# Impact of Grazing Spring Rye on Subsequent Crop Yields and Profitability

Ashley C. Conway
Robert G. Bondurant
Fred H. Hilscher
Jay Parsons
Daren Redfearn
Mary E. Drewnoski

## Summary with Implications

*Steers (729 ± 19 lb BW) grazed in two November-planted cereal rye fields for 22 d in April, either with or without an ionophore in their free choice mineral supplement. Subsequent corn yields were measured to assess impact of planting cereal rye as a cover crop (not grazed) or grazing the rye compared to a no rye control. There was no statistical impact of rye or grazing on subsequent corn yield. Supplying an ionophore in the mineral did not uniformly improve gains across fields. However, gains were high at 3.2 lb/d and were able to offset the cost of planting rye.*

## Introduction

Incorporation of cover crops into traditional cropping systems has been shown to provide numerous agronomic benefits, including improved soil organic matter, reduced nutrient runoff, and weed suppression. Producers could also benefit from added economic diversity by integrating cattle into this production system by grazing the cover crop. Cereal rye is commonly utilized as a cover crop, but little work has been done on the incorporation of grazing late fall planted rye in the spring in Nebraska. The spring grazing potential of late fall planted rye including animal performance, duration of grazing and economics as well as the impacts on subsequent cash crop yields are not well known. Different cattle management strategies also have the potential to improve the economics and performance of the system, such as providing ionophore to grazing cattle, which has been shown to improve ADG and reduce bloat in cattle grazing wheat pasture, but this has not been extensively studied in cereal rye pastures. The objective of this study was to assess the impacts of incorporating rye with and without grazing on subsequent crop yield, and test ionophore supplementation through a free choice mineral on growing calf performance while grazing rye.



## Procedure

Two fields averaging 103 ac each near Mead, NE, were separated into three blocks with each block containing four treatments: a negative control strip (120 ft wide) not planted with cereal rye (5.5 ± 1.6 ac), a positive control strip (120 ft wide) planted with cereal rye but not grazed (5.1 ± 1.5 ac), and two pastures (10.2 ± 3.0 ac) planted with rye and grazed. Cattle in one pasture were provided free choice trace mineral supplement without a monensin ionophore, and the other pasture provided a mineral with monensin ionophore (4 oz target intake to supply 200 mg/h/d), resulting in a total of 3 replications per treatment in each field. Field 1 was in a corn-soybean-wheat crop rotation, with the most recent harvest being wheat harvested in July of 2016, followed by a hay crop of sorghum-sudan grass, which was swathed on September 26, 2016 and baled after approximately 2 weeks of drying in October. Field 2 was in a corn-soybean rotation, with the most recent harvest being soybeans harvested on October 18, 2016. Elbon cereal rye was planted on October 28, 2016 at a rate of 70 lb/ac, and fertilized with 11–52–0 at a rate of 40 lb N/ac on November 15, 2016.

On April 4, 2017, 184 commercial crossbred steers (729 ± 19 lb BW) were turned out for grazing when rye had reached approximately 4 to 5 inches of growth. Prior to turn out, cattle were limit fed for 7 days on a diet of 50% Sweet Bran and 50% alfalfa hay (on DM basis), and three day empty body weights were taken to assign cattle to pastures. Based on rye biomass production, Field 1 was stocked at a rate of 0.9 hd/ac and Field 2 was stocked at a rate of 1.8 hd/ac. Cattle grazed for a total of 22 days, with two pastures having half the number of cattle removed at 14 d due to low forage availability. Cattle were limit fed at the end of the trial for 5 days on the same diet as stated previously to equalize gut fill, and three day BW were taken. Weights were adjusted to account for 1 lb/d gain during the limit fed periods. During the grazing period, mineral disappearance was measured by weighing feeder tubs weekly and taking samples for dry matter adjustment.

Stand counts for corn plants were collected in mid-June when corn had reached approximately V6-V8 stage of growth (six to eight visible above-ground leaves). Three sampling points within each treatment in each block were randomly selected across the field. At each sampling point, the number of corn plants within a 17.5 ft length of row was counted for three adjacent rows, resulting in an average for each sampling point. Corn yields were measured using hand harvest methods when corn had reached black layer formation (Oct 9$^{th}$, 2017). Three locations in each treatment within each block were selected, and a 17.5' length of row was hand harvested, where corn ears had the husk removed and a total ear weight was obtained in the field. Three randomly selected ears were also weighed separately and retained for DM analysis. Ears were dried and kernels removed from the cob, and both parts were dried in a 140° F forced air oven for 48 h, where dry weights were used to calculate the proportion of kernel to cob, and DM yield estimate for corn grain. Data presented were adjusted to 85% moisture bushel yields.

Economics were evaluated by conducting a partial budget analysis. Rye seed cost was budgeted at $16.80/ac, fertilizer cost at $10.00/ac, custom drilling at $13.36/ac and fertilizer at application costs of $6.00/ac. Cattle costs included fencing at $4.40/ac, mineral costs of $0.07/hd/d for control and $0.08/hd/d for ionophore, and $0.10/hd/d for yardage costs.

