

# 23 Supplementation of Stocker Cattle on Small Grain Forage

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## Objectives

- Understand the unique nutrient content of wheat pasture and other small grains.
- Discuss supplementation of cattle grazing high-quality pastures.
- Discuss frothy bloat in cattle and how to reduce its incidence.
- Present different strategies for providing supplemental nutrients to cattle grazing small grain pastures.

Winter wheat pasture is a unique and economically important renewable resource in Oklahoma and the southern Great Plains. Income is derived from both grain and the increased value added as weight gain, to growing cattle grazed on wheat pasture. The potential for profit from grazing stocker cattle on wheat pasture is exceptionally good because of the high quality of the forage and the very favorable seasonality of prices for stocker and feeder cattle that favor price appreciation of the cattle. As more producers have opted to forgo grain harvest for graze-out, there has been adoption of planting other small grains (oats, cereal rye, triticale and barley) and cool-season annuals (turnips, radishes, other brassica species and annual ryegrass). These alternative cool-season annuals have similar quality attributes to wheat pasture, so the supplementation recommendations are similar.

Supplementation of cattle grazing cool-season annuals is of interest to:

1. Provide a more balanced nutrient supply plus feed additives such as ionophores and bloat preventive compounds.
2. Substitute supplement for forage where it is desirable to increase stocking rate in relation to grazing management and/or marketing decisions.
3. Substitute supplements for forage with conditions of low-forage standing crops.

It is usually said the higher the risk, the higher the rewards for the value of cattle. Predicting performance of stocker cattle grazing cool-season annuals is particularly challenging because of potentially large variations in

weather and forage production. If weight gains of growing cattle cannot be predicted with some degree of accuracy, realistic breakevens, a prerequisite to sound marketing decisions, cannot be calculated. The ability to predict cattle performance will become more important as the feedlot and stocker segments of the industry compete for supplies of stocker/feeder cattle, and as coordinated beef production systems come to fruition.

## Forage Nutritive Characteristics of Wheat and Other Cool-Season Annuals

In the fall and early spring, cool-season annual grasses planted into dedicated crop fields or interseeded into warm-season grass sod have been used extensively for grazing stocker cattle to improve net-farm income in the Southern High Plains and Southeastern U.S. Improvements in net income are achieved with the availability of high-quality forages at a time of year when weaned cattle are at a seasonally low price and other predominant forages are dormant and of low nutritive quality. Figure 23.1 shows the nutrient content of wheat pasture often seen during the fall and spring. Cool-season annual grass forages are extremely high in CP (> 25% DM basis) and low in fiber (40% to 49% NDF and 19% to 29% ADF, DM basis) during the fall and early spring prior to stem elongation. Even though increases

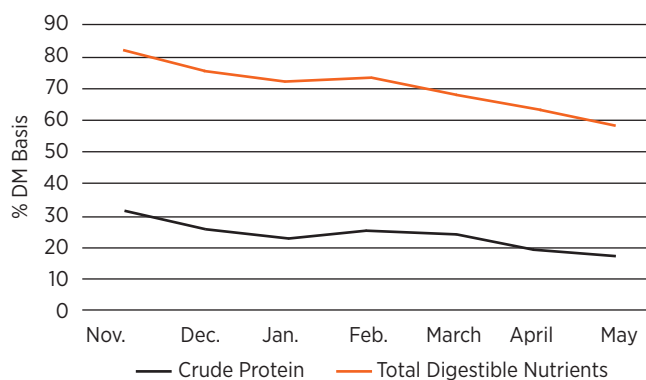


Figure 23.1 Crude protein and total digestible nutrient content of wheat forage. (Adapted from Beck et al., 2014)

All Web addresses given in this chapter are subject to change. The links to these websites will be updated regularly at the Master Cattleman website at [extension.okstate.edu/programs/master-cattleman.html](http://extension.okstate.edu/programs/master-cattleman.html)

in fiber content (increasing to more than 50% NDF) and reductions in CP content (decreasing to less than 20% on DM basis) are noted during April and May, CP content and estimated energy content of the forages were greater than animal requirements for a 500-pound growing steer to gain in excess of 2.5 pounds per day until the end of the spring grazing season each year. This indicates that cool season annuals provide a nutrient-dense diet for grazing cattle and any differences in animal performance from the expected levels are likely due to restrictions in forage availability.

## Mineral Content of Wheat Forage

Wheat pasture poisoning is a noninfectious metabolic disorder of cows grazed on wheat pasture. It occurs most frequently in mature cows that have been grazing wheat pasture for 60 days or more and are in the latter stages of pregnancy or are nursing calves. Cows with wheat pasture poisoning have low blood concentrations of both calcium and magnesium. While a similar tetany like condition may occur in stocker cattle, its incidence is extremely low. Considerable variation occurs in the mineral composition of wheat forage. The data in Table 23.1 have been selected to indicate the calcium, phosphorus, magnesium and potassium content of wheat forage in relation to the requirements for the same minerals of a 400-pound steer calf gaining 2 pounds per day.

The values indicate that wheat forage contains marginal to sufficient phosphorus and magnesium, excess potassium that is characteristic of small grains forages in general and inadequate amounts of calcium for growing cattle. Therefore, calcium is the macromineral of primary concern in many wheat pasture-grazing situations. In these situations, wheat pasture stockers should be supplemented with an additional 10 grams of calcium per day. While this may seem like a very small amount of calcium, therefore perhaps not important, the total calcium requirement of a 400-pound steer calf gaining 2 pounds per day is 28 grams. The additional calcium could be included as calcium carbonate in other supplements or a mineral mixture. Mineral mixtures will not be effective if desired amounts are not consumed. Intake of mineral mixtures must be monitored.

The lower values for phosphorus content of wheat forage (Table 23.1) are from Bushland, Texas (Stewart et al. 1981). In that area, and perhaps the Oklahoma Panhandle and southwestern Kansas, wheat pasture stocker cattle also

**Table 23.1. Mineral composition of wheat forage.**

| Item                     | Calcium | Phosphorus  | Magnesium | Potassium |
|--------------------------|---------|-------------|-----------|-----------|
| Composition, % DM        | 0.35    | 0.25 - 0.40 | 0.15      | 3-5       |
| Requirement <sup>a</sup> | 0.55    | 0.26        | 0.10      | 0.6       |

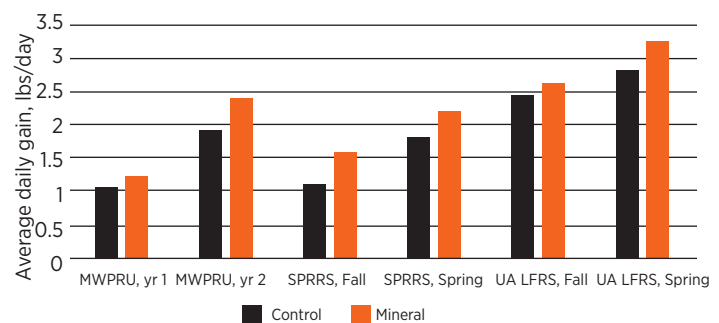
a For a 496-pound, 10-month-old Charolais x Angus steer gaining 2.2 pounds per day and consuming 12.43 pounds of wheat forage dry matter.

