# PROFITABLE CALF BACKGROUNDING INTEGRATING ANNUAL FORAGE CROPS

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**ABSTRACT**
In the four-state region of Montana, North Dakota, South Dakota, and Wyoming, cereal forages have become an increasingly important crop for livestock producers. Some small grains cut for hay have rough awns which can affect palatability and cause mouth irritation in cattle. New cereal forage cultivar development has only focused on the absence of awns or biomass production and not animal feeding performance. Our study objectives were to: 1) obtain animal performance comparisons of experimental- and traditionally-grown cereal forages; 2) demonstrate animal performance for an experimental awnless winter wheat cultivar; and 3) evaluate steer cost of gain for the experimental- and traditionally-grown cereal forages. A 57-day backgrounding performance study was conducted using 80 purchased crossbred weaned steer calves (678 ± 8.8 lbs. body weight). Calves were stratified by body weight (BW), randomly allotted to pens, and assigned to one of four cereal forage dietary treatments (n = 4): 1) barley harvested as hay (BH); 2) barley harvested as silage (BS); 3) oat harvested as hay (OH); and 4) awnless winter wheat cultivar harvested as hay (WH). Steers were fed once daily (0900) and given ad libitum access to their roughage source, 8.0 lbs./head/day of rolled barley grain, and 1.0 lbs./head/day of a 30% CP supplement containing Rumensin®. Diets were formulated to target an ADG of 2.60 lbs. Two-day un-shrunk weights were recorded on day 0, 28, and 57. Diet, ort, and fecal samples were collected on day 0, 28, and 57. Diet samples were composited by pen and analyzed for dry matter, organic matter, crude protein, acid detergent fiber, and neutral detergent fiber. Steers consuming BH and BS had similar ($P > 0.10$) final BW. Dry matter intakes were not affected by treatment ($P = 0.11$). Calves consuming BS had the highest ($P < 0.01$) total gain and ADG of all four treatments. Calves consuming BS had the highest feed conversions ($P = 0.02$). Steers consuming WH had the highest feed cost of gain ($P = 0.04$) and total cost of gain ($P = 0.03$) of all four dietary treatments. Barley harvested as silage demonstrated greater potential as a backgrounding feedstuff as compared to the barley, oats or awnless winter wheat harvested as hay.

Key Words: annual forage, backgrounding, calf

## Introduction

In the four-state region of Montana, North Dakota, South Dakota, and Wyoming, cereal forages have become an increasingly important crop to livestock producers. Few statistics are available, but cereal hays are harvested on over 500,000 acres in this region. One explanation for the popularity of cereal forages may be reoccurring drought conditions and their use as an emergency hay crop. Small grains are used in crop rotations to renovate alfalfa stands and are an effective way to reduce costs associated with weed and disease control. Cereal hays are a significant source of winter forage for livestock producers in this area. Cereal forages can be an inexpensive, readily available feed source since they are easier to grow when compared to alfalfa regarding seed drills, herbicides, and risk and require similar harvesting techniques as legumes (Helsel and Thomas, 1987). Winter cereals have advantages over spring cereals concerning production, water use efficiency and seasonal distribution of workload.

Previous research has shown differences in feeding value among cereal forage species and across maturity stages at harvest. Barley forage has often been determined to have higher quality when compared to oat, wheat, or triticale forages (Cherney and Martin, 1982; Cherney et al., 1983; McCartney and Vaage, 1994; Khorasani et al., 1997). Some cereal grain seed heads contain rough awns. Awns can affect palatability and cause mouth irritation in livestock. Bolsen and Berger (1976) found lambs consuming awned wheat silage had decreased dry matter intake (DMI) compared to lambs consuming awnless wheat silage. New cultivar development has focused on awn absence or biomass production and not animal feeding performance.

We designed and conducted steer backgrounding feeding trials to evaluate the following objectives: obtain animal performance comparisons of experimental and traditional cereal forages; demonstrate animal performance for an experimental awnless winter wheat cultivar; and evaluate steer cost of gain for experimental and traditional cereal forages.

**Materials and Methods**

A backgrounding performance study was conducted using 80 purchased crossbred, weaned steer calves (initial BW 678 ± 8.8 lbs.). Calves were stratified by BW, randomly allotted to one of 16 pens (5 steers/pen), and assigned to one of four cereal forage dietary treatments (n = 4): 1) barley harvested as hay (BH); 2) barley harvested as silage (BS); 3) oat harvested as hay (OH) and 4) awnless winter wheat cultivar harvested as hay (WH). The barley variety used for silage and hay was 'Robust'; the oat variety used for hay was 'Loyal'; and the winter wheat variety used for hay was 'Willow Creek'. This awnless winter wheat was an experimental variety developed by Montana State University in Bozeman, Montana. Cereal forages utilized in the feeding trial were seeded at the recommended rates for the soil types and environments of southwest North Dakota and Miles City, Montana. Barley hay, BS, and OH harvest were conducted at the same stage of maturity (soft dough stage) during the months of June and July 2005. The WH cultivar was grown and harvested at flowering near Miles City, MT by a commercial farmer and delivered to the Hettinger Research Extension Center prior to the start of the trial.

