Forage Production and Calf Gains When Grazing Oats following Corn Harvest

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Summary with Implications

A 4 yr. study was conducted to evaluate forage yield and grazing potential of double cropped annual forages following corn silage or high-moisture corn harvest. An irrigated field in a corn-soybean rotation was split in half and harvested as either corn silage or high-moisture corn, and crops were sampled to determine any effects on subsequent yield due to cover and grazing. Over the four years, steers grazing oats after corn silage harvest gained an average of 2.35 lb/d, while those grazing corn residue and oats after high-moisture corn harvest averaged 1.28 lb/d. Average oat forage production after corn silage was 2,208 lb/ac, while due to later planting dates, oat production after high-moisture corn harvest averaged 910 lb/ac. Planting cover crop forages following corn silage harvest provides producers opportunities for additional body weight gain with greater forage production than planting after high-moisture corn, with no apparent impacts on subsequent yields.

Introduction

Grazing livestock on late-summer planted double-cropped annual forages may provide opportunities for producers to extend their grazing season between summer range and winter residue grazing. Double-cropped annual forages (DCAF), commonly referred to as cover crops have increased in popularity recently. Cover crops provide numerous agronomic advantages for land owners, including, soil conservation, weed control, and economic incentives (grazing rent). Additionally, late-summer planted cover crops may provide animal gains and economic benefits for livestock producers and land owners. Corn harvest timing affects the amount of fall forage produced, due to limited growing degree days (GDD). Early harvested corn, such as corn silage (CS) results in more GDD available for fall forage production compared to high-moisture corn (HMC) harvest, where forage production is used as a supplement to corn residue. Therefore, the objective of this study was to determine calf gains and forage production of oats following corn silage or high-moisture corn harvest, as well as their impact on subsequent crop yields.

Procedure

Field and Planting Details

In a 4 yr study, a pivot irrigated field located at the Eastern Nebraska Research and Extension Center (ENREC) near Mead, NE was utilized to determine oat forage production and calf gains following CS and HMC harvest, as well as their effects on subsequent crop yield. The 104-acre field was split into a corn and soybean rotation (52-ac each). Corn and soybeans were planted with 7.5-in row spacing. The half of the field planted to corn was split again into CS (26-ac) and HMC (26-ac). Each year, corn was harvested as either CS (September 1st) or HMC (September 15th), and double-cropped with an oat monoculture, and grazed according to treatment. Horsepower oats were drilled at 90 lb/ac following CS and HMC harvest, and a 32% ammonium nitrate fertilizer was applied at a rate of 40 lb/ac. In 2018, due to limited emergence of the oats planted on the CS, Horsepower oats were re-planted on the CS at 90 lb/ac on the day that oats were planted on the HMC. Treatments included double crop annual forage (DCAF) followed by grazing (Cov-G), DCAF without grazing (Cov-NG), and no DCAF (NC-NG). Treatments were initially applied in 2013; however, due to herbicide restrictions, no grazing occurred until 2015.

Forage Production Measures

Initial oat biomass was sampled in late October to determine forage production, and to determine stocking rates. Total biomass was measured by randomly selecting (36 x 22.5 in) areas within each treatment paddock that contained cover (CS Cov-G, CS Cov-NG, HMC Cov-G, and Cov-NG). Forage was clipped at ground level, bagged, and dried for 48 h in a 60°C oven to determine initial biomass. Furthermore, corn stover was sampled on the HMC side to account for the total amount of residue removed due to grazing. Growing degree days were calculated for each treatment to account for differences in planting date.

During initial biomass sampling, forage quality samples were taken for each treatment (2 rep/treatment) containing oats. Samples were taken by randomly clipping oats at ground level uniformly across each paddock. Samples were dried at 100°C for 24 h to determine DM and analyzed for OM, CP, NDF, and ADF.

After the grazing period, forage biomass was sampled the same as initial biomass, and transects were taken to determine percent cover. Transects were taken using a 100 ft tape stretched randomly across areas within each treatment. At each 1 ft., it was determined whether the soil was covered or not, these were then averaged to determine a percentage of cover at each area.

Crop Yield

Corn silage, high-moisture corn, and soybean yields were collected to determine subsequent crop yields following the previous years imposed treatments. Hand harvest of corn included cutting the corn plant at the first node for 17.5 ft at 9 locations/treatment. Corn ears were removed, and the ear and remaining plant stover (husk, leaf, and stalk) were weighed separately. For CS the remainder of the corn plant was ground

Table 1. 4 yr. averages of calf performance grazing oats seeded after corn silage or high-moisture corn harvest, forage production, growing degree days, and soil cover

	Treatment			
Item	CS[1]	HMC[2]	SEM	*P*-value
Calf Performance				
Initial BW, lb	491	488	14.3	0.53
Ending BW, lb	592	541	17.2	0.02
ADG, lb	2.35	1.28	0.381	0.01
Gain, lb / ac	244	143	66.7	0.04
Oats Forage Production				
Biomass, lb / ac[3]	2208	910	155.7	<0.01
GDD[4]	649	354	36.0	<0.01
Post graze cover, %[5]	66.8	86.6	3.60	<0.01

[1]Calf performance and forage production of oats seeded after corn silage harvest

[2]Calf performance and forage production of oats seeded after high-moisture corn harvest

[3]Biomass determined prior to the grazing period

[4]GDD (growing degree days of oats) = [maximum temperature (°C)—minimum temperature (°C) (if min. temp. < 0, then set = 0] summed from d oats seeded to d initial oat biomass sampled.