Data were analyzed using the MIXED

**Table 1. Results of corn yield, corn plant population, and cattle performance and economics from the first year of planting and grazing cereal rye over 22 days in the spring with and without an ionophore supplement.**

| | Grazed Control | Grazed Ionophore | No-graze, Rye | No Rye | SEM | *P-value* |
|---|---|---|---|---|---|---|
| Stand count-early, plants/ac | 31,370[b] | 32,463[ab] | 33,667[a] | 32,296[b] | 442 | 0.02 |
| Stand count-harvest, plants/ac | 31,167[b] | 33,556[b] | 35,778[a] | 32,944[b] | 1201 | 0.10 |
| Corn Yield, bu/ac[1] | 189 | 203 | 204 | 211 | 14.1 | 0.59 |
| ADG, lb | 3.1 | 3.3 | - | - | 0.24 | 0.60 |
| Gain per acre, lb | 98.8 | 96.7 | - | - | 7.4 | 0.84 |
| Returns, $/hd[2] | 37.63 | 48.68 | - | - | 6.55 | 0.31 |
| Returns, $/ac | 62.81 | 70.09 | - | - | 8.00 | 0.56 |

[1] Due to flooding, some of Field 2 was replanted with different hybrids, thus only data from Field 1 was analyzed and reported.

[2] Seed cost of $16.80/ac, fertilizer cost of $10.00/ac, custom drilling and application costs of $13.36/ac and $6.00/ac. Cattle cost included fencing at $4.40/ac, mineral costs of $0.07/hd/d for control and $0.08/hd/d for ionophore, and $0.10/hd/d for yardage costs with calf price at $140/cwt.

procedure of SAS 9.4 (SAS Institute Inc., Cary, NC). Rye biomass, cattle performance and economic returns were analyzed with field and treatment at fixed effects and block as a random effect. Corn yield and stand count data were analyzed with treatment as a fixed effect and block as a random effect. Due to replant (due to partial flooding) with different hybrids in Field 2, only yield data from Field 1 were analyzed and reported. Mineral disappearance was analyzed with field, treatment, and week as fixed effects. Results were declared significant when $P < 0.05$ and tendencies were declared when $0.10 < P < 0.05$.

## Results

Rye biomass production at the beginning of the grazing season was significantly different ($P = 0.03$) between Field 1 and 2, but not different ($P = 0.45$) between treatments. The average production at the start of grazing on March 27 was 450 lb/ac DM, but Field 1 was measured at 411 ± 20 lb/ac DM, and Field 2 was measured at 492 ± 20 lb/ac DM. Field 1 established slower, and had less biomass than Field 2 despite planting and fertilizing at the same time. This can potentially be attributed to differences in soil moisture between the two fields. Field 1 entered the study after a wheat harvest followed by a short-season crop of sorghum-sudan hay, and Field 2 entered the study after a soybean harvest. Although not measured, the additional hay crop is suspected to have had an impact on rye establishment and subsequent spring growth because it appeared there was reduced soil moisture. At the end of the grazing period, there was a significant interaction ($P < 0.01$) between fields and treatment for rye biomass production. There were no differences ($P = 0.62$) in rye biomass at the end of grazing in the two fields, with control (no ionophore) having 503 lb/ac and ionophore having 538 lb/ac. The ungrazed treatments had significantly ($P < 0.01$) more biomass with Field 1 being less ($P < 0.01$) at 776 lb/ac than Field 2 at 3596 lb/ac. The stocking rate and number of grazing days resulted in a harvest of 0.47 AUM/ac in Field 1 and 1.06 AUM/ac in Field 2.

There was a significant difference ($P = 0.02$) between treatments on corn plant populations at establishment. Ungrazed rye plots appeared to have the greatest plant populations, with no difference ($P > 0.10$) between the no-rye or grazed rye treatments. However, there was no statistical difference ($P = 0.59$) between treatments for the subsequent corn yield in 2017 (Table 1), but some numerical differences were observed. The rye was killed at planting, which may have contributed to the numerically lower corn yields in the grazed and ungrazed rye treatments.

There was no effect of treatment ($P = 0.17$) on mineral disappearance. However there was a field effect ($P < 0.01$), whereby mineral disappearance was greater in Field 2 at 6.1 oz/hd/d than Field 1 at 3.8 oz/hd/d. There was a tendency ($P = 0.06$) for an interaction between field and supplement for average daily gain (ADG). Cattle supplemented with control mineral gained 2.87 lb/d and cattle receiving ionophore gained 3.57 lb/d in Field 1, but in Field 2, control cattle gained 3.41 lb/d compared to 2.90 lb/d for the ionophore-supplemented cattle. When averaged across the 22 d grazing period, steers gained 3.2 lb/day (Table 1). Total gain per acre averaged 98 lb/ac, although there was a significant ($P < 0.01$) field effect with Field 1 averaging 60 lb/ac and Field 2 averaging 136 lb/ac. This was expected, since Field 2 produced more biomass and was stocked at nearly double the stocking rate.

The price of the calves per pound did not change during the short time period, and there was no price slide for this class of cattle sold in May 2016; the value used to calculated costs and revenue was $140/cwt. Total cost to establish the rye for this operation was $50.56/ ac for Field 1 and $50.03/ac for Field 2. There was no significant difference ($P = 0.31$) between grazing mineral treatments in returns per head or per acre (Table 1). There was a difference ($P < 0.01$) between fields, due to the differences in stocking rate with Field 1 returning $32.53/ac and Field 2 returning $111.7/ac.

## Conclusions

In this study, steers demonstrated considerable growth over a short period of time, indicating that growing cattle can perform well on spring rye maintained in a vegetative state. Furthermore, no statistically negative impacts on corn yield or establishment were observed with planting and grazing rye. No consistent improvement of ADG was observed with providing an ionophore in the mineral supplement. Grazing growing calves in early spring on late fall planted cereal rye offset the costs of planting the rye and provided additional returns.

Ashley C. Conway, graduate student, Lincoln

Robert G. Bondurant, research technician, Lincoln

Fred H. Hilscher, research technician, Lincoln

Jay Parsons, associate professor, agriculture economics

Daren Redfearn, associate professor, agronomy and horticulture, Lincoln

Mary E. Drewnoski, assistant professor, UNL Department of Animal Science, Lincoln, Neb.