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Drylot Beef Cow-Calf Production

Photo: NDSU Carrington Research Extension Center

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Why Consider Drylot?

The drylot beef cow-calf enterprise is an alternative management system to traditional pasture or range beef production. Strictly defined, it is feeding confined cow-calf pairs in a feedlot environment during part or all of the traditional summer or fall-winter grazing season.

In a practical sense, it means feeding confined cows and calves forages, crop residues and grains that may have more value marketed through cattle than as a cash crop. Many cattlemen manage their cows in a drylot during the winter and after calving until pastures are ready. Advantages and disadvantages to consider include:

Advantages

- Increased marketability of crop residues, forages and other feedstuffs
- Opportunity for close/daily observation of the herd
- Easier synchronization and artificial insemination
- Increased number of cows per bull with natural service
- Flexibility of management (drylot during breeding or prior to weaning)
- Very low weaning stress for calves
- Easy transition to backgrounding because calves are "bunk broke"
- More beef produced per acre due to efficient machine harvest vs. grazing
- Allows for pasture and rangeland rest and/or restoration
- Market for damaged grains such as frost-damaged, drought-stressed, sprouted or otherwise damaged crops
- Good market alternative for inexpensive feedstuffs
- Extends production life of broken-mouth cows
- Maximizes use of facilities
- Increased manure accumulation for fertilizing cropland
- Marketing flexibility
- With careful management, cost of production can be competitive with other production systems

Disadvantages

- Increased labor and equipment is required for feeding
- More manure to spread because cattle are not on pasture
- More rapid depreciation of facilities and equipment
- Greater level of management needed for ration balancing and herd health
- Potential for increased crowding and associated stress
- Potential for more rapid spread of contagious diseases
- More challenging environment (dust, mud, flies, etc.) for cattle
- More harvested feed required for lactation and creep rations
- Increased odor from manure

Drylot production systems likely will not replace traditional grazing systems for beef cattle production, but in some situations, they may supplement grazing practices or be a viable alternative management system. Drylot production is an option during a drought, or when expanding a cow herd or an operation has experienced a loss of pasture resources. Drylot production systems may allow new cattlemen the opportunity to start a herd without a large investment in land.

Dairy farmers wanting to reduce labor inputs and still utilize feed storage and cattle facilities could switch to drylot beef cows. Farmers with weather-damaged or low-value crop products, such as screenings, sprouted grains and straw or stover, may be able to add value to these feedstuffs by marketing them through a drylot cow herd.

Some crop rotations may benefit from high-yielding forages that are harvested as silage or hay and marketed through drylot beef cows. Modeling studies suggest a typical eastern North Dakota farm of about 2,000 acres with conventional cropping could support 85 beef cows without deliberate feed production on the cropland acres. The addition of a drylot beef cow enterprise would increase and stabilize net income and improve the biological and economic sustainability of this farm.

Photo: NDSU Carrington Research Extension Center

Nutrition

The critical period for drylot beef cows corresponds to the normal production calendar. Adequate nutrition must be provided for a cow to produce milk at her genetic potential plus return to estrus and rebreed for a 365-day calving interval.

A wide variety of feedstuffs can be used in balancing cow rations. Ingredients should be analyzed for nutrient content and rations balanced to meet requirements based on milk production, cow condition, age and cow size. The National Academies of Science, Engineering, and Medicine Nutrient Requirements of Beef Cattle (2016) provides basic nutritional information on dry matter (DM), energy, protein, minerals and vitamins for a wide range of cow weights and milking abilities.

Feeding by Nutrient Requirements

Cow-calf pairs should be sorted and fed by nutrient requirements to avoid overfeeding or underfeeding. Young, thin cows and first-calf heifers need more energy and protein in their diets and should be penned and fed separately to meet their needs. Mature cows in good flesh need less energy per equivalent body weight. Dominant cows may prevent more timid animals from eating when feeder space is limited.