[5]Percent cover determined by transects after the grazing period. Treatment averages.

through a chipper, weighed wet, subsampled, and dried to determine yield.

Soybean plants were hand harvested at ground level. Samples were then bundled, and dried in a drying room at 60°C until threshing. During threshing, grain and stover were collected, weighed wet, and dried. Dry matter oven weights for the grain and stover were used to calculate soybean grain and stover yield per acre.

Cattle Grazing and Management

Sixty-two steer calves (initial BW = 467 lb; SD = 20 lb) were utilized in 2015, fifty-five (initial BW = 503 lb; SD = 29 lb) in 2016, thirty-four (initial BW = 463 lb; SD = 29 lb) in 2017, and thirty-six steer calves (initial BW = 507 lb; SD = 7 lb) were utilized in 2018 for oat grazing. Prior to grazing, steers were limit fed a common diet of 50% Sweet Bran (Cargill Wet Milling, Blair, NE) and 50% alfalfa hay for 5 d, then weighed for 3 consecutive d to establish initial BW. Cattle were stratified by BW and assigned randomly to paddocks with two paddocks in each the CS and HMC treatments. Due to differences in available forage, number of head varied between paddocks. Therefore, a set number of head were determined to be testers within each treatment paddock. In 2015, and 2016 10 hd/paddock were assigned as testers, while only 5 hd/paddock were assigned as testers in 2017 and 2018. Grazing performance was determined based upon the tester performance averaged over all calves in the treatment paddock.

Calves were implanted with 36 mg Zeranol (Ralgro, Merck Animal Health, Madison, NJ) and turned out into their respective paddocks in early November.. Stocking rates were calculated using a predetermined 70 d grazing period, with a 60% grazing efficiency, intakes estimated at 2.5% of BW, and initial biomass measurements of lb DM / ac within each grazing paddock. Stocking rates ranged from 0.65 to 1.66 hd/ac on the CS and 0.92 to 1.32 hd/ac on the HMC treatment. In 2015–2017 treatments were grazed until forage availability was determined to be limiting intake, whereas weather in 2018 resulted in termination of grazing (62, 42, 48, and 30 days; respectively over the four years). Upon removal from the grazing treatments, steers were limit fed the same 50:50 alfalfa and Sweet Bran diet for 8 d and were weighed for 3 consecutive d to limit differences in gut fill and determine ending BW.

Data were analyzed using the MIXED procedure of SAS (SAS Institute, Inc., Cary, N.C.). Paddock was the experimental unit for calf performance and oat forage quality data. Treatment was analyzed as a fixed effect for steer performance, and subsequent corn and soybean yields. Treatment means were separated using the pdiff statement when the F-test was significant. Data were considered to be significantly different at *P* ≤ 0.05.

Results

Forage Production and Quality

Oat forage biomass production was greater following CS than HMC with 2,208 lb DM / ac compared to 910 lb DM / ac, respectively (*P* < 0.01, Table 1). Corn stover from the HMC provided 1,669 lb DM / ac making total lb DM / ac between the treatments similar. Although, due to limited oat emergence on the CS in 2018, HMC oat biomass was more similar to CS than in previous years (1,531 vs. 1,952 lb/ac, respectively). Furthermore, GDD were calculated to estimate the number of possible days of oat forage growth from the time of planting to initial biomass measurements, based on average daily temperature. Average GDD were significantly different for the two treatments, with oats planted on CS averaging 649 d and HMC averaging 354 d, respectively (*P* <0.01). Significantly greater forage production following CS is likely due to the difference in average GDD between the treatments and cover from the HMC residue. Due to HMC residue, percentage ground cover, estimated using transects, was significantly different between CS and HMC (66.8% and 86.6% respectively; *P* < 0.01). However, planting of oat forage on the CS side provided improved soil cover regardless of grazing treatment, resulting in more similar cover provided by the corn residue remaining on the HMC side, compared to the NC-NG CS treatment.

