23 Supplementation of Stocker Cattle on Small Grain Forage

Gerald Horn, Greg Highfill and Ryan Reuter

Objectives

- **Discuss cattle supplementation.**
- **Discuss frothy bloat in cattle and how to reduce its incidence.**
- **Present three different strategies for providing energy supplements to growing cattle on wheat pasture.**

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.

Supplementation of cattle grazing wheat pasture 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 wheat pasture stocker cattle is particularly challenging because of potentially large variations in weather and forage standing crops. 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.

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-lb 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, and 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.

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[a]	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.

Nutrition Management

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, http://agecon.okstate.edu/cattleman/manual_chapters.asp

The lower values for phosphorus content of wheat forage (Table 23.1) are from Bushland, Texas (Stewart et al.). In that area, and perhaps the Oklahoma Panhandle and southwestern Kansas, wheat pasture stocker cattle should also 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, Okla. (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 on January 14 were, respectively, 0.16 percent, 0.26 percent, 0.16 percent and 1.72 percent 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 percent) to a mineral mixture containing 12 percent calcium, 12 percent phosphorus and 12 percent salt. The owner reported that this resolved the bone-chewing problem.

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 that are 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 percent 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 of 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 percent to 3 percent of body weight of steers grazed on wheat pasture (for example, 44.8 pounds to 48 pounds of forage containing 25 percent 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 percent to 34 percent 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 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

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

Wheat Pasture	*No Bloat*	*Bloat (2%-5% Death Loss)*
Number of samples	9	7
Dry matter (DM), %	28.48	22.31
Neutral-detergent fiber	44.59	35.02[a]
Crude protein, % DM	25.40	31.75[a]
Soluble nitrogen, % DM	1.85	3.24[a]

[a] (P<.05).
Source: Horn et al., 1977.

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 23.1).

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 rechewing 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 are 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.

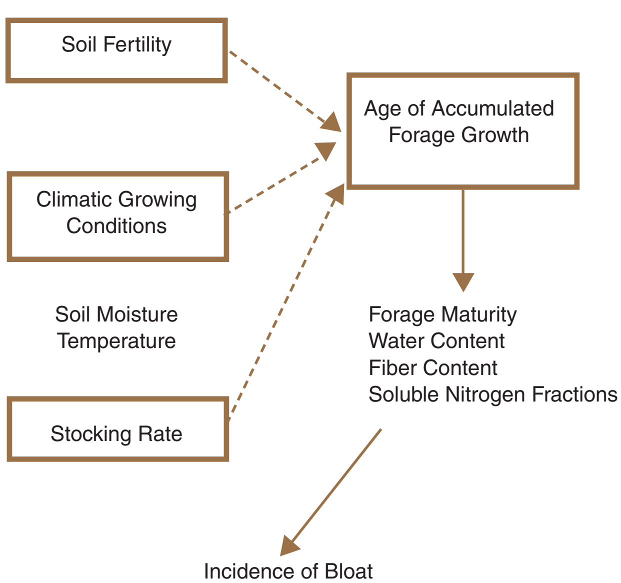

Figure 23.1. Some variables affecting forage maturity and possibly the incidence of bloat in wheat pasture stockers.

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 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 hand 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. Spreadsheet programs such as the OSU STOCKER PLANNER are excellent tools for evaluating decisions relative to feeding 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 can also 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.

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 percent calcium, 4 percent phosphorus, 5.5 percent magnesium and about 20 percent 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 pound 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 percent poloxalene) into the mineral mixture (25 percent Bloat Guard® and 75 percent 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 pound 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.

Table 23.3. Effect of straw consumption on calculated daily weight gains of wheat pasture stockers[a].

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

[a] Calculated for a 440-lb 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.

A three-year study was conducted in which fall-weaned steer calves (initial mean weight of 378 pounds) grazed clean-tilled wheat pasture (November 23 to March 24, plus or minus 3 days to 7 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 pound to 0.4 pound per head per day
  SS — 0.35 pound to 0.9 pound 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 percent to 12 percent 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.

Energy Supplementation

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.

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<.10). Each pound of added silage DM decreased DM intake of wheat forage by 0.66 pound. 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).

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, Okla., 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 percent soybean hulls and 42 percent 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 percent of body weight (for example, 4 pounds per day for a 533-pound steer) and stocking rate was increased 22 percent to 44 percent. Nonsupplemented, control cattle had free-choice access to a high-calcium (16 percent) 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 pound 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 percent of body weight, which was a little less than the target of 0.75 percent.

