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Field Crops Research

Interseeding Cover Crops in Seed Corn at the V4-V6 Stage

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In a Nutshell

- If cover crops can successfully be established when interseeded into corn in June, this may permit farmers to use existing equipment (rather than high-clearance machines or airplanes); may permit the use of more diverse cover crop species; and ultimately may increase the amount cover crop biomass produced.
- Jack Boyer interseeded a 4-species and 6-species cover crop mix into seed corn at the V4-V6 stage in randomized and replicated strips.

Key Findings

- Both the 4-species and 6-species mixes survived below the seed corn canopy and produced similar amounts of aboveground biomass by mid-October.
- The interseeded cover crop mixes had no adverse effect on seed corn yield.

Project Timeline
2016

Interseeded cover crops in Jack Boyer's seed corn on July 8 (left) and Aug. 29, 2016 (right). Cover crops were seeded on June 8.

Background

The Iowa Nutrient Reduction Strategy, released in 2013, identified cover crops as an in-field practice to reduce nonpoint source pollution (IDALS et al., 2013). In Iowa, cover crops are typically either aerially seeded into standing corn around the time of physiological maturity in late summer or drilled immediately following corn harvest in the fall. However, there are concerns about cover crop performance with both of these seeding methods. With the aerial seeding method, accurate seed placement and timely rains (in the usually dry late summer) are necessary for cover crop germination and establishment. When drilling a cover crop after corn harvest, very few heat units remain in the season for much cover crop growth limiting the potential soil-holding and nutrient-retention benefits of the cover crop that fall. In the past few years, researchers in Pennsylvania and Wisconsin (Roth et al., 2015) and Minnesota (Wells and Noland, 2016) have been investigating the practice of interseeding cover crops into corn with a modified, high-clearance drill seeder when the corn is six to eight inches tall (approx. V4-V5 stage of development). With this work in mind, farmer-cooperator Jack Boyer wanted to see if a cover crop could be successfully seeded into his seed corn with a tractor-mounted broadcast seeder at this stage in June. One of the major concerns with interseeding covers into corn at this point in the season is shading by the corn once the canopy is closed. In 2015, Jack tried interseeding cereal rye into his commercial corn when it was about six inches tall (Gailans and Boyer, 2015). The rye sprouted and grew to five inches by early July but by September the rye was brown and dead; none of the rye survived in the dark below the corn canopy. Seed corn, however, allows much more sunlight to penetrate through the canopy than commercial corn. In fact, Jack had success seeding a cover crop into seed corn in mid-August in 2014 (Gailans and Boyer, 2015b). If a cover crop can be successfully established in standing seed corn at June, though, this presents the opportunity to reap more environmental benefits from the cover crop with potential increased fall growth and likelihood of winter survival.

The objective of this research project was to quantify the persistence and biomass production of two cover crop mixes that are seeded into seed corn at the V4 stage in early June. "I'm Interested in learning more about early seeding of cover crops in seed corn," Jack says. "And perhaps learning of some species to plant in seed corn fields to help with soil health and erosion."

Methods

This research project was conducted by Jack Boyer of J Boyer Farms, Inc. near Reinbeck in Tama County in north-central Iowa.

Treatments included two cover crop mixes and a control that received no cover crop. One mix consisted of annual ryegrass, berseem clover, crimson clover, lentils, radish and turnips (6-species); the other mix consisted of annual ryegrass, crimson clover, radish and rapeseed (4-species). The design of the project was a randomized complete block with all treatments replicated four times in strips running the length of the field. Strips measured between 50-60 ft wide and ran the length of the field. Field operations and cover crop seeding rates are listed in **Table 1**.

Table 1

Field operations and cover crop seeding rates in Jack Boyer's seed corn field in 2016.	
Seed corn planting date	May 13
Pre-planting N rate	145 lb N/ac
Cover crop mixes seeding date	June 8
Cover crop mixes seeding rate	20 lb/ac
6-species mix proportions	Annual ryegrass (40%); berseem clover (15%); crimson clover (15%); lentils (15%); radish (10%); turnips (5%)
4-species mix proportions	Annual ryegrass (60%); crimson clover (20%); radish (15%); rapeseed (5%)
Female row detassel date	July 18
Male row destruction date	Aug. 8
Seed corn harvest date	Oct. 1

Seed corn was planted to the entire field in a 4:1 (female:male) row pattern. The female rows were detasseled on July 18 and the male rows were destroyed on Aug. 8. Seed corn was harvested on Oct 1.

The two cover crop treatments were interseeded into strips on June 8 when the seed corn was six inches tall. Jack used a broadcast spreader above the corn to accomplish this.

Cover crop aboveground biomass at the end of the season around the time of a hard freeze was collected by clipping shoot material from randomly placed quadrats (one ft x one ft) in each strip on Oct. 12. Replicate samples were combined, dried and weighed. Aboveground biomass was to be assessed the following spring just prior to termination but none of the cover crops successfully overwintered. Biomass samples were submitted to the Soil and Plant Analysis Lab at ISU in Ames for analysis.

Data were analyzed using JMP Pro 12 (SAS Institute Inc., Cary, NC) and cover crop biomass and seed corn yield comparisons employ least squares means for accuracy. Statistical significance is determined at $P \leq 0.05$ level and means separations are reported using Tukey's Least Significant Difference (LSD).