The number of pens should allow for sorting and feeding cows in groups according to age, condition and stage of gestation/lactation. Different nutrient requirements based on milk production, cow condition and other factors may require additional pens for optimum use of feed resources. Breeding systems may impose additional pen requirements to expose cows to the desired sire.

After the breeding season is over, sorting cow-calf pairs by sex of calf will permit higher-energy creep rations to be offered to steer or bull calves for faster growth and easier transition to the feedlot. Heifer calves should be offered a low to moderate energy creep diet to minimize fat deposition in the udder, which can affect milk production potential negatively.

Feedstuffs

Cows can utilize a wide variety of feedstuffs as long as the ration is palatable and balanced for the cow's needs and genetic potential. Several years' experience with a drylot beef cow herd at the NDSU Carrington Research Extension Center has validated the concept that a balanced ration formulated to meet the cows' needs supports healthy and productive animals with excellent reproductive performance.

Corn grown for silage produces more energy per acre than any other crop. Corn silage is very palatable and conditions a ration with other ingredients. Alfalfa is excellent forage as haylage or dry hay and provides protein, energy and minerals. Nondairy-quality alfalfa or mixed grass-alfalfa forages should be fed at economic and nutritionally appropriate levels.

A wide variety of feeds can be used for drylot cows. Consider cost per unit of protein and/or energy in purchasing and feeding these ingredients and include transportation and storage losses.

Most all crop residues, Conservation Reserve Program hay, ditch hay, slough hay and other low-quality forages can be used in drylot diets when properly supplemented. Forages that are very low in quality or digestibility should be used sparingly in cow rations because rumen impaction can occur. This is especially true when these low-quality forages are chopped and included at higher proportions of a dry diet.

Table 1 shows example rations for lactating beef cows. Ration 1 below has been used successfully for cows of average milking ability at the NDSU Carrington Research Extension Center Livestock Unit. Ration 2 resulted in a few more open cows than Ration 1, but cow and calf growth were satisfactory. Ration 3 is a no-silage diet for average milking cows.

If 100 percent hay rations are considered, analysis for protein and energy are critical. Grain and other supplemental energy or protein can be fed to make up any shortage of nutrients. Distillers grains with solubles are commonly used in cow rations. Rations 5 and 6 provide example diets with ethanol coproducts. Condensed distillers solubles, a liquid coproduct, are useful when mixed with low-quality forage and are an excellent ration conditioner.

The amount of mineral supplied in the diet will vary with feeds included in the ration. As a general recommendation, cows should be provided with trace mineral salt and a calcium (Ca)-phosphorus (P) mineral supplement to achieve a Ca-to-P ratio of 1.5-to-1 in the entire diet. The use of distillers coproducts or grains may eliminate the need for a phosphorus supplement.

A mineral mix can be fed free choice, but mixing it in the ration ensures more uniform intake. Cows fed high volumes of crop residue may require more careful mineral supplementation because crop residues tend to be lower in minerals, compared with other forages such as alfalfa or grass hay. Give special consideration to mineral supplementation if deficiencies or toxicity problems are known.

With the increased use of distiller grains with solubles in beef cow rations, fat and sulfur levels should be monitored closely. The maximum sulfur (S) level ranges from 0.3 to 0.5 percent, according to the National Academies of Science, Engineering, and Medicine Nutrient Requirements of Beef Cattle (2016).

Table 1. Rations for Lactating Beef Cows in Drylot (Percent As Fed).

Ingredient	Ration 1	Ration 2	Ration 3	Ration 4	Ration 5	Ration 6
Corn silage (35% DM)	70	78	-	-	-	-
Alfalfa-grass hay (15% CP)	30	-	80	18	-	-
Sunflower meal (39% CP)	-	12	-	-	-	-
Grass hay (11% CP)	-	-	-	-	40	-
Straw or stover	-	10	20	32	23	36
Wheat midds	-	-	-	50	-	-
Dry distillers grains w/solubles	-	-	-	-	37[a]	-
Wet distillers grains w/solubles	-	-	-	-	-	64[a]

[a]These diet formulations should be considered examples of upper limits of distillers grains with solubles and also assume relatively lower levels of fat and sulfur in the coproduct used.

