PRACTICAL farmers of Iowa
working together, always learning

Livestock Research

Summer Annual Forage Established After Cereal Rye + Hairy Vetch Cover Crop

Staff Contact:

Stefan Gailans– (515) 232-5661
stefan@practicalfarmers.org

Cooperators:

- **Dave & Meg Schmidt - Exira**

Funding By:

Walton Family Foundation

Web Link:

http://bit.ly/pfi_livestock

In a Nutshell

- Cover crops and summer annual forage mixes can provide a host of benefits to annual cropping systems: add biodiversity, reduce soil erosion, reduce nutrient loss, increase soil organic matter and reduce weed pressure.
- Dave and Meg Schmidt evaluated the effect of applying chicken litter to a cereal rye + hairy vetch cover crop and grazing the cover crop ahead of establishing a summer annual forage mix.

Key findings

- Grazing the cereal rye + hairy vetch cover crop resulted in more biomass production than where not grazed.
- The application of chicken litter did not affect cover crop growth or summer annual forage biomass production.
- Hairy vetch in the cover crop successfully established (seeded in late August 2015) and may have contributed a substantial amount of N to the succeeding summer annual forage crop.

Project Timeline:
2016

Cattle graze the summer annual mix in late August at Dave and Meg Schmidt's farm, Troublesome Creek Cattle Co., near Exira.

Background

Summer annual forages are capturing the attention of farmers using integrated crop-livestock production systems. Summer annual forages are often comprised of a mix of warm season plant species that are planted in the spring and produce a substantial amount of quality fodder for grazing livestock by late summer. This occurs just in time to give summer pastures a rest. Sometimes also referred to as "full season cover crops," summer annual forages are noteworthy because they add biodiversity to annual cropping systems both above- and belowground. Because summer annual forages are planted in the spring like corn or soybeans, winter cover crops can also be incorporated into such a system. Winter cover crops like cereal rye help to hold the soil in place, sequester nutrients and suppress spring weeds; legumes like hairy vetch can fix nitrogen from the atmosphere to provide to succeeding crops (in this case, the summer annual forages). The degree to which cover crops provide these benefits is directly tied to the amount of growth the cover crop achieves. Dave and Meg Schmidt, who raise cattle and crops, devised a trial to learn how cover crops and chicken litter could be added to their summer annual forage production.

This trial sought to answer two questions: 1) Should chicken litter be applied to a cereal rye + hairy vetch cover crop to maximize cover crop biomass and N supply for a summer annual forage mix? 2) How will early spring grazing of the cereal rye + hairy vetch cover crop affect performance ahead of the summer forage mix? Dave is particularly interested in nutrient cycling from the chicken litter and cover crops to the summer annual forages: "I hope to produce a better summer annual forage crop than in years past by adding nitrogen from hairy vetch and chicken litter."

Methods

Farmer-cooperators, Dave and Meg Schmidt, conducted this trial on their farm, Troublesome Creek Cattle Co., near Exira in Audubon County in western Iowa. Main treatments were a cereal rye + hairy vetch cover crop receiving chicken litter in the fall and a cereal rye + hairy vetch cover crop receiving no chicken litter. The Schmidts implemented four replications (8 paired strips total) with strips measuring approximately 50 ft wide and 400 ft long. Sub-plot treatments were established by grazing half of each strip with cattle in spring 2016.

Cereal rye ('Elbon') and hairy vetch ('TNT') were drilled at rates of 151 lb/ac and 17 lb/ac, respectively, on Aug. 26, 2015.

Chicken litter was applied to designated strips on Sept. 3. The litter was applied at a rate of 2.5 t/ac with an analysis of 48-51-50 lb N-P-K per ton of litter. This amounted to 120 lb N, 128 lb P and 125 lb K applied per acre to these strips.

Cattle were allowed to graze one-half of each strip (litter and no-litter) on March 5, 2016 for approx. 10 hours. Plant height in grazed areas was reduced from five inches to two inches.