Upon arrival, steer calves were weighed and rectal body temperatures taken to determine the incidence of respiratory illness (BRD complex). Steers having a rectal body temperature of 105$^{o}$ F or greater were given a subcutaneous injection of Excede™ (Ceftiofur Crystalline Free Acid, Pfizer Animal Health, Exton, PA) antibiotic in the middle one-third posterior aspect of the ear. At processing, calves were vaccinated twice with Pyramid® 5 vaccine (Bovine Rhinotracheitis-Virus Diarrhea-Parainfluenza-3-Respiratory Syncytial Virus; modified live virus; Fort Dodge Animal Health, Ft. Dodge, IA) and Ultrabac® 7 Clostridial vaccine (Pfizer Animal Health, Exton, PA); vaccinated once with One Shot® bacterin-toxid for Mannheimia haemolytica (Pfizer Animal Health, Exton, PA), and poured with Dectomax® Pour-On dewormer (doramectin; Pfizer Animal Health, Exton, PA) for internal and external parasites. Calves were implanted with a Ralgro® implant (Schering-Plough Animal Health Corporation, Kenilworth, NJ) at the beginning of the backgrounding study.

Steers were fed once daily (0900) based on individual pen bunk calls and given ad libitum access to their roughage source, 8.0 lbs. of rolled-barley grain, 1.0 lb. of a 30% CP supplement containing Rumensin®, and fresh water (Table 1). Diets were formulated to target an ADG of 2.60 lbs. Deccox® medicated crumbles were fed during the study for coccidiosis prevention. All hays were chopped to a 2-inch length prior to feeding. Two-day un-shrunk weights were recorded on day 0, 28 and 57. A health protocol was established through a local veterinary clinic which included a monthly pen walk-through by the attending veterinarian. Diet, ort, and fecal samples were collected on day 0, 28, and 57. Diet samples were composited by pen and analyzed for dry matter (DM), organic matter (OM), nitrogen (AOAC, 2000), NDF, and ADF (Van Soest et al, 1991).

**Table 1. Dietary ingredient and nutrient compositions of diets fed to crossbred steer calves (DM basis).**

| | Diets | | | |
|---|---|---|---|---|
| Ingredient | Barley Silage | Barley Hay | Oat Hay | Wheat Hay |
| Barley Silage, % | 63.3 | --- | --- | --- |
| Barley Hay, % | --- | 56.08 | --- | --- |
| Oat Hay, % | --- | --- | 54.27 | --- |
| Wheat Hay, % | --- | --- | --- | 58.75 |
| Barley Grain, % | 31.48 | 37.67 | 39.22 | 35.38 |
| 30% CP supplement[a] , % | 4.02 | 4.82 | 5.01 | 4.52 |
| Deccox medicated crumbles, % | 1.20 | 1.43 | 1.49 | 1.35 |
| Nutrient Concentration | | | | |
| DM, % | 58.2 | 84.5 | 83.8 | 87.7 |
| CP, % | 13.60 | 12.40 | 9.56 | 11.20 |
| $NE_m$ , Mcal/cwt | 78 | 62 | 53 | 72 |
| $NE_g$ , Mcal/cwt | 50 | 36 | 27 | 45 |
| OM, % | 89.8 | 78.1 | 71.6 | 85.2 |
| NDF, % | 30.6 | 39.1 | 62.4 | 46.2 |
| ADF, % | 18.0 | 24.7 | 46.0 | 26.2 |
| Ca, % | 1.24 | 1.02 | 0.93 | 0.71 |
| P, % | 0.40 | 0.30 | 0.28 | 0.30 |
| Nitrate, ppm | 900 | 400 | 500 | 300 |
| Deccox, mg | 170 | 170 | 170 | 170 |
| Rumensin, mg | 213 | 213 | 213 | 213 |

[a] 30% Commercial supplement (as fed): 29.0% CP, Ca 17.0%, P 0.45%, K 1.2%, Mg 0.7%,Vitamin A 242,000 IU/lb, Vitamin $D_3$ 24,200 IU/lb, Vitamin E 726 IU/lb, Cu 550 ppm, Zn 930 ppm, and Mn 1000 ppm.