Nutrient quality of oats (OM, CP, NDF, and ADF) is reported in Table 2. Oat OM was not different (*P* = 0.38) whether it was planted following CS or HMC harvest (86.7% and 87.0%, respectively). Nonetheless, CP was greater in the oats seeded following HMC compared to CS at 22.7 and 18.0%, respectively (*P* < 0.01). Oats planted following HMC harvest were less mature than those following CS, likely contributing to the increase in CP content. There was a tendency (*P* = 0.09) for oats planted after CS to have greater NDF compared to HMC (38.3% and 35.9% respectively). Furthermore, ADF was greater for oats following CS compared to HMC (24.0 vs. 21.9, respectively; *P* < 0.01). Nonetheless, oats planted after CS or HMC harvest resulted in a high quality forage for grazing.

Calf Performance

Calf initial and ending BW, average daily gain (ADG), and gain per acre is reported in Table 1. Steers grazing oats following CS had greater ending BW than those grazing after HMC (592 and 541 respectively; *P* = 0.02). Accordingly, calves grazing the CS treatment had greater ADG than steers grazing the HMC treatment (*P* = 0.01) with an ADG of 2.35 and 1.28 lb/d, respectively and gain per acre was greater for the CS treatment than the HMC treatment (244 lb/ac and 143 lb/ac respectively; *P* = 0.04). Calf gains differed between the two treatments due to greater oat production on the CS treatment. Additionally, calves grazing the HMC treatment consumed the oats prior to the corn residue, thus, planting oats after HMC harvest may not be an effective supplementation strategy when grazing.

Crop Yields

An interaction was observed between corn treatment and DCAF treatment for subsequent soybean yields (*P* = 0.01; Figure 1). The interaction suggests that when soybeans were planted after HMC, the oats with or without grazing had no impact on subsequent soybean yield. However, when soybeans followed CS, oats without grazing reduced yields, compared to oats with grazing and no oats with no grazing. Regardless of the corn treatment, grazing DCAF did not appear to impact subsequent soybean yields. Corn yields were compared across treatments for 2017 and 2018, to evaluate the impact of grazing in 2015 and 2016 respectively. Corn silage yields, HMC grain, and HMC stover yields were not different among treatments (*P* ≥ 0.10; Table 3).

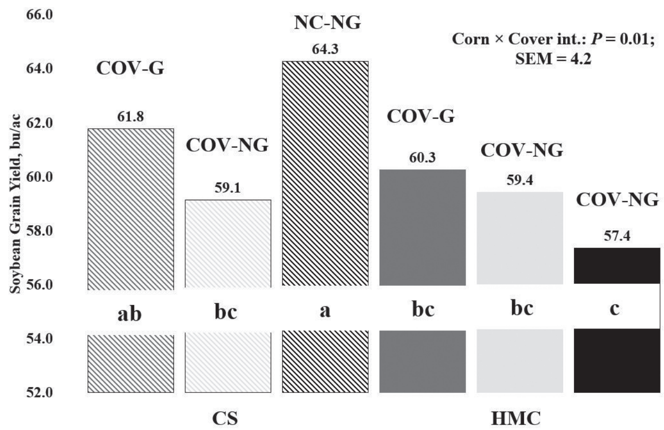

Figure 1. 4yr. Averages for subsequent soybean yields (bu/ac) following oat forage with and without grazing

Table 2. 4 yr. averages for forage quality of oats planted after corn silage and high-moisture corn harvest

	Treatment			
Item[1]	CS[2]	HMC[3]	SEM	*P*-value
OM	86.7	87.0	0.01	0.38
CP	18.0	22.7	0.91	<0.01
NDF	38.3	35.9	0.02	0.09
ADF	24.0	21.9	0.01	<0.01

[1]All treatment means are percentages

[2]Nutrient content of oats seeded after corn silage harvest

[3]Nutrient content of oats seeded after high-moisture corn harvest

Table 3. 4 yr. averages for subsequent corn yields following oat forage with and without grazing[1]

	Treatment[2]				
Item	Cov-G	Cov-NG	NC-NG	SEM	*P*-value
Corn Silage Yield, ton/ac	8.6	7.3	8.8	0.49	0.10
HMC Grain Yield, bu/ac	222	210	203	1.3	0.48
HMC Stover Yield, ton/ac	4.1	4.0	3.6	0.19	0.21

[1]Average corn silage and high-moisture corn yields from 2017, and 2018 following oats planted after corn silage or high-moisture corn harvest, in 2016 and 2017

[2]Cov-G = grazed oats, Cov-NG = ungrazed oats, NC-NG = ungrazed without oats drilled

Conclusion

Grazing double-cropped oats following corn harvest provides producers an opportunity to add additional weight to weaned calves, and may offer an economic incentive to cropping systems with no impact on subsequent crop yields. Due to fewer GDD, substantially less forage production is observed following HMC harvest, leading to less desirable gains compared to oats planted after CS. Seeding and grazing of oat forage following CS offers numerous benefits for livestock and crop producers.

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