Source: 1996 Beef Cattle NRC.

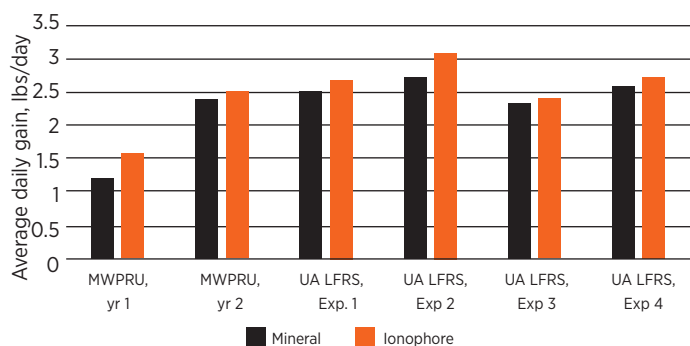
should receive supplemental phosphorus, depending on soil type and actual mineral analysis of wheat forage. More recently, a case of phosphorus deficiency was encountered in a group of growing steers grazing wheat pasture near Loyal (north-central Oklahoma). The farm had been in alfalfa for about six years prior to planting wheat. The application of phosphorus fertilizer for the wheat crop was less than recommended from soil test results. Phosphorus, calcium, magnesium and potassium contents of wheat forage samples collected Jan. 14 were, respectively, 0.16%, 0.26%, 0.16% and 1.72% of dry matter (DM). The Angus steers appeared healthy and were fairly fleshy, but seemed to crave bones, which were present in native grass adjacent to the wheat pasture from carcasses of cows that had died in previous years. Depraved or decreased appetite is a classical sign of phosphorus deficiency in beef cattle. The mineral mixture fed was changed from a low-phosphorus mineral (4.0%) to a mineral mixture containing 12% calcium, 12% phosphorus and 12% salt. The owner reported this resolved the bone-chewing problem.

## Feeding Minerals to Cattle Grazing Small Grain Pastures

Figure 23.2 shows the response of steers grazing wheat pasture to mineral supplementation in experiments from two locations in Oklahoma (OSU Marshall Wheat Pasture Research Unit and USDA ARS Southern Plains Range Research Unit) and one in Arkansas (University of Arkansas Livestock and Forestry Research Station). In each of these experiments, the control steers were offered plain white salt, while a balanced complete mineral designed to match the deficiencies for growing calves grazing wheat pasture was offered. At the MWPRU site, a complete mineral supplying the ionophore monensin (Rumensin<sup>®</sup>) was offered as well. From these six experiments in three locations, it is apparent that feeding a balanced complete mineral increased gains of steers grazing wheat pasture by 0.34 pounds per day. This increase in gains occurred whether the calves were restricted in growth (baseline gains of around 1 pound per



**Figure 23.2 Response of steers grazing wheat pasture to supplemental free-choice mineral supplements compared with white salt.** (Adapted from Fieser et al., 2007, Gunter et al., 2019, and Beck et al., unpublished.)



**Figure 23.3** Response of steers grazing wheat pasture to free-choice mineral mixture containing the ionophore monensin compared with non-medicated mineral mixture. (Adapted from Fieser et al., 2007; Beck et al., 2014; Weiss et al., unpublished.)

day) or calves were gaining rapidly (baseline gains of 2.8 pounds per day). Furthermore, this increased performance with cattle grazing wheat pasture in both the fall and winter and during spring grazeout.

Figure 23.3 shows the performance advantage of including an ionophore (monensin) in self-fed minerals for steers grazing wheat pasture in six experiments in Oklahoma (OSU Marshall Wheat Pasture Research Unit) and Arkansas (University of Arkansas Livestock and Forestry Research Unit). The average gain response to the ionophore was a 0.2-pound-per-day increase in average daily gain, the range of response was from 0.1-pound-per-day to 0.4 -pound-per-day increase across these experiments. These experiments were conducted with both fall and spring wheat pasture and with wheat pasture that had limited forage availability and had supplemental silage on offer, which highlights the consistent response to this technology.

The question relative to the effect of feeding mineral mixtures (often high-magnesium mineral mixtures) to wheat pasture stockers on the incidence of bloat is commonly raised. Supplemental magnesium has not been shown to decrease the incidence and/or severity of bloat in stocker cattle on wheat pasture. There may be a relationship between ruminal motility and the ability of stocker cattle to eructate ruminal gases and the calcium status of the cattle. Ruminal and gut motility is greatly compromised by subclinical deficiencies of calcium. Therefore, the concern of providing additional calcium to growing cattle on wheat pasture is two-fold: to meet requirements for growth and to perhaps decrease the bloat problem by an effect on ruminal motility. Of interest would be whether dry bloat problems sometimes observed in wheat pasture stocker cattle are related to a subclinical deficiency of calcium.

## Frothy Bloat

Frothy bloat is a major cause of deaths in wheat pasture stocker cattle in Oklahoma. Death losses from wheat pasture bloat are believed to be about 2% annually and sometimes are much higher on individual pastures. Bloat can strike suddenly and without warning. Some basic points relative to the causes and prevention of frothy bloat in wheat pasture stockers are:

1. Bloat occurs when the rate of eructation or removal of rumen fermentation gases is less than the rate production. This may result from an increased rate of production of gases or from impaired function of the rumen, cardia or esophagus.
2. Rumen fermentation gases may become entrapped in ruminal fluid froth or foam and cannot be eructated regardless of the functionality of the rumen and/or other digestive organs.
3. The chemical composition of wheat forage changes, depending upon environmental growing conditions, the stage of wheat plant growth or maturity and fertility level; therefore, it affects the likelihood that stable ruminal foam will be formed when wheat forage is grazed.

## Factors Contributing to Wheat Pasture Bloat

Some of the factors involved in the occurrence of frothy bloat of wheat pasture stocker cattle include:

1. Wheat forage intake, on an as-grazed basis, is very high to support the high rates of weight gain commonly observed for wheat pasture stocker cattle. High forage intake (dry matter basis) has been measured of 2.8% to 3% of body weight of steers grazed on wheat pasture (for example, 44.8 pounds to 48 pounds of forage containing 25% dry matter for a 400-pound steer). High forage intake and the fact that wheat forage ferments (digests) very rapidly in the rumen are conducive to the production of extremely large volumes of rumen fermentation gases which, if not eructated normally, can lead to bloat.
2. Wheat forage is high in crude protein with reported values of 18% to 34% of forage dry matter. A possible relationship exists between the incidence of bloat in stocker cattle and the crude protein content of wheat forage. The protein content of wheat forage is influenced by plant growth stage and level of nitrogen fertilization. Results of analyses of wheat forage samples collected many years ago from pastures in Oklahoma where bloat did or did not occur are shown in Table 23.2. Forage samples from bloat-provocative pastures contained less dry matter and total fiber [neutral-detergent fiber (NDF)]. The concentration of crude protein and soluble nitrogen fractions in forage

**Table 23.2.** Chemical composition of wheat forage where bloat was not observed and bloat-provocative pastures.

| Wheat Pasture           | No bloat | Bloat<br>(2%-5% death loss) |
|-------------------------|----------|-----------------------------|
| Number of samples       | 9        | 7                           |
| Dry matter (DM), %      | 28.48    | 22.31                       |
| Neutral-detergent fiber | 44.59    | 35.02 <sup>a</sup>          |
| Crude protein, % DM     | 25.40    | 31.75 <sup>a</sup>          |
| Soluble nitrogen, % DM  | 1.85     | 3.24 <sup>a</sup>           |

a (P<.05).