At the low end of the range (0.3 percent) are high-concentrate diets that result in greater production of hydrogen sulfide gas in the rumen, compared with forage-based diets. Diets for cows may approach the 0.5 percent maximum level because these diets generally contain much greater levels of forage or roughage.

The calculation of dietary S intake must include S present in the feed and the water. In some areas, high-sulfate water may contribute the majority of the S intake for beef cattle.

Excess dietary S can be a problem for ruminants for two reasons. First, high levels of sulfur (above 0.3 to 0.5 3 percent of diet dry matter) from feed and water can lead to polioencephalomalacia (PEM). Second, sulfur interferes with copper absorption/metabolism. Producers in areas with suspected high sulfate in the water should test their water.

Table 2 provides examples of various inclusion rates and sulfur contents for distillers grains with solubles and the impact on overall dietary S content in a corn- and corn silage-based diet. Notice the table has several situations that are close to or above the suggested maximum level of sulfur in the diet. The table is for example purposes only. Producers are encouraged to work with a nutritionist to formulate diets with appropriate S content for their production environments.

The fat or oil content of cattle diets should not exceed 5 to 6 percent of dry-matter intake. Ethanol coproducts such as distillers grains plus solubles and condensed distillers solubles, as well as oilseeds such as sunflower, soybean and canola, are high in oil content. Diets with greater than 6 percent oil or fat content can have detrimental effects on fiber utilization. Consequently, take care when formulating diets containing these feedstuffs.

Table 2. Sulfer Content Scenarios for Beef Cow Diets.

Inclusion rate, % DM	Sulfur Content of Distillers Grains		
	.60%	.80%	1%
20	.21	.25	.29
30	.27	.33	**.37**
40	.33	**.41**	**.49**

Limit Feeding or Partial Restriction of Hay

Hay-restricted diets can be economical during winter feeding of gestation diets or summer lactation rations. Producers need secure facilities to control hungry cattle for these types of diets. For producers with marginal facilities, substituting grain for only part of the hay or roughage is advised. A minimum of 0.5 pound of hay per 100 pounds of body weight is suggested (6 pounds of hay/day for a 1,200-pound cow).

During extremely cold weather or in pastures with little winter protection, hay could be increased to 0.75 pound of hay per 100 pounds of body weight or 9 pounds of hay/day for a 1,200-pound cow. Additional forage can be provided in the form of low-quality hay, straw or stover bales placed in hay feeders. However, this hay must be purchased or harvested at a low price to maintain an economical diet.

Substituting grain for hay is economical when forages are in short supply or very expensive. In the past, grains often have been priced ***lower*** per unit of energy than hay but often ***higher*** per pound. In this scenario, smaller amounts of grain must be fed to substitute economically for hay.

Feeding a restricted amount of grain with little or no forage can be a management problem because cows will compete for any available forage and “work the fences.” The following list includes recommendations from The Ohio State University (OSU) for limit feeding grain to 1,300-pound beef cows.

- Midgestation cows (November-December): Feed 4 pounds of first-cutting hay; 2 pounds of 36 percent protein, vitamin, mineral supplement; and 1 percent of cow body weight of corn per cow (for example, 13 pounds for a 1,300-pound cow). For late gestation and/or very cold weather, increase the corn an additional 2 to 3 pounds per head per day.
- Feed corn whole. Whole corn works better than ground corn when daily hay intake is limited to less than 5 pounds per day.
- Adjust corn intake to achieve the desired weight and/or body condition score.
- When starting the program, take three to four days to increase the corn and decrease the hay to the 4-pound level. Make sure bunk space is adequate so all cows get their share and that cows are in a securely fenced area.