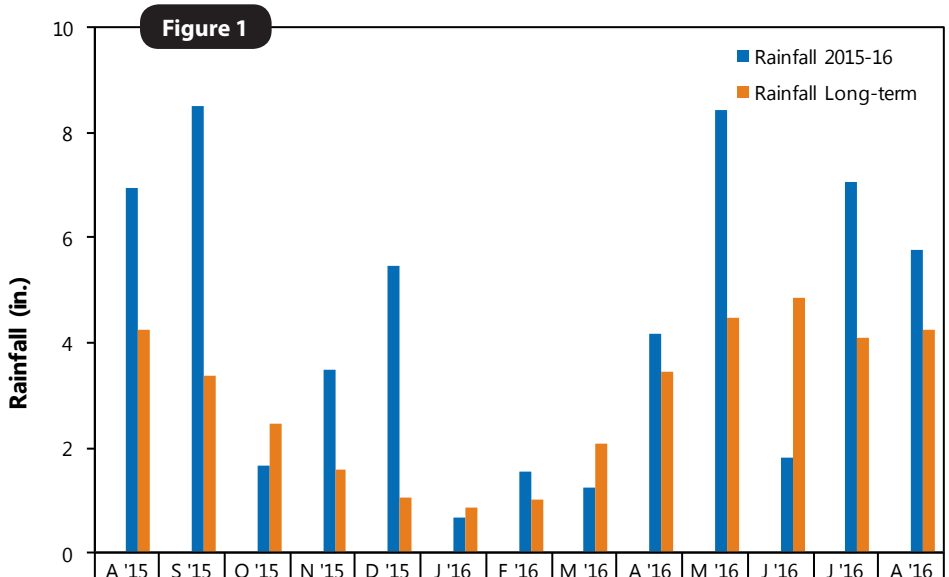
Aboveground biomass of the cereal rye + hairy vetch cover crop was collected from individual sub-plots on June 4. Samples were subsequently dried and weighed and submitted to the Plant and Soil Analysis Lab at Iowa State University to determine C and N concentrations.

Termination of the cereal rye + hairy vetch cover crop was achieved by rolling with a cultimulcher on June 6 and coming back with an herbicide pass (2,4-D [1 pt/ac] and glyphosate [1.3 qt/ac]) on June 11. The herbicide pass was used because the rolling killed all of the cereal rye but only about half of the hairy vetch, according to Dave.

A summer annual forage mix was drilled into the rolled/sprayed cover crop on June 13. This mix consisted of: sorghum-sudangrass (8.4 lb/ac); pearl millet (4.9 lb/ac); corn (7.5 lb/ac); Japanese millet (2.3 lb/ac); collards (1.1 lb/ac); rapeseed (1.1 lb/ac); sunflowers (2.3 lb/ac); mung beans (3.5 lb/ac); cowpeas (8.3 lb/ac). Aboveground biomass of the annual forage mix was collected from individual sub-plots on Aug. 15 prior to cattle grazing. Samples were dried and weighed.

Data were analyzed using JMP Pro 12 statistical software (SAS Institute Inc., Cary, NC). Means separations between treatments are reported using the least significant difference (LSD) generated from a t-test. Statistical significance is reported at the $P \leq 0.10$ level.

Figure 1



	A '15	S '15	O '15	N '15	D '15	J '16	F '16	M '16	A '16	M '16	J '16	J '16	A '16
Temperature (˚F) 2015-16	68	67	52	41	30	20	29	44	51	59	74	73	73
Temperature (˚F) Long-term	72	63	52	37	24	19	24	36	49	61	70	74	72

Figure 1. Mean monthly temperature and total monthly rainfall for 2015-2016 and the long-term averages at the Audubon (65 years; approx. 10 mi. from Schmidt's) weather station (Iowa Environmental Mesonet, 2016).

Results and Discussion

Mean monthly temperature and total monthly rainfall for the experimental period near the Schmidt's farm compared to the long-term averages is presented in **Figure 1** (Iowa Environmental Mesonet, 2016). November and December 2015 were particularly warmer and wetter than average. These made for very favorable conditions for cereal rye and hairy vetch establishment and winter survival. Dave also notes that snow covered the field and sheltered the cover crop for much of the winter. Temperatures in April and May 2016 were near normal, though, rainfall was nearly twice the average which resulted in very favorable conditions for cereal rye + hairy vetch cover crop biomass production. After a very dry June, rainfall for July and August exceeded long-term averages by two-fold.