Source: Horn et al., 1977.

samples from bloat-provocative pastures were all significantly higher.

The extent to which the analyses in Table 23.2 reflect stage of wheat forage growth or age of accumulated forage growth (maturity) is not known. The data do suggest, however, that a subtle relationship exists between climatic growing conditions, soil fertility management and stocking rates as they affect wheat forage maturity and the incidence of bloat (Figure 23.4).

Wheat forage of several days' accumulated growth may be more fibrous and less succulent than wheat forage of only a few days growth. Stockers grazing the more fibrous, less succulent wheat forage may secrete greater quantities of saliva during the chewing associated with eating and during re-chewing of regurgitated boluses. The increased amounts of saliva may have an anti-foaming effect, thus reducing the incidence of frothy bloat. The significantly decreased total fiber content (NDF, Table 23.2) supports this rationale. In general, one would expect higher incidences of bloat during periods of rapid forage growth and in small forage standing crops. These periods often occur during fall and mid-winter grazing periods through early February, as day length increases and active plant growth begins. Frosts tend to increase fragility of leaf surfaces and rate of fermentation of the soluble carbohydrate fractions of forage, changing in the behavior of grazing cattle, increasing bloat. From a practical standpoint, wheat pasture stockers that are frequently seen chewing their cuds may be less likely to bloat than those that do not. Also freeze-burned (brown to whitish), dormant wheat forage is not likely to cause bloat.

Another contributing factor to the bloating of stockers on wheat pasture is the marked changes in grazing behavior occurring in stocker cattle in response to the movement of weather fronts through the southern Great Plains. Horn et al. (1976) reported that there is a period of little or no grazing prior to weather fronts, and the front is followed by a period

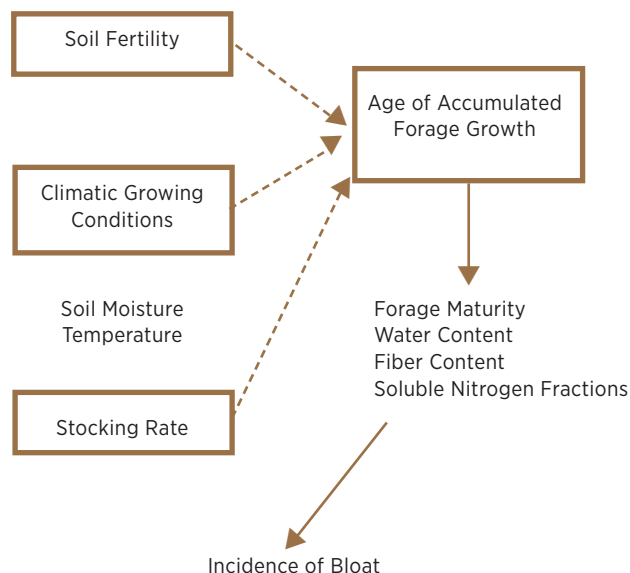
of very active grazing. This change in rate of intake of highly fermentable forage is conducive to bloat.

## Management Practices to Reduce the Incidence of Bloat

Producers should separate animals with predisposition of bloat. Often, marked differences exist among animals within herds regarding their predisposition or susceptibility to bloat. Where physical facilities and labor management permits, animals identified as having a predisposition to bloat should be managed differently to minimize bloat issues.

Another way to control bloat is to feed poloxalene. The feed additive poloxalene was developed in the early 1960s (Bartley and Bassette, 1961) and it markedly decreases the incidence and severity of both alfalfa and wheat pasture bloat of cattle. In the event of a bloat outbreak, poloxalene is the product of choice to administer to cattle at a dosage of 1 gram to 2 grams per 100 pounds of body weight per day. Poloxalene is a surfactant that reduces the surface tension of foam, decreasing foam formation in the rumen and entrapment of fermentation gases. There are several poloxalene-containing products available for use in grazing programs, including feed additives, top dresses for pastures, mineral supplements, blocks and liquid feeds. It is important to remember that to be effective, adequate amounts of poloxalene must be consumed on a daily basis. Since bloat outbreaks can occur very quickly, producers may want to consider having a small emergency supply of poloxalene-containing supplement on hand throughout the bloat season. Guaranteed consumption of a sufficient amount of poloxalene may require feeding a palatable supplemental feed containing poloxalene each day. Because of cost, it is generally not economical to feed poloxalene continuously throughout the wheat pasture-grazing period. Producers need to evaluate each pasture, looking for a history of bloat issues occurring on that pasture, the number of cattle bloating and the severity of the bloat in making the decision to feed poloxalene-containing products. Breakeven death loss percentages can be easily calculated for different scenarios, daily cost of product and days of feeding poloxalene.

Feeding monensin also can help reduce bloat. Although monensin (Rumensin®) is not a true bloat-preventive compound like poloxalene, studies have shown that it does decrease the incidence and severity of wheat pasture bloat. The Oklahoma Green Gold supplement is a monensin-containing energy supplement designed to be hand fed daily at the rate of 2 pounds per animal or every other day at the rate of 4 pounds per animal. The research in support of this supplementation program, its effect on cattle performance and potential effects on bloat are discussed later. The strategy of using this supplementation program is to feed it throughout the wheat pasture grazing period and to substitute poloxalene for monensin during times of bloat outbreaks. With this approach, cattle are accustomed to going to a feeder and the increased weight gain from the Oklahoma Green Gold program will improve the economics of the total supplementation program.



**Figure 23.4.** Some variables affecting forage maturity and possibly the incidence of bloat in wheat pasture stockers.

Mineral supplements were discussed earlier in this chapter. Additional calcium is needed to meet the requirements of calcium for growth and perhaps to prevent a subclinical deficiency of calcium, which could compromise ruminal motility and contribute to bloat. For a long time, it has been recommended that wheat pasture stocker cattle be given free-choice access to a high-calcium mineral mixture. The one typically used contains 16% calcium, 4% phosphorus, 5.5% magnesium and about 20% salt. In a two-year study that used a negative control (that is cattle that grazed wheat pasture and received no mineral or any other supplement), the mineral supplement increased weight gain in only one year by 0.26 pounds per day. However, from a management standpoint, feeding the mineral supplement provided a means of getting poloxalene into the cattle when bloat was a problem. Hand mixing of Bloat Guard® Medicated Premix (52% poloxalene) into the mineral mixture (25% Bloat Guard® and 75% mineral mixture) resulted in good, efficacious intakes of poloxalene for bloat prevention.