- Table 3 is an example supplement (feed at 2 pounds/cow/day).

Ward et al. (2004) at South Dakota State University replaced alfalfa hay with increasing levels of dry-rolled barley to mid- and late-gestation cows from January to April. Control cows consumed 20 to 23.5 pounds of hay. The "low" barley treatment group consumed 5.3 to 6.2 pounds of barley per day with 12.5 to 13.9 pounds of hay. The "high" barley group ate 10.6 to 12.6 pounds of barley plus 4.9 to 5.7 pounds of hay daily.

A protein/trace mineral supplement was fed to all cows at 0.5 pound per head per day that provided 200 milligrams of Rumensin per head. Both barley groups gained more weight and body condition than cows fed alfalfa, with similar pregnancy rates observed during the following breeding season.

Alternative Feeds

All potential feeds available in the region should be considered in drylot production. The conventional feedstuffs include corn, milo and sorghum silage; alfalfa hay and haylage; prairie hay; brome grass hay; millet hay; corn, milo and millet stover; cereal grain hay and straw; soybean meal; soybean hulls; canola and canola meal; sunflowers and sunflower meal; flax; linseed meal; barley; barley malt; wheat; wheat middlings; corn gluten feed; distillers grains plus solubles; condensed distillers solubles; field peas; dry beans; oats; and sorghum, as well as minor grains such as rye and millet.

Other feeds that are useful include potato-processing products, sugar beet coproducts such as wet and dry beet pulp, beet tailings, molasses and de-sugared molasses; screenings of all kinds; hulls of all kinds; and food-processing waste. A number of studies at the NDSU Carrington Research Extension Center have focused on the usefulness of a wide variety of coproducts and new feed grains available in the region for the cow-calf and feedlot enterprises. The following briefly describes some of the studies and results.

Table 3. Supplement Formulation for High-grain Beef Cow Diet

Ingredient	Percent, DM Basis
Ground corn	32.1
Soybean meal	45.6
Urea	4.1
Limestone	7.8
Dicalcium phosphate	4.3
Trace mineral salt	3.2
Dyna K (potassium)	2.3
Selenium premix (200 ppm)	.4
Vitamin premix[a]	.2
Rumensin 80[b]	.12

[a]Vitamin A, 15,000 IU/gram; Vitamin D, 1,500 IU/gram.
[b]192 mg Rumensin/head/day.
Supplement contains the following nutrients:
Crude protein 36%
Calcium 3.76%
Phosphorus 1%
Note: If using a commercial supplement, feed according to the label instructions.

Wet Potato Coproducts

Lactating mature crossbred beef cows were fed wet potato coproduct (17 percent DM). The wet potato coproduct was included in the ration at 25 percent of the diet dry matter. Wheat straw (45 percent of diet dry matter), wheat midds (15 percent of diet dry matter) and chopped alfalfa hay (15 percent of diet dry matter) made up the remaining ingredients. Compared with corn silage-based diets, cows gained more weight and increased body condition score with the raw potato coproduct diet with no difference in conception rate.

Barley Malt or Wheat Midds

Barley malt (25 percent of dry-matter intake [DMI]) or wheat middlings (22 percent of DMI) were included in lactating drylot mature beef cow diets with wet potato waste (54 percent of DMI), straw (21 to 25 percent of DMI) and small amounts of alfalfa hay (12 percent of DMI) without negative effects. Conception rates were 96 percent at fall pregnancy diagnosis. Wheat middlings were fed at about 50 percent of DMI to lactating first-calf heifers, with straw at 32 percent of DMI and alfalfa at 18 percent of DMI, with no observable differences in animal performance, compared with the corn silage-alfalfa hay-based control ration.

Sunflower Screenings

In another treatment in this study, including sunflower screenings (37 percent of DMI replacing potato waste and malt/midds) resulted in significant weight and body condition loss for the cows and decreased conception rates.

