particular grains are specified. However wheat, barley and oats can be readily interchanged depending upon cost and availability. The interchanges must be made on the basis of TDN levels. A working formula for interchange of grains is 5 lb oats = 4 lb barley = 3.5 lb wheat.

a. Beef Cow Rations

Problems often occur in many areas of the prairies in achieving adequate dry matter contents of corn silage. The rations at the beginning of page 23 are based on corn silage which contains 65 - 68% moisture. At higher moisture levels, animal intake must increase and may become inadequate to supply the animals' requirements.



Weaning calves 2 to 3 weeks before freeze-up and placing them on pasture reduces stress normally caused by weaning and immediately placing on dry food. It also allows cows to improve in condition before going into the winter.

b. Wintering Beef Calves

Heifers

Heifer calves can be fed a wide variety of rations with satisfactory results. Good-quality legume-grass forage is preferable in terms of its effects on long-term reproductive efficiency but medium-quality hay, cereal and grass silages can also be used with good results. Low-quality hays and cereal straws can also be used with good results. Low-quality hays and cereal straws can be utilized effectively, particularly if chopped or ground and properly supplemented with grain, protein, mineral and vitamin A supplements. Growth-promoting implants are not recommended for heifers destined for breeding but

	manure pack loose housing	free stall loose housing	tie stall housing
Dairy Cattle			
Milk cows	15(1.5)	4(0.4)	8(0.8)
Dry cows and heifers	8(0.8)	2(0.2)	4(0.4)
Calves	3(0.3)	1(0.1)	2(0.2)
Beef Cattle			
Cows & bred heifers	4-8(0.4-0.8)		
Yearlings	3-6(0.3-0.6)		
500 lb calves	3-4(0.3-0.4)		
Sheep			
Ewes and rams	0.75(0.08)		
Feeder lambs	0.25(0.03)		

Note: It is good practice to remove all twine from straw when bedding pens. Consumption of twine can cause serious problems and interfere with manure handling.

adjusted for such constituents as vitamins and antibiotics to ensure that the animal receives the required daily intake (i.e., if it is necessary to increase the grain mix from 2 to 4 lb per head per day, for example, the percent of vitamin A and antibiotics in the supplement should be halved). A mineral mix made up of 2 parts of dicalcium phosphate (18% Ca, 10.5% P) to 1 part of cobalt-iodized, trace-mineralized salt should be available free choice in all cases, as well as cobalt-iodized block salt. It may be preferable to inject vitamin A to ensure that all animals get the required amount. Vitamin D is not needed for animals exposed to the sun.

Steers

Steer calves are normally fed for growth rather than fattening during the winter. If steers are to make good gains when placed on pasture the following summer, it is important that rate of gain during the winter be restricted to at 1—1¼ lb per day. If, on the other hand, steers are to go into a feedlot, the rate of winter gain can be increased to between 1½ to 2 lb daily without adversely affecting animal performance. Where feed supplies are short, producers may opt to feed out all calves at lower rates of gain to assure adequate numbers for pasture of feedlot next spring, even though it may mean less efficient use of feed in terms of gain produced per unit.

For efficient performance, particularly when feeding for higher rates of gain, steers should be implanted with Synovex S or Ralgro. (They should receive a second treatment when placed on pasture or into the feedlot).

When rapid gains are desirable, where grinding-mixing facilities are available, and where forage supplies are ample but of poor- to medium-quality it may be useful to feed all-ground rations (½ in. screen). This will also permit inclusion of supplements at uniform levels (see sections 5 and 8b).

Wintering beef cows with minimal shelter. A slatted fence, bedded mound, self-feeder for straw, feeding bunk for supplemental hay, silage, grain etc., and a calving shelter (with heat lamp) can provide adequate care at reasonable cost.