The question relative to the effect of feeding high-magnesium mineral mixtures on the incidence of bloat is commonly raised. There is no data to support the suggestion that supplemental magnesium will decrease bloat of wheat pasture stocker cattle.

### Feeding Low-quality Roughages to Wheat Pasture Stocker Cattle

Low-quality roughages such as wheat straw are commonly fed free-choice to stocker cattle on wheat pasture. Producers often say they will feed low-quality roughages on wheat pasture to slow the rate of passage, thereby increasing the utilization of wheat forage and reduce the incidence of bloat.

A very important question relative to feeding low-quality roughages to wheat pasture stockers is what effect they may have on wheat forage intake and stocker weight gains. Intakes of 2 pounds to 3 pounds of straw dry matter per day, if substituted for wheat forage, could decrease weight gains of stockers by as much as 0.46 pounds per day (2.11 pounds versus 1.65 pounds) as indicated in Table 23.3. These gains were estimated by calculating the effect of substituting wheat straw for wheat forage, taking into account the much lower energy value of wheat straw.

A three-year study was conducted in which fall-weaned steer calves (initial mean weight of 378 pounds)

**Table 23.3. Effect of straw consumption on calculated daily weight gains of wheat pasture stockers<sup>a</sup>.**

| Item                                 | All wheat forage | Wheat forage +2 lbs straw | Wheat forage +3 lbs straw |
|--------------------------------------|------------------|---------------------------|---------------------------|
| Daily gains, lbs                     | 2.11             | 1.80                      | 1.65                      |
| Change from all wheat forage, lb/day | -                | -0.31                     | -0.46                     |

<sup>a</sup> Calculated for a 440-pound steer with a total dry matter intake (wheat forage alone or wheat forage plus straw) of 3% of body weight.

Source: Mader et al., 1983 and Mader and Horn, 1986.

grazed clean-tilled wheat pasture (Nov. 23 to March 24, plus or minus three days to seven days) and were fed no supplemental feed or had free-choice access to wheat straw (WS) or sorghum-sudan hay (SS) (Mader et al., 1983 and Mader and Horn, 1986). Results were as follows:

- Daily consumption of low-quality roughage was low and ranged from:
  - WS — 0.15 pounds to 0.4 pounds per head per day
  - SS — 0.35 pounds to 0.9 pounds per head per day
- Live and carcass weight gains of steers were not affected by offering low-quality roughage.
- Feeding steers two times the amount of low-quality roughage as listed in the first bullet did not affect intake, digestibility or rate of passage of wheat forage.
- Bloat was observed only during the last two weeks of the period of lush spring growth of wheat forage of the first year. The incidence and severity of bloat of the control, wheat straw and sorghum-sudan fed steers were not different among treatments. Intake of wheat straw and sorghum-sudan hay was only about 5% to 12% of roughage intakes reported in the literature to effectively control or aid the prevention of bloat. Therefore, it seems unlikely that low-quality roughage consumed in amounts similar to those of this study will control bloat of stocker cattle on wheat pasture.

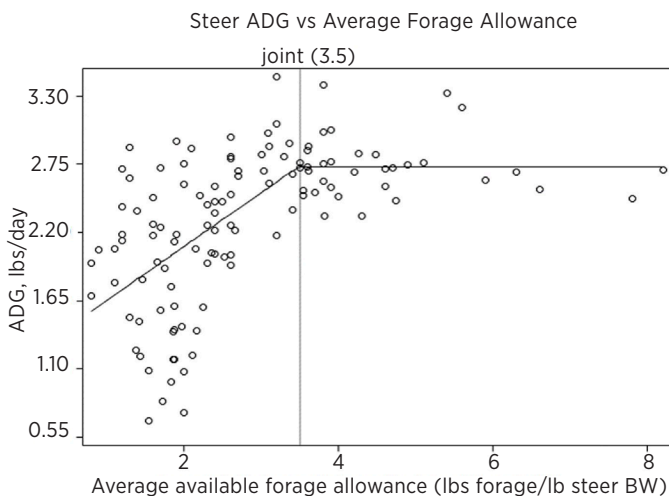
Significant positive or negative responses to feeding low-quality roughage to stocker cattle on wheat pasture have not been seen. It appears to be a practice of little consequence other than the cost of the low-quality roughage and the labor required. However, if cattle on wheat pasture do not have a dry place to lie down, availability of low-quality roughages may improve performance by providing bedding and aiding maintenance of normal body temperature during severe storms.

### Setting Stocking Rates Based on Forage Allowance

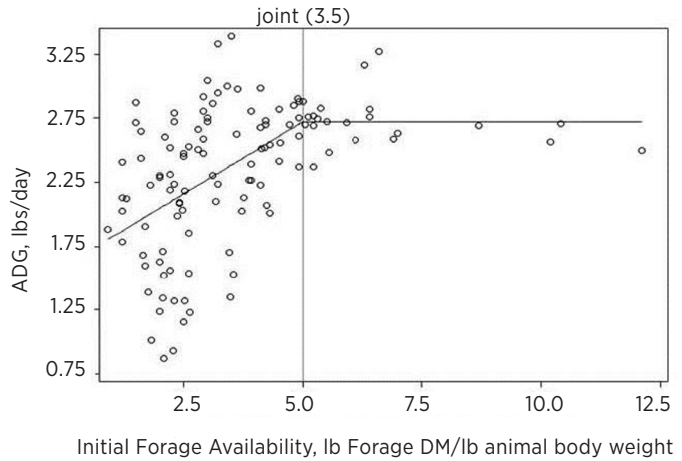
The forage DM production of cool-season annual grasses follows a biphasic production curve, in which productivity during the fall and winter is at a much lower level than during the spring. Thus, stocking rates should be much less in the fall and winter from early November to late February, ranging from 2 acres to 3 acres per steer up to 1 acre per steer with excellent forage growth conditions. In the spring from late February to early May, generally 2 acres to 2.5 steers per acre is typical. Stocking rate is a fundamental variable for managing pastures and there is a distinct relationship between stocking rate and animal performance for each forage type. In order to determine the forage allowance that would result in the optimal stocking rate for fall and winter grazing of cool-season annual pastures, the forage production and steer performance from the experiments reported in several experiments [Bowman et al. (2008) and Morgan et al. (2012)] were used to determine the response of ADG to initial forage allowance expressed as pounds of forage dry matter per pound of steer

bodyweight. The response of ADG to forage allowance was fit to find the average forage allowance during the fall and winter grazing season to reach maximum performance for growing steers. This data set used pasture means for cattle grazing small-grain pastures during the fall and winter from 2003 to 2009 and included 117 records. In this analysis, the average forage allowance during the fall and winter ranged from 0.8 pounds to 8.2 pounds of forage DM per pound of average steer bodyweight. The response of ADG to the average forage allowance (average pound forage DM per pound average bodyweight; Figure 23.5) indicates that the maximum ADG is expected at 3.5 pounds forage DM per pound average bodyweight with expected performance of 2.7 pounds per day. It is interesting to note that an ADG of approximately 2 pounds per day would be expected at forage allowance of approximately 1.8 pounds of forage per pound steer bodyweight. This level of performance (i.e., 2 pounds per day) is the level that many stocker producers set as the goal for the period of stocker cattle ownership, which allows the fixed and variable costs of stocker ownership to be spread over multiple units of gain.