Type of Energy Supplement. 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 pound 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 for both types of supplement. This is substantially less than conversions of 9 to 10 that have traditionally been 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 that are 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 pound (P<0.05). In another year, daily gain of the cattle in the feedlot was not affected by two supplementations on wheat pasture.

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 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.

Spreadsheet programs such as the OSU STOCKER PLANNER are excellent tools for evaluating a myriad of questions, management decisions, etc. in a stocker cattle program. Copies can be downloaded from the website beefextension.com. Pasture can be priced on a cost of gain basis or as $ per cwt of cattle per month. In addition, the pasture cost can be modified to represent actual pasture cost ($ per head).

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 pound 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 23.6. The plus sign 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 23.7.

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 23.8. In four of the five trials, the mean (± standard 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 ± .10
Supplement conversion: 4.72 ± .50.

Table 23.6. Characteristics of ionophores.

	Monensin	*Lasalocid*
Weight Gain Response	*Equal if proper dosage of ionophore achieved*	
Bloat protection	+	
Palatability		+
Potential for toxicity	+	
FDA clearance for every-other-day feeding	+	

Table 23.7. Contents of the Oklahoma Green Gold supplement.

Ingredient	1992/93[a]	1997/98[b]
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[c]	0.50	0.50
Magnesium oxide	0.35	0.22
Rumensin® 60 premix		0.15[d]
Rumensin® 80 premix		0.125[e]
Vitamin and trace-mineral premix		0.10
Vitamin A-30		0.05

[a] Source: Andrae et al., 1994.
[b] Source: Paisley et al., 1998.
[c] Fine mixing salt (99.5% NaCl).
[d] To provide 90 mg monensin/lb of supplement.
[e] To provide 100 mg monensin/lb of supplement.

Table 23.8 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	Daily gain, lbs Control	Daily gain, lbs Supplement	Gain response	Mean supplement intake, lbs/hd/day	Supplement conversion[d]
1992-1993					
Stillwater	2.31	2.87[a]	+.56	1.55[b]	4.16
1997-1998					
Stillwater	2.56	2.94[a]	+.38	1.74[c]	4.55
Marshall	2.50	2.90[a]	+.40	1.92[c]	4.80
1998-1999					
Stillwater	2.56	2.90[a]	+.34	1.82[c]	5.35
Marshall	2.55	2.53	-.02	1.78[c]	–

[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.

Because the incidence of bloat was not large enough during the five trials previously listed, the effect of this supplemntation 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 mg per day because the steers weighed 1,164 ± 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). While the wheat was in a rapid growth stage during this time, it 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 (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 percent to 90 percent 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 polioencelphalomalacia, 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 percent to 2.75 percent calcium, 1 percent phosphorus, 0.7 percent magnesium, 60 parts per million copper, and 0.75 percent to 1.25 percent 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 mg to 100 mg of monensin per pound.

This supplementation program does require close management. Monensin in large amounts will kill cattle. However, if one considers the lethal dose for monesin (1 percent) to be 5.5 mg per kg body weight (or 1,250 mg per head per day for a 500-pound steer), then there is a theoretical safety ratio of 6.25 for 500-pound cattle consuming 200 mg 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.

Energy Supplements to Stretch a Shortage of 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 did present 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 percent of mean body weight) of whole 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. 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 23.9.

Weight gain of all steers was about 2.2 pounds per day during the 84-day trial and was not different (P>.62) 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 rolled corn 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 steers to 13 steers per pasture were used. Wheat forage standing crops on Dec. 7 (date of turnout), Jan. 17, and March 12 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. Steers had free-choice access to a high-calcium (16 percent) mineral mixture. While the target level of intake of whole corn was 1 percent of body weight, the cattle did not achieve this level of intake until about Jan. 17 (day 41). Corn intake was very consistent among pastures and averaged 0.75 percent of body weight from Dec. 7 to March 15 (98 days). Mean weight of the steers at the start of the trial was 540 pounds, and they gained 1.86 ± 0.11 (standard deviation) pounds per day.

Table 23.9. Energy supplements for stretching wheat pasture.

	Whole corn	*Dry-rolled corn*	*Wheat middlings/ soybean hulls*
No. pastures	2	2	2
No. steers	10[a]	12	12[b]
Initial weight, lbs (12/5/91)	438	438	439
Final weight, lbs (2/28/92)	622	630	625
Daily gain, lbs[c] (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.