Note that screenings can be highly variable. During the study, the scientists noted decreasing nutrient content as the sunflower cleaning season advanced. Further work with sunflower screenings infected with sclerotinia bodies (52 percent of sunflower screenings on a weight basis) fed to mature lactating beef cows indicated no deleterious effect on gain or body condition score when this product was fed at about 40 percent of DMI in a diet that contained corn silage, alfalfa hay and straw.

Low-quality Barley

Research was conducted to evaluate barley that was infected (36 parts per million deoxynivalenol or DON) and non-infected. In the research, dry-rolled barley was fed to first-calf heifers in mixed diets that included corn silage, alfalfa hay and straw. During mid and late gestation, heifers were fed 8.15 pounds of barley daily, with 9.37 pounds offered after calving. No negative effects were observed for cow and calf performance.

Dry Edible Bean Splits

Dry edible beans and dry edible bean splits contain an enzyme inhibitor that can cause severe diarrhea in cattle. These products must be roasted at 300 F if fed at more than 4 to 5 percent of DM intake to deactivate the enzyme inhibitor.

Other Feedstuffs and Coproducts

Additional field studies have incorporated canola meal, linseed meal, sunflower meal, crambe meal, distillers grains, flax, oat hulls and other feeds successfully in balanced mixed rations for lactating and gestating beef cows.

The volume of coproducts continues to grow, especially with the development of the ethanol and biodiesel industries. Coproduct prices have had significant seasonal swings, with lower demand and price in the summer.

Be careful when purchasing coproducts for long-term storage. Moisture content can affect shelf life and increase the potential for spoilage, as well as affect flowability and handling characteristics. In addition, variation in levels of fat and minerals, especially sulfur, and other physical and nutritional issues can be problematic.

Publications are available from NDSU (www.ag.ndsu.edu/pubs/beef.html) and The Ohio State University (http://beef.osu.edu) that provide additional information on a variety of feedstuffs available throughout the region.

Feed Preparation and Feeding

Tub grinding hay or crop residues increases feed cost but reduces waste, enhances consumption and facilitates mixing with silages and concentrates or supplement. Some long-stemmed forage should be offered to stimulate rumination and prevent compaction. As a general rule, coproduct feeds do not need processing. However, grains should be rolled or ground to increase digestibility.

Rations can be fed once per day, bunk space permitting. Twice-daily feeding of drylot cows has not been evaluated. Some producers have used self-feeding gates or electric fences successfully to self-feed silage or hay; however, controlling consumption is difficult.

Winter feeding on frozen ground with or without snow cover is acceptable if feed is placed on clean ground every day. This practice will facilitate distribution of manure during aftermath grazing.

Creep Feed

Calves in the drylot should be offered creep feed beginning at 2 months of age. Moderate-energy creep feeds should be offered to reduce overfattening, especially in heifer calves. Chopped mixed hay and feed grains (rolled or coarsely ground field peas, barley, corn) or selected coproducts have been used successfully in mixed creep diets.

Commercial pelleted diets are more convenient and can be custom formulated but cost more per ton than various grains or coproducts. Malt barley pellets, soybean hulls, wheat middlings and other coproducts are useful as creep feed when mixed with corn, given equivalent prices.

Creep feed consumption may increase to 8 to 10 pounds per head per day at 160 days of age. Creep pastures are recommended if grassed areas are available adjacent to the drylot. Using creep pastures reduced creep feed consumption, provided an improved environment and increased weaning weights in research at NDSU's Carrington Research Extension Center.

Photo: NDSU Carrington Research Extension Center

Early Weaning

Early weaning is easier with cow-calf pairs managed in a drylot, compared with typical pasture-based production systems. Early weaning can reduce cow feed costs while maintaining calf growth. Creep feeding is highly recommended prior to early weaning calves.