Cover crop biomass prior to termination

The Schmidts collected cereal rye + hairy vetch cover crop aboveground biomass samples on June 4 prior to rolling and spraying a few days later. **Figure 2** shows the mean cover crop biomass observed from the grazing and chicken litter treatments. The 10 hours of grazing on March 5 significantly increased the amount of aboveground biomass produced by June 4. On average, there was 11,128 lb/ac of cover crop

Figure 2

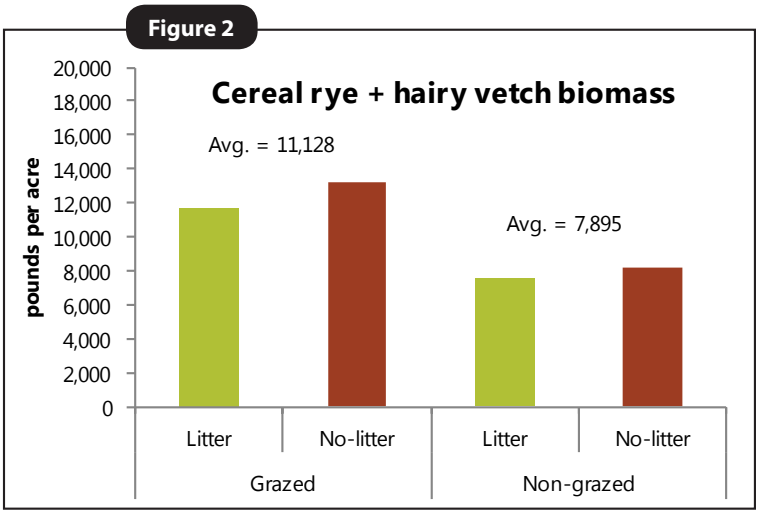


Figure 2. Mean cover crop biomass as affected by grazing and chicken litter application at Dave and Meg Schmidt's farm near Exira in Audubon County in 2016. Cover crop was a mix of cereal rye and hairy vetch seeded on Aug. 15, 2015 and sampled on June 4, 2016. Chicken litter was applied to strips on Sept. 3, 2015. Grazing by cattle occurred for approx. 10 hours on March 5, 2016. Biomass was significantly affected by grazing (LSD = 2,800; $P = 0.0624$) but not by chicken litter ($P = 0.8992$).

biomass in the grazed area compared to 7,895 lb/ac where no grazing took place (LSD = 2,800 lb/ac; P = 0.0624). Regrowth of the cover crop from March to June was obviously not impeded by the grazing; in fact it appeared to be stimulated. "Between March and June, the grazed rye + vetch was noticeably more uneven than the non-grazed cover; presumably due to increased growth in urine spots," Dave reports.

The application of chicken litter, however, did not have an effect on cover crop biomass production. Regardless of whether the cover crop was grazed or non-grazed, mean cover crop aboveground biomass was statistically equivalent between the litter (9,631 lb/ac) and no-litter (9,393 lb/ac) treatments. Dave notes that this amount of cover crop biomass resulted in a six-inch "mulch" following termination by rolling and spraying.

Table 1 shows the results of C and N analyses performed on the sampled cereal rye + hairy vetch cover crop biomass. Neither grazing nor the application of chicken litter had any effect on C or N concentration, C or N content, or C:N ratio of the cover crop biomass. Dave was quite impressed by the amount of N in the aboveground biomass (208 lb N/ac when averaged across all treatments). Because the cover crop was permitted to grow until early June and produced between 8,000 and 11,000 pounds of biomass per acre, more N was taken up by the cover crop than would be expected if the cover crop was terminated in April or early May in a corn-soybean rotation (Gailans and Boyer, 2015).