Backgrounding performance, feed intake, and nutritional data were analyzed as a randomized complete design using the GLM procedures of SAS (SAS Inst. Inc., Cary, NC) to test the main effect of dietary forage source using pen as the experimental unit. Planned pairwise comparisons (least significant difference) were used to separate forage least square means when the protected F-test was significant ($P < 0.10$).

**Results and Discussion**

Steers consuming BH and BS had similar final weights; however, steers consuming BS had higher final weights as compared to the steers fed OH and WH ($P < 0.10$; Table 2). Both gain and ADG were influenced by dietary treatments ($P = < 0.01$; Table 2). Calves consuming BS diet had the highest gain and ADG of all four treatments, with no difference between BH, OH and WH fed steers ($P > 0.10$). Dry matter intake was not affected by treatment ($P = 0.11$); however, BH steers had DMI that was numerically higher than the other three treatments (Table 2). Feed conversions were the highest for BS steers ($P = 0.02$; Table 2) as compared to the OH, BH and WH steers. Steers consuming WH had the highest feed cost of gain ($P = 0.04$; Table 2) and total cost of gain ($P = 0.03$; Table 2) of all four dietary treatments. One explanation for the high feed and total costs for WH may be due to transportation costs from Miles City, MT to Hettinger, ND. Transportation costs added an additional $0.09/lb. to the final cost of WH, which the other three dietary treatments did not incur since they were grown and harvested at the Hettinger Research Extension Center.

**Table 2. The influence of forage source on backgrounding steer performance.**

| | Treatments[a] | | | | | |
|---|---|---|---|---|---|---|
| Item | Barley Silage | Barley Hay | Oat Hay | Wheat Hay | SEM[b] | *P*-value[c] |
| Final Wt, lbs. | 858$^{y}$ | 844$^{xy}$ | 824$^{x}$ | 819$^{x}$ | 11.6 | 0.07 |
| Gain, lbs. | 183$^{y}$ | 159$^{x}$ | 150$^{x}$ | 143$^{x}$ | 7.02 | < 0.01 |
| ADG, lbs/d | 3.22$^{y}$ | 2.78$^{x}$ | 2.63$^{x}$ | 2.51$^{x}$ | 0.122 | < 0.01 |
| DMI, lbs/d | 19.4 | 22.1 | 19.4 | 19.8 | 0.84 | 0.11 |
| Dry feed conversion, lb. | 6.06$^{y}$ | 8.05$^{x}$ | 7.56$^{x}$ | 8.15$^{x}$ | 0.45 | 0.02 |
| Feed cost of gain, $/lb. | 0.35$^{x}$ | 0.34$^{x}$ | 0.32$^{x}$ | 0.41$^{y}$ | 0.019 | 0.04 |
| Total cost of gain, $/lb. | 0.49$^{x}$ | 0.51$^{x}$ | 0.52$^{x}$ | 0.62$^{y}$ | 0.028 | 0.03 |

[a] BH = Barley Hay; BS = Barley Silage; OH = Oat Hay; WH = Awnless Winter Wheat Hay.

[b] n = 4.

[c] *P*-value for *F*-test of treatment.

[x,y] values with different superscripts are significantly different (P< 0.10).

Diets were formulated to achieve a 2.60 lbs. ADG; however, the BS treatment had higher $NE_g$ values (Table 1) during the feeding trial as compared to the other three dietary treatments which may have resulted in higher gain and ADG (Table 2). McCartney and Vaage (1994) found ADG and subsequent animal performance was highest for growing beef heifers consuming barley silage as compared to oat or triticale silage. Todd et al. (2003) had similar DMI values (22.10, 21.10, and 17.80 lbs./d, respectively) for steers consuming four different irrigated BH varieties (MT 981060, Valier, Haybet, and Westford). Umoh et al. (1982) reported similar DMI values for steers fed Horsford and Stepford barley hay. During our study, all three dry hay diets had large amounts of fines present in their feed bunks during ort collections as compared to the BS steers (data not reported). It appears that the BS steers possibly did not sort their daily feed allotment as much and consumed a more consistent diet of their daily feed allotment as compared to the other three treatments, thus improving BS steers feed conversions and ADG, despite having lower DMI.

**Implications**

In this backgrounding study, barley harvested as silage demonstrated greater potential as a backgrounding feedstuff as compared to barley, oats, or awnless winter wheat harvested as hay. More research is needed to further define the effects these cereal grain varieties have on backgrounding steer performance. Utilizing cereal grains as forage crops in post-weaning cattle rations offers unique business opportunities to producers in this region, especially in periods of drought.

*Acknowledgements: We would like to thank the South Dakota Agricultural Experiment Station and the Four-State Ruminant Consortium for funding this project.*

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*Reprinted from the 2006 NDSU Carrington Research Extension Center Feedlot Research Report. Volume 29. Oct 10, 2006*