Weaning drylot calves can be as simple as removing cows from the pen, with calves remaining in familiar facilities with water and creep feed available. Producers also can separate the calves from the cows with a fence. Highly palatable, nutrient-dense mixed diets containing grains, coproducts, excellent-quality forages and supplements are recommended.

Following weaning, cows can be turned out on small-grain stubble, corn residue or other grazeable forages. Early weaning allows cows to regain condition before winter, plus provides a longer time to graze crop aftermath.

Herd Health

Health problems experienced in the drylot are generally the same as those occurring in pasture/range operations. However, in a poorly designed and poorly managed operation, the drylot can be a hot, crowded, dusty or muddy, fly-infested environment. A well-drained or paved site with a southern exposure and periodic manure removal reduces environmental stress.

The animal density can result in more rapid disease transmission, so prompt, thorough treatment with appropriate follow-up is in order. Consult your local veterinarian for specific recommendations on vaccinations, parasite control and antibiotic treatments. Foot rot can be a problem once established on the site, so prompt treatment is appropriate.

Other problems that may be associated with drylot cows and calves are hairballs in calves and impaction in cows. These are very infrequent occurrences, however.

Hairballs can be mitigated by providing high-quality forage and creep feed separately to young calves to dilute ingested hair from shedding cows. Impaction is more likely to occur in cows fed large amounts of

chopped straw without the addition of other forages such as long hay, significant amounts of silage or other moist feeds.

Fly Control

Regular manure removal, especially during rainy summers, is important in controlling the fly population. Aggressive spraying of the premises with residual sprays, providing cows and calves with dust bags and rubs, and the use of insecticide ear tags are all helpful.

Parasitic wasps have been used successfully to control flies in isolated livestock operations. Feed additives that kill fly larvae in the manure can be helpful if all animals in the area receive the product. No single practice should be relied on as the sole fly control method.

Breeding and Selection

Estrus synchronization and artificial insemination are easier with cows in a drylot. The concentration of cows in a small area allows for faster and easier heat detection than in pastures or on the open range. Androgenized cows or sterilized bulls are useful for assisting in heat detection in the drylot.

Natural-service sires used in the drylot can service 10 to 25 percent more cows due to repeated contacts and less distance to travel. Proven bulls with good libido should be used to take advantage of the increased exposure.

A breeding plan should be developed using breeds that are acceptable to the producer and to the market. Systematic crossbreeding involving two or three breeds in rotation works well in a drylot, but it needs to be sustained with heifer selection and breeding back to the most unrelated breed of sire.

Performance records are easier to keep in a drylot with daily observation of individual animals. Selecting replacement females is easier and more accurate with good performance records. Weighing, tagging, vaccinating and treating animals are all much easier in a drylot than on the open range.

Herd Size

An economical size for a drylot cow-calf operation has not been well-defined. Breeding systems with two or three breed rotations impose some minimum cow numbers on the enterprise. For example, a three-way rotation should have a minimum of 120 to 150 cows to make the best use of herd sires while maximizing heterosis.

Larger herds may be more efficient due to economies of scale, but logistics and labor need to be addressed. Smaller herds of 50 to 100 cows may be economically feasible, depending on the producer's equipment, feed sources, facilities, labor and marketing goals.

Marketing

Drylot production systems provide greater marketing flexibility for cows and calves. Prospective buyers can inspect feeder calves more easily. Reduced weaning stress and faster adaptation to feedlot rations are important merchandising points. Calves are more accessible, so market timing is flexible. Cull or open cows can be fed longer if cheap feeds are available for improved return at slaughter or auction.

Calves kept for feedlot finishing go on feed extremely well and may finish with higher marbling scores due to reduced stress and a longer feeding period. Red Angus-based steers at the Carrington Research Extension Center have been marketed at 1,225 pounds at less than 1 year of age and graded up to 75 percent USDA Choice or better.

Having spring- and fall-calving herds in one operation complicates management but may provide more marketing windows and a consistent supply of beef if a finishing feedlot is included in the operation. Vertically integrated enterprises may market locally recognized, natural or organic meat through a local locker plant at premium prices.