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 will often 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 percent 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 percent of body weight. This energy supplementation program increased daily gain by 0.33 pound and allowed stocking rate to be increased by one-third. 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 to 10 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 percent 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 percent to 1 percent of body weight were about 2 pounds per day during two separate wheat pasture years.

References

Andersen, M.A. and G.W. Horn (1987) Effect of Lasalocid on Weight Gains, Ruminal Fermentation and Forage Intake of Stocker Cattle Grazing Winter Wheat Pasture. *Journal of Animal Science* 65:865.

Andrae, J.G., G.W. Horn, and G. Lowrey (1994) Effect of Alternate-Day Feeding of a Monensin-Containing Energy Supplement on Weight Gains and variation in Supplement Intake by Wheat Pasture Stocker Cattle. Animal Science Research Report P-939:158-161. Oklahoma Agricultural Experiment Station, Oklahoma State University.

Bartley, E.E. and R. Bassett (1961) *Journal of Dairy Science* 44:1365.

Branine, M.E. and M.L. Galyean (1990) Influence of Grain and Monensin Supplementation on Ruminal Fermentation, Intake, Digesta Kinetics and Incidence and Severity of Frothy Bloat in Steers Grazing Winter Wheat Pasture. *Journal of Animal Science* 68:1139.

Cravey, M. D. (1993) Influence of High-Starch vs. High-Fiber Energy Supplements on Performance and Forage Intake and Utilization by Stocker Cattle Grazing Wheat Pasture. Ph.D. Thesis. Oklahoma State University.

Horn, F.P. et al. (1976) Influence of Periods of Starvation on Blood Ammonia and Plasma Urea Concentrations of Steers Grazing Wheat Pasture. Animal Science Research Report MP-96. p. 48.

Horn, G.W. and S.I. Paisley (1999) Developments in the Management and Supplementation of Stocker Cattle on Wheat Pasture. Proceedings: Plains Nutrition Council Spring Conference. San Antonio, TX. Publication No. AREC 99-9. Texas A&M Research And Extension Center, Amarillo. p. 48-73.

Horn, G.W., B.R. Clay, and L.I. Croy (1977) Wheat Pasture Bloan of Stockers. Animal Science Research Report MP-101. Oklahoma Agricultural Experiment Station. p. 26.

Horn, G.W. et al. (1981) Effect of Monensin on Ruminal Fermentation, Forage Intake and Weight Gains of Wheat Pasture Stocker Cattle. *Journal of Animal Science* 52:447.

Horn, G.W. et al. (1995) Influence of High-Starch vs. High-Fiber Energy Supplements on Performance of Stocker Cattle Grazing Wheat Pasture and Subsequent Feedlot Performance. *Journal of Animal Science* 73:45.

Mader, T.L. and G.W. Horn (1986) Low-Quality Roughages for Steers Grazing Wheat Pasture. II. Effect on Wheat Forage Intake and Utilization. Journal of Animal Science 62(4):1113-1119.

Mader, T.L. et al. (1983) Low-Quality Roughages for Steers Grazing Wheat Pasture. I. Effect on Weight Gains and Bloat. *Journal of Animal Science* 56(5):1021-1028.

Paisley, S.I. and G.W. Horn (1998) Effect of Ionophore on Rumen Characteristics, Gas Production, and Occurrence of Bloat in Cattle Grazing Winter Wheat Pasture. Animal Science Research Report MP-965:141.

Paisley, S.I. et al. (1998) Alternate Day Feeding of a Monensin-Containing Energy Supplement on Weight Gains of Steers Grazing Winter Wheat Pasture. Animal Science Research Report P-965:132-135. Oklahoma Agricultural Experiment Station, Stillwater.

Potter, E.L. R.L. VanDuyn, and C.O. Cooley (1984) Monensin toxicity in cattle. *Journal of Animal Science* 58:1499.

Stewart, B.A. et al. (1981) Chemical Composition of Winter Wheat Forage Grown Where Grass Tetany and Bloat Occur. *Agronomy Journal* 73:337.

Trapp, J.N. (1998) Seasonal Price Index Updates for Oklahoma Livestock and Livestock Products. Oklahoma Agricultural Experiment Station *Current Farm Economics* 71(3):56.

Vogel, G.J. et al. (1987) Influence of Supplemental Silage on Performance and Economics of Growing Cattle on Wheat Pasture. *The Professional Animal Scientis*t 3:50.

Vogel, G.J. et al. (1989) Effects of Supplemental Silage on Forage Intake and Utilization by Steers Grazing Wheat Pasture or Bermudagrass. *Journal of Animal Science* 67:232.