The C:N ratio of the cover crop was less than 25 across treatments (Table 1). Ratios less than 25 are typically considered favorable for biomass N becoming made plant-available through the process of microbial decomposition (Sullivan, 2003). The inclusion of a legume (hairy vetch) in the cover crop is a likely factor in these C:N ratios. A pure stand of cereal rye cover crop left to grow until June (maturity) would likely result in a greater C:N ratio which would in turn contribute to net N immobilization rather than biomass N becoming plant-available (Sullivan and Andrews, 2012).

Summer annual forage biomass prior to grazing

After rolling and spraying the cereal rye + hairy vetch cover crop in early June, the Schmidts seeded a summer forage mix that featured: sorghum-sudangrass; pearl millet; corn; Japanese millet; collards; rapeseed; sunflowers; mung beans; cowpeas (see Methods section for seeding rates). Just prior to allowing cattle to graze this mix, the Schmidts collected biomass samples to determine how much forage was produced (**Figure 3**). Neither the grazing of the cereal rye + hairy vetch cover crop in March nor the application of chicken litter the previous September had any statistical effect on the amount of summer forage biomass produced by mid-August. On average, 16.5 tons of forage biomass per acre was produced across all treatments.

Despite no effect by either of the treatments, Dave was impressed by the amount of summer forage produced following the cereal rye + hairy vetch cover crop. "If there hadn't been such good cover when we seeded the summer annual forage, there's no way anything would have germinated in June because the ground was so hard and dry everywhere else," Dave says. "We got 0.4 in. of rain a few hours after drilling but overall June was a very dry month" (**Figure 1**). Dave adds, "We finally had a decent yield with summer annual forages this year. I'm not sure why, but something has improved because the weather was almost perfect last year too so I don't think it's that." Favorable growing conditions in July and August, as well as some possible N contribution from the cereal rye + hairy vetch cover crop, may have been contributing factors to what Dave calls decent annual forage production this year. Recall that the mean C:N ratio of the cover crop preceding the an-

The summer annual mix emerging from the cereal rye + hairy vetch cover crop "mulch" approximately one month after being seeded. Photo taken July 8, 2016.

Table 1

Aboveground biomass, biomass C and N concentrations, total C and N contents and C:N ratios for the cereal rye + hairy vetch cover crop just prior to termination in early June 2016.

Response	Grazed		Non-grazed	
	Litter	No-litter	Litter	No-litter
Biomass (lb/ac)	11,707	10,550	7,555	8,236
C conc. (%)	41.5	42.5	42.1	41.6
C cont. (lb C/ac)[a]	4,864	4,488	3,191	3,437
N conc. (%)	2.3	2.0	2.2	2.3
N cont. (lb N/ac)[a]	271	202	166	193
C:N ratio	18	22	20	19

[a]C and N contents are calculated as the product of biomass x C concentration and N concentration, respectively.

Figure 3

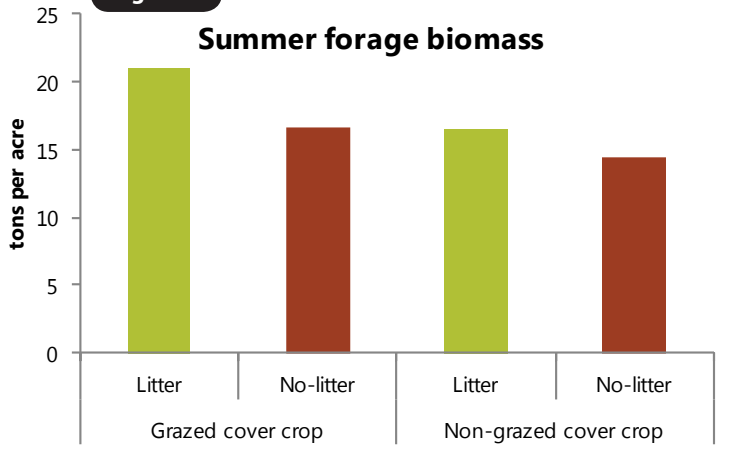


Figure 3. Mean summer forage biomass as affected by grazing of cereal rye + hairy vetch cover crop and chicken litter application at Dave and Meg Schmidt's farm near Exira in Audubon County in 2016. Summer forage mix was seeded on June 13 and sampled on Aug. 15. Chicken litter was applied to strips on Sept. 3, 2015. Grazing of cover crop by cattle occurred for approx. 10 hours on March 5, 2016. Summer forage biomass was not significantly affected by grazing of cover crop (P = 0.4559) or chicken litter application (P = 0.9992).