Facilities and Equipment

Site Selection

The site chosen for a cow-calf drylot facility should be well-drained with appropriate pollution controls to avoid contaminating watersheds. Wintering quarters for gestating cows may need to be upgraded to control runoff. Check with state and local officials to determine permitting requirements.

Site selection should be based on water availability, roads, slope of the land and soil type, proximity to neighbors, drainage, wind direction and potential for odor issues. These are physical and operational criteria that can affect quality of life and relationships in the neighborhood. Refer to the "Midwest Plan Service Beef Housing and Equipment Handbook" (www-mwps.sws.iastate.edu/catalog/livestock-categories/beef-operations/beef-housing-and-equipment-handbook; fourth edition, 1987) for facilities recommendations and critical design dimensions.

Number of Pens

Separate pens are suggested for (1) first-calf heifers and old or thin cows, (2) the main cow herd with multiple pens if numbers require, (3) growing replacement heifer calves and (4) bulls, possibly two pens for young and old bulls. Large numbers of pairs in one pen make sorting for artificial insemination (AI) or health care difficult.

Excessive crowding from severe weather, wild animals or other circumstances can result in injury or death to small calves. Sixty to 80 pairs per pen is the recommended maximum, but this will vary with space allotment and pen design.

Pen Design

Pen size and lot space per cow-calf pair are quite variable, depending on the drainage and soil type. A general recommendation is for a minimum of 500 square feet per pair, with 800 to 1,000 square feet desirable, especially with less than optimum drainage. Larger lots tend to allow more blowing dirt, a potential cause of pneumonia for baby calves.

Partially paved areas may be useful around waterers and bunk lines, and for relatively flat lots. Smaller paved areas (300 to 500 square feet per pair) increase crowding but may reduce fly problems and problems associated with mud, especially if paved areas are scraped often.

Fencing

Fencing for the drylot should be sturdy, low-maintenance and able to withstand the stress of mature cows crowding and reaching. Used railroad ties, treated posts and steel pipe are long-lasting and low-maintenance. Steel cables or metal rod, such as well stem, sucker rod or pipe, are excellent for fencing.

Mesh panels and lumber fences require more maintenance and will need replacement at much shorter intervals. Panels tend to get pushed out of shape in high-stress areas. Full-dimension rough lumber is preferred over smooth boards, but rough lumber often can warp and can contain many knots.

High-tensile electric fence or barbed wire can be used successfully but requires frequent tightening. High-tensile fence is subject to penetration from crowding or frightened animals, requiring time-consuming sorting of animals. If animals put pressure on a fence, running an electric wire along the inside or the top of the fence may be necessary.

Fences should be a minimum of 60 inches tall, especially if larger cows or animals of questionable disposition are involved.

Shade

If shade is constructed, 40 square feet per cow-calf is recommended. Cows made very limited use of the pole-framed corn-cribbing shade available at the Carrington Research Extension Center. Dual-purpose, shade/windbreak-designed, self-supporting structures may be useful equipment for beef cows in the northern Plains.

Feed Bunks

A variety of feed bunks are acceptable and work well for feeding cows in drylot production systems. Mixed rations can be fed in fence-line feed bunks or feeding fences designed without bunks. Feeding in bunks within pens is possible, but mud and the need to enter and exit the pen with feeding equipment can be problematic.

Feeders that can be placed inside pens include turned tractor tires, commercial metal or wood bunks and salvaged wide conveyor belting pulled up to a "U" shape. Round bale feeders or forage racks on a trailer chassis are useful for feeding free-choice forages.

Some types of feeders generate more feed waste than others. Each cow should have 26 to 30 inches of bunk

Photo: NDSU Carrington Research Extension Center

space if rations are limit-fed. Cow rations are usually very bulky, so a high-capacity bunk is recommended.