Managers are faced with decisions regarding stocking rate at the beginning of the grazing season with only the forage produced up to that point to consider in setting the stocking rate. Analysis of the forage DM available at turnout in these experiments indicates the initial forage DM yield is highly correlated with average forage DM yield ( $r = 0.94$ ), so the analysis was conducted only considering the initial forage allowance (pounds initial forage DM per pound bodyweight) on ADG during the fall and winter (Figure 23.6). The response of ADG to the initial forage allowance indicates that a maximum ADG of 2.7 pounds per day could be expected at 5.0 pounds of forage DM per pound initial bodyweight and ADG of 2 pounds per day could be expected at an initial forage allowance of approximately 2.4 pounds forage DM per pound initial bodyweight. So, if forage mass at initial turnout is 1,200 pounds of forage DM per acre (about 6 inches to 7 inches of average plant height), stocking rates should be set at 2 acres per 500-pound steer to reach



**Figure 23.5** Effect of average wheat forage allowance (expressed as pounds of forage DM per pound of steer bodyweight) during the fall and winter on performance of grazing stocker steers. (Adapted from Beck et al., 2013.)



**Figure 23.6** Effect of initial wheat forage allowance (expressed as pounds of forage DM per pound of steer bodyweight) during the fall and winter on performance of grazing stocker steers. (Adapted from Beck et al., 2013.)

maximum steer performance. During the spring graze-out period, forage growth is rapid and the forage allowance at that time can be reduced to 1.5 pounds of forage DM per pound of steer bodyweight or less without negatively impacting steer performance, in fact if forage allowance is too high (stocking rates are too light) wheat forage will mature rapidly and reductions in forage quality with excess maturity will reduce potential steer performance.

## Energy Supplementation

Because the protein levels in this highly digestible forage are so high during the fall and early spring, the TDN:CP ratio (see discussion in chapter 22) often is less than 3:1 or 4:1. This indicates there is not adequate ruminally available energy present for maximal microbial growth, so proteins are not fully incorporated into microbial proteins and nitrogen is excreted. This impacts the type of supplements that should be used for cattle grazing wheat and other cool-season annual pastures.

Steers would then respond to small-package energy supplements (Oklahoma Green Gold supplement program described below), designed to supply required minerals and vitamins, carry growth-promoting ionophores and provide energy to correct ruminal TDN:CP ratio imbalances (see discussion below).

### Oklahoma Green Gold Supplementation Program

Two ionophores (monensin and lasalocid) are available for wheat pasture stocker cattle. Both, if delivered in the proper dosage, increase weight gains of growing cattle on wheat pasture by 0.18 pounds to 0.24 pounds per day more than that of the carrier supplement and improve the economics of supplementation programs. In addition, producer experience and research indicate that monensin decreases the incidence and severity of bloat from wheat pasture (Branine and Galyean 1990). Other characteristics of the two ionophores are listed in Table 23.4. The plus sign

**Table 23.4. Characteristics of ionophores.**

|   | <i>Monensin</i>                                     | <i>Lasalocid</i> |
|---|---|------------------|
| <i>Weight gain response</i>               | <i>Equal if proper dosage of ionophore achieved</i> |                  |
| Bloat protection                          | +   |                  |
| Palatability                              |   | +                |
| Potential for toxicity                    | +   |                  |
| FDA clearance for every-other-day feeding | +   |                  |

indicates a more favorable or greater response of one over the other.

While some producers prefer self-limiting supplements that can be fed free-choice, others prefer to hand-feed supplements. Hand-feeding obviously allows much better control of supplement intake, and monensin has FDA approval for every-other-day feeding to stocker cattle.

The Oklahoma Green Gold supplement is a monensin-containing energy supplement for growing cattle on wheat pasture. It is designed to be hand-fed daily at the rate of 2 pounds per animal or every other day at the rate of 4 pounds per animal. The supplement contents are shown in Table 23.5.

Potential benefits of the Oklahoma Green Gold supplementation program include:

- Provide additional digestible energy and help balance the energy-to-crude-protein-ratio of wheat forage.
- Provide monensin to improve the economics of the supplementation program and decrease the incidence and severity of bloat.
- Provide additional calcium for growth of stocker cattle.
- Provide a means from a management standpoint of getting other feed additives into the cattle when needed, for instance, Bloat Guard® (poloxalene) in cases of severe or protracted bloat outbreaks.

A summary of five trials conducted during three years showing the effect of the supplementation program of live weight gain of stocker cattle grazing wheat pasture is shown in Table 23.6. In four of the five trials, the mean ( $\pm$  standard

**Table 23.5. Contents of the Oklahoma Green Gold supplement.**

| Ingredient                       | 1992/93 <sup>a</sup> | 1997/98 <sup>b</sup> |
|----------------------------------|----------------------|----------------------|
| Ground milo                      | 66.65                | 62.15                |
| Wheat middlings                  | 21.00                | 21.00                |
| Sugarcane molasses               | 4.80                 | 5.00                 |
| Limestone                        | 4.00                 | 4.30                 |
| Dicalcium phosphate, 21% P       | 2.55                 | 2.55                 |
| Magnesium mica (Smectite)        |                      | 4.00                 |
| Fine mixing salt <sup>c</sup>    | 0.50                 | 0.50                 |
| Magnesium oxide                  | 0.35                 | 0.22                 |
| Rumensin <sup>®</sup> 60 premix  |                      | 0.15 <sup>d</sup>    |
| Rumensin <sup>®</sup> 80 premix  |                      | 0.125 <sup>e</sup>   |
| Vitamin and trace-mineral premix |                      | 0.10                 |
| Vitamin A-30                     |                      | 0.05                 |

<sup>a</sup> Source: Andrae et al., 1994.

<sup>b</sup> Source: Paisley et al., 1998.

<sup>c</sup> Fine mixing salt (99.5% NaCl).

<sup>d</sup> To provide 90 mg monensin per pound of supplement.

<sup>e</sup> To provide 100 mg monensin per pound of supplement.

deviation) response to the hand-fed supplement (excluding the negative gain from Marshall in 1998-1999, which was considered an outlier) was: Daily gain:  $+ 0.42 \pm 0.10$  and Supplement conversion:  $4.72 \pm 0.50$ .