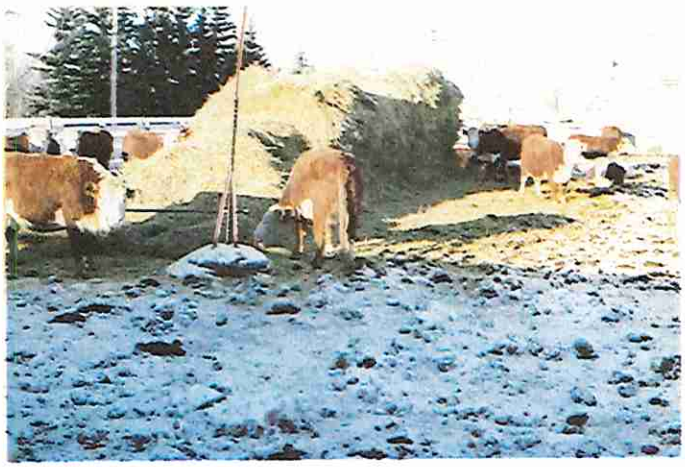
Rations for wintering steer calves (450-750 lb)

(a)	Brome alfalfa hay (long)	12 lb
	Rolled barley	6 lb
	Cobalt-iodized salt	0.12 lb
	Dicalcium phosphate	0.1 lb
	Vitamin A powder (10,000 IU/g)	2 g
	Aurofac 10	6 g
	Average daily gain (lb)	2.15
	Feed/lb gain	8.5
(b)	Dehy pellets	4 lb
	Ground barley straw	7 lb
	Rolled barley	7 lb
	Cobalt-iodized salt	0.14 lb
	Dicalcium phosphate	0.18 lb
	Vitamin A powder (10,000 IU/g)	3.2 lb
	Aurofac 10	9 g
	Average daily gain (lb)	2.18
	Feed/lb/gain	8.4
(c)	Crested wheatgrass hay	11.0 lb
	Rolled barley	5.5 lb
	Cobalt-iodized salt	0.1 lb
	Dicalcium phosphate	0.1 lb
	Vitamin A powder (10,000 IU/g)	1.6 g
	Aurofac 10	4.8 g
	Average daily gain (lb)	2.04
	Feed/lb gain	8.2
(d)	Ground crested wheatgrass hay	13.9 lb
	Rolled wheat	3.5 lb
	Cobalt-iodized salt	0.1 lb
	Dicalcium phosphate	0.18 lb
	Dry Vitamin A (10,000 IU/g)	1.6 g
	Aurofac 10	4.5 g
	Average daily gain (lb)	2.60
	Feed/lb gain	6.8
(e)	Ground crested wheatgrass hay	13.5 lb
	Rolled wheat	3.45 lb
	Acidulated fatty acids	0.53 lb
	Cobalt-iodized salt	0.1 lb
	Dicalcium phosphate	0.18 lb
	Dry Vitamin A (10,000 IU/g)	1.6 g
	Aurofac 10	4.5 g
	Average daily gain (lb)	2.96
	Feed/lb gain	6.0

Cobalt-iodized salt, dicalcium phosphate, vitamin A, and Aurofac 10 are mixed with the grain either in large quantities or daily. The effect of acidulated fatty acids on increasing weight gains and feed/lb gain is obvious by comparing d and e.

The above rations have been fed to wintering steer calves with the results shown. If feeding for lower rates of gain, the amount of these rations fed daily could be limited. If self-feeding is to be practised, the proportion of roughage to grain could be increased (i.e., energy level of the ration reduced).

A slotted fence and well-bedded mound provides good protection from wind and wet ground, saving feed energy for production.



Self feeding straw to wintering beef cows. The use of electric fence and movable posts facilitates feeding with minimal wastage.

c. Ewe Rations

Sheep do not consume straw as readily as do cattle, particularly when the straw is fed in long form. Chopping or grinding does improve straw utilization by sheep; however, care must be taken to ensure adequate supplementation to prevent impaction. The shorter gestation period of the ewe and the effectiveness of flushing for rebreeding necessitates some changes in sheep rations based on straw from those for cattle. For flushing, 1 lb of whole barley or oats per ewe per day is effective when the fall pasture is inadequate. During late pregnancy the grain allowance of the ewe should be increased to about 2 lb per head per day.