nual forage mix was 19.8 at the time of its termination by rolling/spraying in June (**Table 1**). Microbial decomposition and release of N from plant biomass will generally take place with C:N ratios less than 25 (Sullivan, 2003). The cover crop C:N ratio favorable for microbial decomposition observed in this trial is likely the result of the successful establishment of the legume component of the cover crop (hairy vetch) by seeding the cover crop in late August 2015.

Conclusions and Next Steps

This on-farm trial sought to investigate the use of cover crops and the application of chicken litter in a summer annual forage production system. And because they raise cattle, the Schmidts wanted to know if grazing the cereal rye + hairy vetch cover crop in early spring would also be compatible with this system. "Going into this trial we fully expected the spring grazing to decrease the amount of cereal rye + hairy vetch biomass produced by the time it was terminated," Dave says.

The cereal rye + hairy vetch cover crop was not affected by the application of chicken litter in September 2015, but the grazing in March 2016 did improve growth compared to where no grazing occurred (**Figure 2**). The cover crop produced between 8,000 (non-grazed) and 11,000 (grazed) pounds of biomass per acre containing around 200 lb N/ac by early June 2016.

The summer annual forage seeded after terminating the cover crop was not affected by either the application of chicken litter or the grazing of the cover crop (**Figure 3**). The Schmidts did, however, perceive some benefits from the cover crop preceding the summer forage. The tremendous amount of biomass produced by the cover crop created a six-inch thick mulch that reduced weeds and conserved moisture during a very dry period in June directly following the seeding of the summer forage. Additionally, the 200 lb N/ac in the cereal rye + hairy vetch cover crop at the time of termination (**Table 1**) may have been a contributing factor to what Dave considered their best-ever summer annual forage production.

A key finding from this trial was that the grazing of the cereal rye + hairy vetch cover crop in March 2016 did not negatively affect cover crop performance (cover crop was actually improved by grazing) nor did the grazing adversely affect the production of the summer annual forage later on. This is notably important for the Schmidts who desire to graze their cattle as much as they can rather than purchase supplemental feed like hay.

For the future, Dave is considering such a system ahead of a soybean crop: "Grazing and then rolling [the cover crop] seems like a pretty compelling win-win. Even if the resulting mulch just decreases the weed pressure (rather than eliminates) it might be worth trying with soybeans. This system provides ideas for breaking up the corn-beans monopoly on rented crop ground."

Dave Schmidt noted that hairy vetch vines were six-feet in length at the time of sampling on June 4.

References

Gailans, S. and J. Boyer. 2015. Effect of seeding date on cover crop performance. Practical Farmers of Iowa Cooperators' Program. Ames, IA. http://practicalfarmers.org/farmer-knowledge/research-reports/2015/effect-of-seeding-date-on-cover-crop-performance/ (accessed Oct. 21, 2016).

Iowa Environmental Mesonet. 2016. Climodat Reports. Iowa State University, Ames, IA. http://mesonet.agron.iastate.edu/climodat/ (accessed Oct. 12, 2016).

Sullivan, P. 2003. Overview of cover crops and green manures. NCAT-ATTRA. Fayetteville, AR.

Sullivan, D. and N. Andrews. 2012. Estimating plant-available nitrogen release from cover crops. PNW 636. Pacific Northwest Extension. Oregon State University. Corvallis, OR. https://catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/pnw636.pdf (accessed Oct. 13, 2016).

PFI Cooperators' Program

PFI's Cooperators' Program gives farmers practical answers to questions they have about on-farm challenges through research, record-keeping, and demonstration projects. The Cooperators' Program began in 1987 with farmers looking to save money through more judicious use of inputs. If you are interested in conducting an on-farm trial contact Stefan Gailans @ 515-232-5661 or stefan@practicalfarmers.org.