Because the incidence of bloat was not large enough during the five trials previously listed, the effect of this supplementation program on bloat is unknown. However, Branine and Galyean reported that monensin decreased the incidence and severity of bloat from wheat pasture. In a study reported by Paisley and Horn, 12 rumen cannulated steers that grazed the same wheat pasture near Stillwater were randomly allotted to three experimental groups. Gelatin capsules containing nothing, monensin or lasalocid were placed directly into the rumen of each steer each day. Dosage of the ionophores was 300 milligrams per day because the steers weighed  $1,164 \pm 67$  pounds. After a preliminary period of 16 days, the steers were assigned a bloat score each morning from March 15 through March 28 (14 days). The wheat was in a rapid growth stage during this time and was fairly immature. Hard freezes on the mornings of March 14, 15 and 16 increased the incidence of bloat and slowed the rate of wheat growth. Monensin decreased

**Table 23.6. Summary of effect of monensin-containing energy supplement (hand fed every other day) on weight gain and supplement conversion by wheat pasture stocker cattle.**

| Year/location | <i>Daily gain, lbs</i> |                   | <i>Gain response</i> | <i>Mean supplement intake, lbs/hd/day</i> | <i>Supplement conversion<sup>d</sup></i> |
|---------------|------------------------|-------------------|----------------------|---|--|
|               | <i>Control</i>         | <i>Supplement</i> |                      |   |  |
| 1992-1993     |                        |                   |                      |   |  |
| Stillwater    | 2.31                   | 2.87 <sup>a</sup> | + .56                | 1.55 <sup>b</sup>                         | 4.16                                     |
| 1997-1998     |                        |                   |                      |   |  |
| Stillwater    | 2.56                   | 2.94 <sup>a</sup> | + .38                | 1.74 <sup>c</sup>                         | 4.55                                     |
| Marshall      | 2.50                   | 2.90 <sup>a</sup> | + .40                | 1.92 <sup>c</sup>                         | 4.80                                     |
| 1998-1999     |                        |                   |                      |   |  |
| Stillwater    | 2.56                   | 2.90 <sup>a</sup> | + .34                | 1.82 <sup>c</sup>                         | 5.35                                     |
| Marshall      | 2.55                   | 2.53              | - .02                | 1.78 <sup>c</sup>                         | -  |

a Different from control ( $P < .05$ ).

b Contained 90 mg monensin/lb as-fed.

c Contained 100 mg monensin/lb as-fed.

d Pounds of as-fed supplement per lb of increased weight gain.

Source: Andrae et al., 1994 and Paisley et al., 1998.

( $P < .05$ ) both the incidence and severity of bloat and was more efficacious for prevention of bloat than lasalocid. In addition to increasing rate of weight gain, the Oklahoma Green Gold supplementation program should decrease bloat.

The rate of feeding the supplement is not high enough to allow stocking rate to be increased more than normal stocking rates for the area in which it is fed. Supplement specifications include:

**Sources of Energy.** About 82% to 90% of the as-fed formula should consist of corn, milo, wheat middlings and/or soybean hulls as the source(s) of energy. Corn gluten feed should not be used because of concerns that the additional sulfur may accentuate the incidence of polioencephalomalacia, sometimes occurring in wheat pasture stocker cattle. No roughage products other than soybean hulls should be included in the supplement.

**Form.** It is recommended that the supplement be manufactured as a small pellet because intake data was obtained with pelleted supplements. Pellets also decrease the potential for segregation of ingredients.

**Mineral content.** The supplement should contain 2.25% to 2.75% calcium, 1% phosphorus, 0.7% magnesium, 60 parts per copper and 0.75% to 1.25% salt for the as-fed formula. No additional iron or potassium should be added to the supplement.

**Vitamin content.** The supplement should contain a minimum of 10,000 IU of added vitamin A.

**Monensin concentration.** The as-fed supplement should contain 90 milligrams to 100 milligrams of monensin per pound.

This supplementation program requires close management. Monensin in large amounts will kill cattle. However, if one considers the lethal dose for monensin (1% deathloss) to be 5.5 milligrams per kg body weight (or 1,250 milligrams per head per day for a 500-pound steer), then there is a theoretical safety ratio of 6.25 for 500-pound cow consuming 200 milligrams monensin per day. Feeding the supplement every other day may increase the likelihood that some cattle could eat more than the desired amount of supplement. The primary challenge in using this supplementation program is one of having good management and enough time to be a good observer of what the cattle are doing. While this supplementation program worked well, the studies were with small numbers of cattle on pastures of 18 acres to 24 acres in size. Feed bunk space was adequate for all cattle to eat the supplement during a single feeding. Producers have to be good observers of cattle feeding behavior in relation to location of feed bunks in the pasture. Care has to be taken that there is adequate bunk space so some cattle do not overconsume the supplement. Equines should not be allowed access to this supplement. Ingestion of monensin by equines has been fatal.

Feeding moderate amounts of energy supplement to growing cattle on wheat pasture increases the stability of the enterprise and improves the predictability of cattle performance, which decreases production risk. It also increases stocking rate and flexibility by having more cattle on hand during fall/winter grazing for subsequent grazing during the graze-out period, if desirable. Because of the

seasonality of stocker/feeder cattle prices and the dynamics of breakeven selling prices in stocker cattle budgets, the latter of these can be particularly important to the economics of growing cattle on wheat pasture.

## Energy Supplements to Stretch a Shortage of Wheat Pasture

If forage allowance falls below 3 pounds to 5 pounds of forage DM per pound of steer bodyweight or stocking rates are increased to offset requirements to purchase additional cattle for grazeout in less favorable economic conditions, other alternative supplementation strategies can be considered to stretch wheat forage resources.

### Silage

Silage is used very successfully to stretch available wheat forage and allow initial stocking densities on wheat pasture to be increased in some areas of the southern Great Plains. In studies reported by Vogel et al. (1987 and 1989), use of supplemental silage allowed initial stocking density on wheat pasture to be doubled without decreasing weight gains of stocker cattle. Supplemental silage decreased wheat forage intake linearly ( $P < 0.10$ ). Each pound of added silage DM decreased DM intake of wheat forage by 0.66 pounds. The extent of ruminal digestion of DM and NDF of wheat forage was increased by feeding silage, indicating that silage had a positive associative effect on utilization of wheat forage (Vogel et al., 1989).