The intake data are applicable to the first 15 weeks of pregnancy. The grain allowance may need to be increased from 15 weeks until parturition, depending to the condition of the ewe.

d. Wintering Replacement Lambs

There is little information available on rations for wintering replacement ewe lambs under prairie conditions. The lamb has a relatively small digestive capacity in relation to its body size and requirements for growth. Therefore the rations must contain a TDN level of about 60%. Growing lambs in the range of 60 - 80 lb will

Amounts of Feed Required to Winter a Pregnant Beef Cow (lb)

Ration base		Straw	Hay	Grain	Silage	Other
Straw	(a)	2800	800	800	—	—
	(b)	2800	1200	—	—	200 (32%)
	(c)	2800	—	—	—	1600 (range pellets)
Ammoniated straw						
	(a)	3600	—	1000	—	—
	(b)	3600	400	600	—	—
Chaff		3600	—	800	—	200 (32%)
Brome-alfalfa		—	4400	—	—	—
Slough hay		—	3200	1000	—	—
Native hay		—	4000	400	—	—
Green feed		—	3600	600	—	—
Brome-alfalfa silage		2400	—	500	5000	—
Cereal (corn) silage		2400	—	—	5000	200 (32%)

Access to cobalt-iodized salt blocks and a salt-mineral mix at all times, as well as vitamin A supplementation is assured.

normally eat about 3 - 3 ½ lb/day of a 60% TDN ration based on forage. Straw is of limited use in such a ration unless under very high grain levels and appropriate supplements are also supplied.

Amounts of feed required to winter steer calves at different rates (lb) of gain (190-day feeding period)[1]

A.D.C.	Brome-alfalfa hay	Barley	Protein suppl (33%)	Self mineral mix
0.05	1370	300	64	8
1.0	1750	400	85	11
1.5	2125	480	110	14

Steers gaining 1.5 lb/day were full-fed, those gaining 0.5 and 1.0 lb/day were hand fed amounts required to produce rates of gain indicated. All received vitamin A in the feed.

[1] Plus free access to cobalt-iodized block salt and a salt-mineral mix (1 salt:2 calcium phosphate).

Ewe rations

Feedstuff		Intake (lb/day)
Straw-based		
(a)	Straw	1 ½ lb
	Alfalfa	2 lb
(b)	Straw	1 ½ lb
	Alfalfa	1 lb
	Barley	1 lb
(c)	Straw	2 lb
	Range pellets (20% Protein)	1 ½ lb
(d)	Ammoniated straw	2 ½ lb
	Oats	1 lb
(e)	Chaff	2 ½ lb
	Oats	1 lb
Hay-based		
(a)	Brome alfalfa hay	2 lb
	Oats	1 lb
(b)	Slough hay[1]	2 lb
	Barley	1 lb
(c)	Green feed[1]	2 lb
	Barley	1 ½ lb
(d)	Native hay	2 lb
	Oats	1 lb

The intake data are applicable to the first 15 weeks of pregnancy. The grain allowance may need to be increased from 15 weeks until parturition, depending on the condition of the ewe.

[1] With pregnant ewes fed green feed or coarse slough hay there may be significant wastage unless the material is chopped or ground, thus barley rather than oats should be fed to compensate for this wastage.