With fence-line bunks, a concrete apron behind the bunk allows firm footing for the cows and easy cleaning. This apron should be 10 feet to 12 feet wide and slope ½ inch per foot. Feeding on the ground is not recommended, even with large pens, because feed easily can become contaminated with feces, and feed waste increases dramatically when feed is offered in this fashion.

Water

Water requirements of lactating cows in the summer are much greater than for gestating animals. Lactating cows need up to 20 gallons of water per day.

Tanks or water fountains may be adequate. A large water tank or reservoir allows more cows to drink in a shorter time, but cleaning such tanks can be difficult. Water should be accessible to young calves as well. A backup well or secondary water source is highly recommended.

Creep Feeding

Creep gates with adjustable vertical bars and openings 17 to 18 inches wide are most effective in providing access for calves but not cows. Creep feeders should be placed in well-drained areas easily accessible to calves, preferably along the opening to the creep pasture. Large-volume feeders have been designed for mixed grain-forage rations that can be filled with a feed wagon, front-end loader or large-diameter augers.

Creep feeder space is not critical, and a minimum of 4 inches per head is suggested. Calves tend to eat in shifts, and as long as the creep feed flows to the feeder opening without bridging, creep feed intake will not be impacted greatly.

Small-fence line bunks may be used for calves but require more frequent filling. In addition, fence-line bunks do not provide protection from rain and snow and can result in excessive creep feed spoilage or waste.

Feed Storage

Feed storage should be close to the drylot. Bunker silos are cost-effective for large volumes of silage. Upright concrete stave silos and oxygen-limiting systems represent high-capital investment items that could reduce labor but should be evaluated critically for positive economic returns in a cow/calf enterprise.

Returns from hay storage sheds depend heavily on a number of factors, including market price of hay and cattle, rainfall, bulk density of the hay package, original quality of the hay and length of storage. One- or 2-year-old hay or straw is typically more digestible than new forage, although most vitamin A is lost and some dry-matter loss occurs due to ground contact or weathering.

Waste Management and Composting

The economic value of manure from a confined cow operation depends on how it is handled and relative fertilizer prices. Incorporation of straw for bedding or from wasted feed improves the carbon-nitrogen ratio and sequesters more nitrogen in the composted manure.

Composting manure stabilizes and concentrates the nutrients, resulting in less total volume to be spread but more fertilizer value per unit of weight. Composting should be done by removing the manure from the pen and placing it in a windrow. Turning can be accomplished with a payloader or commercial compost turning machine.

Composting is a microbial process that converts organic wastes into stable material that is an excellent fertilizer. Optimum moisture content for composting is 50 to 60 percent. A few weeks after piling, when the internal temperature has reached 130s to 140 F, "rolling the pile over" with a compost turner or front-end loader provides optimum results. The repeated turning assures more thorough composting of manure and bedding material, and destroys weed seeds.

The heating, or "thermophilic," phase is repeated two to three times. Each time, the maximum temperature reached in the windrow will be lower. This phase is followed by about two months of curing, or "mesophilic," phase, when turning should continue at less frequent intervals.

Ideally, composted or fresh manure should be tilled into the soil just after spreading. Beef cows produce about 63 pounds of fresh manure per day. Accumulations from drylot cows on paved lots from May 1 through Sept. 15 average 1.75 tons to 2 tons of dry matter per cow and is dependent on the type of diet, cow size and ration digestibility.

Beef cattle manure from an open feedlot at 50 percent dry matter is estimated to contain approximately 7 pounds of ammonium nitrate, 21 pounds of total nitrogen (N), 14 pounds of P_20_5 (phosphorus) and 23 pounds of K_20 (soluble potash) per ton of raw manure. The value of organic matter and micro-minerals are harder to determine but can be an important determinant of manure value.

Prior to application, composted manure should be analyzed for N, P (phosphorus) and K (potassium). Application rates should be according to crop fertility recommendations and applicable state and local manure application permit regulations and policies.

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