Table 23.7 shows the gain response of feeding free choice round bale Bermudagrass silage to steers grazing wheat pasture in north-central Arkansas. The Bermudagrass round bale silage was 40% dry matter and 14% crude protein (DM basis) and 55% TDN (DM basis). The silage was offered free-choice to calves on wheat pasture stocked at 1, 1.5 or 2 steers per acre during the fall and 2.25 steers per acre in the spring grazeout period; and was replaced as needed (when 20% of previous bale was remaining) about every seven to 14 days depending on silage intake. The negative control (not offered silage) was stocked at one steer per acre in the fall and winter and 2.25 steers per acre in the spring. Forage allowance (pounds foraged per pound steer bodyweight) at the start of fall grazing was 2.2 for steers stocked at one steer per acre, 1.6 for steers stocked at 1.5 steers per acre and 1.3 for steers stocked at two steers per acre. Because there was less forage remaining at the end of the winter grazing season for the heavier-stocked pastures, forage allowance at turnout for the spring grazeout period were 1.0 for steers stocked at one steer per acre during the fall, 0.7 for steers stocked at 1.5 steers per acre during the fall and 0.5 for steers stocked at two steers per acre during the fall. During the fall, feeding silage to steers stocked at the low rate did not affect animal performance with gains right at 3 pounds per day. As stocking rate increased during the fall and winter grazing season, gains decreased even though silage was fed, but the reduction in performance was not as big as would be expected had supplemental forage were not offered. During spring grazeout, feeding silage to steers that were placed on

**Table 23.7. Using round bale silage to increase stocking rate of steers grazing wheat pasture in the fall.**

|   | Control | Silage 1x | Silage 1.5x | Silage 2x |
|---|---------|-----------|-------------|-----------|
| Fall and winter                                       |         |           |             |           |
| Forage mass at turnout, lbs DM/acre                   | 1,214   | 1,188     | 1,309       | 1,361     |
| Forage allowance at turnout, lbs forage/lb bodyweight | 2.25    | 2.19      | 1.62        | 1.27      |
| Stocking rate, steers per acre                        | 1.0     | 1.0       | 1.5         | 2.0       |
| Average daily gain, lbs/day                           | 3.09    | 2.95      | 2.53        | 2.12      |
| Spring grazeout                                       |         |           |             |           |
| Forage mass at turnout, lbs DM/acre                   | 1,559   | 1,557     | 990         | 762       |
| Forage allowance at turnout, lbs forage/lb bodyweight | 1.11    | 1.11      | 0.70        | 0.54      |
| Stocking rate, steers per acre                        | 2.25    | 2.25      | 2.25        | 2.25      |
| Average daily gain, lbs/day                           | 1.43    | 2.03      | 1.56        | 1.83      |
| Total gain per acre                                   | 451     | 561       | 597         | 683       |
| Silage DM offered per acre                            | 0       | 326       | 636         | 816       |
| Pounds silage DM per added gain per acre              | -       | 2.96      | 4.38        | 3.52      |

pastures previously stocked at the lower stocking rate did increase gains by 0.6 pounds per day. This is because the poor growing conditions during the spring grazing season in this experiment limited forage production, which limited performance of the control calves. Total bodyweight gain per acre increased when silage was fed at the low stocking rate compared with the control, and as stocking rate increased, bodyweight gain per acre increased. As stocking rate increased, silage fed per acre increased as well. Even though more silage was fed with increasing stocking rates, the feeding silage was quite efficient in increasing total weight gain per acre, requiring only 3 pounds to 4 pounds of silage dry matter per pound of increased gain per acre.

### High-starch Versus High-fiber Byproduct Feed-Based Energy Supplements

The response of growing cattle on wheat and other small grain pastures to supplemental grain has been variable. To prevent potentially adverse effects of starch on ruminal fermentation, high-fiber byproduct feeds offer alternatives in formulating energy supplements with fairly high energy densities. Examples include wheat middlings, soybean hulls and corn gluten feed. The potential for using these byproduct feeds in supplementing growing cattle on wheat pasture is particularly good because of the rapid rate of ruminal degradation of wheat forage and the resultant relatively low ruminal pH.

Research at the Wheat Pasture Research Unit near Marshall was conducted to evaluate types of energy supplements for growing cattle on wheat pasture. A corn-based, high-starch supplement was compared to a high-fiber byproduct feed-based energy supplement. The high-fiber energy supplement contained about 47% soybean hulls and 42% wheat middlings (as-fed basis), and all supplements contained 40 milligrams per pound of monensin. The supplements were hand fed six days per week at a level of about 0.75% of body weight (for example, 4 pounds per day for a 533-pound steer) and stocking rate was increased 22% to 44%. Nonsupplemented, control cattle had free-choice access to a high-calcium (16%) commercial mineral mixture throughout the study. Details of the studies have been reported by Horn et al. (1995). In general, results were:

**Supplementation Response.** During the three-year period, weight gains during the fall/winter grazing and early spring grazing period (up to time of first hollow stem stage of maturity of wheat) were increased by energy supplementation, regardless of type of energy supplement, by an average of 0.33 pounds per day. Weight gains were 2.02 pounds, 2.33 pounds and 2.38 pounds per day for the control, high-starch and high-fiber supplemented steers, respectively. The gain response was similar at all stocking rates. Mean consumption of the supplements was 0.65% of body weight, which was a little less than the target of 0.75%.

**Type of Energy Supplement.** The type of energy supplement (high-starch versus high-fiber) did not affect weight gains of the cattle. The difference in response by cattle to high-fiber versus high-starch energy supplements is expected to decrease as the amount of supplement fed decreases and as crude protein content of the forage increases. The level of supplement fed in these studies was relatively small, and wheat forage contains excess crude protein. Substitution of supplement for wheat forage did not differ for the two types of supplements. Wheat forage intake was decreased by 0.91 pounds for every pound of supplement consumed (Cravey, 1993).

**Supplement Conversion.** Mean conversion of the supplements (expressed as pounds of as-fed supplement per pound of increased gain per acre) was about 5:1 for both types of supplement. This is substantially less than conversions of nine to 10 traditionally used in evaluating the economics of energy supplementation programs for wheat pasture stocker cattle.

**Cattle Preference for Supplements.** Cattle seemed to like the high-fiber supplement and consumed it much more readily than the corn-based high-starch supplement. Generally, the cattle consumed the high-fiber supplement in a matter of 10 minutes to 30 minutes in the morning. In contrast, the corn-based supplement was eaten during at least two feeding periods during the day (morning and mid-afternoon). From a feed and bunk management standpoint, this difference in the supplements is extremely important on days of inclement weather (rain, snow, etc.) and in situations of bird predation. Contamination of feed bunks by bird excrement was substantial for the corn-based supplement.

In addition, the potential for acidosis is much less for the high-fiber supplement, provided that the wheat middlings used in the high-fiber supplement do not contain a lot of fine starch.

**Feedlot Performance.** Because wheat pasture cattle are some of the more fleshy cattle placed on feed, the potential effect of energy supplementation on subsequent feedlot performance is of interest. Cattle were followed through the feedlot in two of the three years. Supplementation did not affect feed intake or feed conversion in year one, but average daily gain was decreased by about 0.20 pounds ( $P < 0.05$ ). In another year, daily gain of the cattle in the feedlot was not affected by two supplementations on wheat pasture.