Replacement lamb rations

Feedstuff		Intake (lb/day)
(a)	Suncurred alfalfa pellets (15% crude protein)	3 lb
(b)	Legume hay	2 ½ lb
	Barley	1 lb
(c)	Straw (ground)	1 ½ lb
	Protein supplement (32%)	0.5 lb
	Barley	1 ½ lb

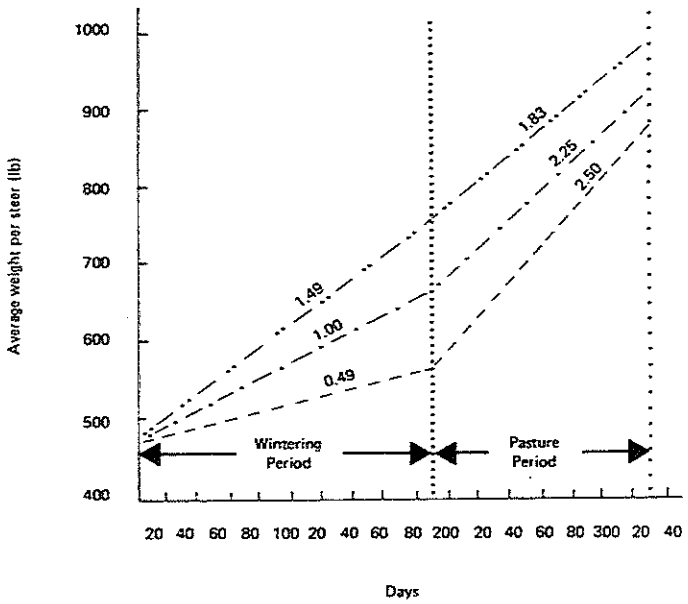
Lambs do much better when the forage component of the ration is ground (½ in. screen).

11. LOOKING AHEAD

Unfortunately, measures to deal with drought situations are too often "too little, too late". Producers, researchers and government officials all tend to have short memories once the threat of drought is over and they become involved in dealing with other, more pressing problems of the moment.

There is a need for *long-term planning* to reduce the adverse effects of drought in the future. Experience has shown that droughts of varying degrees of severity recur every few years and usually catch everyone unprepared to meet the "emergency" situations brought on by pasture, feed and water shortages.

While it is beyond the scope of this bulletin to deal with long-term planning, perhaps some suggestions may be in order.



Relationship between winter and pasture gains of growing beef cattle.

1. *Aim to build up a reserve of at least one year's feed supply* by properly storing all or part of surplus hay, straw, silage and grain. Properly cured hay will store for 2 or 3 years if placed under a roof, silage will store for several years without appreciable nutritional loss if protected from spoilage (air), straw can also be stored under a roof (plastic will deteriorate after a few months of wind and sun) and, of course, grain will keep for several years if protected from spoilage and insects.

2. *Consider routinely growing some oats* or other productive annual cereal crop which could, in an emergency, be used to supplement perennial pastures, either by grazing or by mechanically harvesting and feeding on pasture. If not required, it could be harvested as hay, silage or as grain and straw.

3. *Assess the feasibility of using irrigation.* Largely because of the side effects of modern farming methods (excessive clearing of trees and bush, draining sloughs, etc.) much potentially useful water runs off agricultural lands each spring. If this could be stored and used for irrigating even a few acres of alfalfa (which could supplement rations based on cereal straw) the result could well be worth the effort, particularly in times of hay scarcity.

4. *Look at methods of increasing forage production,* both pasture and hay, to lengthen the *productive* grazing period (shorten the winter feeding period) and provide the extra feed required to build up a reserve. Effective use of commercial fertilizers and of farmyard manure could have dramatic effects in increasing yields. Rotational grazing of pastures can also be effective in increasing production. Resist the temptation to increase numbers of livestock to equal the feed supply available, otherwise there won't be any surplus for the reserve.

5. *Effectively utilize available feed supplies at all times.* Avoid wastage and consider increased emphasis on the use of crop residues and other non-conventional feeds for the wintering period. Closer cooperation between livestock and grain producers may lead to increased effectiveness for both parties.. For example, livestock producers could provide a market for forages produced by grain farmers who would like to include forages in their rotations in the interest of better soil management. Manure from livestock operations could be applied on adjacent grain farms.