The 1991-1992 wheat pasture year was very dry, and many pastures were extremely short of forage at the time of traditional turnout. Some pastures had as little as 300 pounds of forage dry matter per acre. While this was a problem, it presented an opportunity to compare some different types of energy supplements for stretching this severe shortage of wheat pasture. The objective was to compare limited amounts (1% of mean body weight) of whole shell corn, dry-rolled corn, or a 50/50 mix of pelleted wheat middlings/soybean hulls. The supplements were hand-fed six days per week. The target gain for the cattle was 2 pounds per day. Nine pastures were used in the study and initial stocking density was 3.5 acres per steer to provide an initial forage allowance of 1,050 pounds of forage DM per steer (2.4 pounds of forage DM per pound steer bodyweight). Because of the very mild winter and continued growth of wheat forage, cattle in three pastures were distributed by treatment through the other six pastures on Jan. 30, 1992, in an attempt to provide equal or lesser amounts of forage to all cattle. Forage availability in each of the pastures on Jan. 21 was about 1,500 pounds DM per steer, greater than was preferred for the initial objective of the trial. Forage growth after Jan. 30 was excellent. Because wheat jointed so early, the cattle were removed on Feb. 28. Performance of the steers is shown in Table 23.8.

Weight gain of all steers was about 2.2 pounds per day during the 84-day trial and was not different ( $P > 0.62$ )

**Table 23.8. Energy supplements for stretching wheat pasture.**

|  | <i>Whole corn</i> | <i>Dry-rolled corn</i> | <i>Wheat middlings/soybean hulls</i> |
|--|-------------------|------------------------|--------------------------------------|
| No. pastures                           | 2                 | 2                      | 2                                    |
| No. steers                             | 10 <sup>a</sup>   | 12                     | 12 <sup>b</sup>                      |
| Initial weight, lbs (12/5/91)          | 438               | 438                    | 439                                  |
| Final weight, lbs (2/28/92)            | 622               | 630                    | 625                                  |
| Daily gain, lbs <sup>c</sup> (84 days) | 2.17              | 2.25                   | 2.19                                 |

a Increased to 14 on Jan. 30.

b Increased to 18 on Jan. 30.

c Add-on steers of Jan. 30 were not included in calculation of mean daily gains. Differences among treatments are not significant ( $P > .62$ ).

Source: Horn and Paisley, 1999.

among treatments, which is in general agreement with other results. No difference in gain was observed between steers supplemented with a high-starch, corn-based supplement versus a high-fiber byproduct feed-based supplement on wheat pasture. Steers consumed the whole corn much more readily than the rolled corn and usually had slick bunks by midafternoon. Two steers on the rolled corn treatment foundered and showed signs of lameness throughout most of the trial. Because of the small numbers of pastures and steers in this trial, this data should be considered only preliminary. However, from a feed and bunk management standpoint, the whole corn was clearly more desirable than the rolled corn.

The 1995-1996 wheat pasture year presented another opportunity to evaluate a limit-feeding program with whole shelled corn for steers on wheat pasture. Three pastures with 10 to 13 steers per pasture were used. Wheat forage standing crops on Dec. 7, 1995 (date of turnout), Jan. 17, 1996 and March 12, 1996 were 511 pounds, 376 pounds and 251 pounds DM per acre, respectively. Forage allowances on these same dates were 1,024 pounds; 749 pounds and 725 pounds DM per steer (1.9, 1.4 or 1.3 pounds of forage DM per pound per steer bodyweight, respectively). Steers had free-choice access to a high-calcium (16%) mineral mixture. While the target level of intake of whole corn was 1% of body weight, the cattle did not achieve this level of intake until about Jan. 17, 1996 (day 41). Corn intake was very consistent among pastures and averaged 0.75% of body weight from Dec. 7, 1995 to March 15, 1996 (98 days). Mean weight of the steers at the start of the trial was 540 pounds, and they gained  $1.86 \pm 0.11$  (standard deviation) pounds per day.

## Economic Analysis

Several levels of economic analyses can be used in evaluating supplementation programs and other management decisions in stocker cattle programs. One approach is to simply compare cost of the additional weight gain to the gross value of weight gain in the stocker program. An estimate of the value of weight gain can be calculated by determining the gross value of the cattle at the time of purchase and again at the time of sale. The difference in the gross values represents the total value of weight gain. One simply needs to divide the total difference in gross value by the difference in initial and final weight to determine the value of each pound of weight gain. In recent years, value of weight gain for cattle purchased in the fall and sold during spring have ranged from about \$0.75 to \$1.25 per pound.

Value of weight gain is generally higher for heifers compared to steers. This is due to the fact that heifers gain at a slower rate and are not as efficient at converting forage or feed to weight gain compared to steers and therefore, their gain is more expensive to produce.

If the cost of the additional weight gain from supplementation is less than the value of weight gain, supplementation will be profitable. At a supplement conversion of 5 pounds of supplement per pound of increased gain per acre and a feed cost of \$270 per ton, supplement cost per pound of increased gain would be \$0.68. This is valid only

if stocking rate is increased since supplement conversion is expressed on an increased gain per acre basis. Also, any additional costs incurred in feeding the supplement (e.g., fuel, labor, etc.) should be included in the evaluation.

## Conclusion

Supplementation of cattle grazing wheat pasture is of interest to:

- Provide a more balanced nutrient supply and feed additives such as ionophores and bloat preventive compounds.
- Substitute supplement for forage where it is desirable to increase stocking rate in relation to grazing management and/or marketing decisions.
- Substitute supplement for forage with conditions of low-forage standing crops.

Three different strategies for providing energy supplements to growing cattle on wheat pasture were presented. One strategy was to develop a hand-fed small package (a target intake of 2 pounds per day or 4 pounds every other day) monensin-containing energy supplement to provide a more balanced dry organic matter-to-crude protein ratio in the total diet. This supplementation program (Oklahoma Green Gold) consistently increased daily gain by 0.42 pound with a supplement conversion (pound supplement per pound of increased weight gain) of 4.72, which often will be profitable. Increased profits of \$15 per steer to \$31 per steer depended on supplement cost and profit potential of the cattle.

A second strategy was to develop energy supplements that could be fed in larger amounts (about 0.75% of body weight) to increase stocking rate during the fall/winter grazing period and to have more cattle on hand for spring graze-out of wheat. Two types of supplements, a high-starch, corn-based supplement and a high-fiber byproduct feed-based supplement, were compared. During the three-year study, mean daily supplement consumption was 0.65% of body weight. This energy supplementation program increased daily gain by 0.33 pounds and allowed stocking rate to be increased by one-third. The type of supplement did not influence daily gain, supplement conversion or the substitution ratio of supplement for forage. Supplement conversion was about 5 pounds of as-fed supplement per pound of increased gain per acre, and was substantially less than conversions of 9 pounds to 10 pounds traditionally used in evaluating the economics of energy supplementation programs for wheat pasture stocker cattle.

The third strategy was to limit-feed energy supplements in amounts of 1% of body weight in situations of very low initial wheat forage standing crops (less than 300 pounds DM per acre). Weight gain of steers stocked on wheat pasture to provide initial forage allowances of 1,000 pounds to 1,300 pounds DM per steer and limit fed whole shelled corn at a level of 0.75% to 1% of body weight were about 2 pounds per day during two separate wheat pasture years.

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