Results and Discussion

Mean monthly temperature and total monthly rainfall near J Boyer Farms, Inc. compared to the long-term averages is presented in **Figure 1**. Temperatures in 2016 did not deviate from the long-term normal. June, August and September were particularly wet.

Figure 1

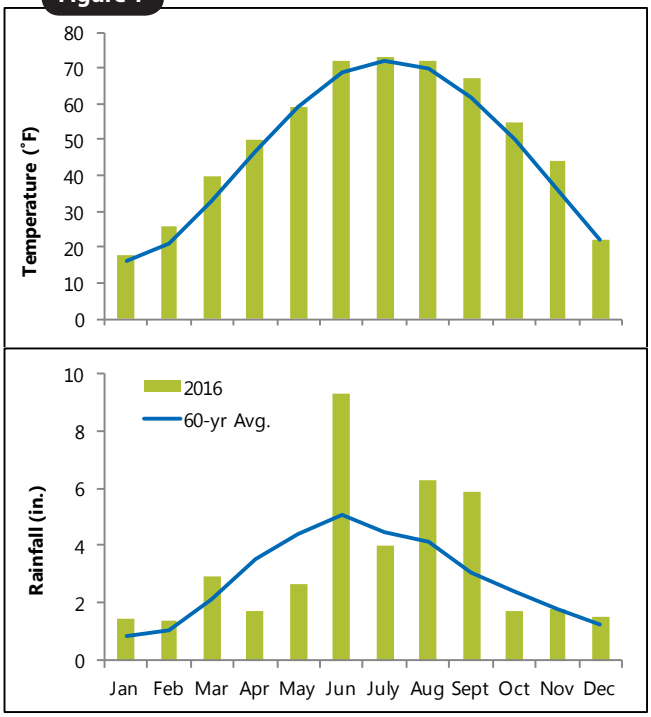

Figure 1. Mean monthly temperature and rainfall for 2016 and the 60-year averages at the Grundy Center weather station (approx. 10 mi. from Jack's farm; Iowa Environmental Mesonet, 2017).

Boyer seeded the two cover crop mixes on June 8 when the seed corn was approx. six inches tall. Aboveground biomass of the cover crop mixes was sampled on Oct. 12. Biomass characteristics are presented in **Table 2**. There were no differences between the two cover crop mix treatments.

Boyer intended to sample the cover crops in the spring of 2017 as well, but upon field inspection in March it was discovered that the cover crops failed to survive the winter. "As far as the annual ryegrass not surviving, I am not surprised," Boyer says. "I have never had it survive in this area."

Seed corn was harvested on Oct. 1. The seed corn company Boyer works with reported a yield index for each strip. The yield index was calculated as follows:

Yield index = Actual yield ÷ Field average x 100.

A value above 100 signifies performance better than the field average.

Figure 2

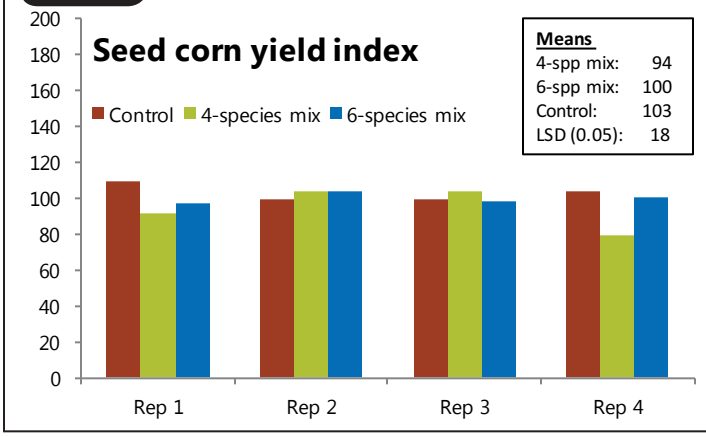

Figure 2. Seed corn yield index for each treatment from each Rep at Jack Boyer's. Seed corn was harvested on Oct. 1, 2016. Mean yield indices and the least significant difference (LSD) at the $P \leq 0.05$ level are indicated in the inset table. Because the difference between any two treatments is less than the LSD, the treatments are not considered significantly different.

Yield indices for both cover crop mix treatments, as well as a no-cover control, is provided for each replication in **Figure 2**. The interseeded cover crops did not have any adverse affect on seed corn yield. Boyer says, "It was interesting to have confirmed by the seed production company that there was no yield drag due to the interseeding of covers into the corn at the V4-V6 stage [early June]."

Table 2

Aboveground biomass characteristics of the two cover crop mixes interseeded into seed corn on June 8, 2016. Cover crops were sampled on Oct. 12, 2016.

Characteristic	6-species mix[a]	4-species mix[b]	Diff.[c]	LSD (0.05)
Biomass (lb/ac)	2,796	2,685	111	972
C conc. (%)	34.7	35.0	0.3	6.2
N conc. (%)	2.6	2.6	0.0	0.7
C content (lb C/ac)	964	939	25	407
N content (lb N/ac)	73	70	3	35
C:N ratio	13.4	13.5	0.1	6.0

[a] 6-species mix = annual ryegrass, berseem clover, crimson clover, lentils, radish and turnips.

[b] 4-species mix = annual ryegrass, crimson clover, radish and rapeseed.

[c] For each characteristic, if the difference is greater than the least significant difference (LSD), the treatments are considered significantly different at $P \leq 0.05$.

Conclusions and Next Steps

This on-farm research trial compared two cover crop mixes that were interseeded into seed corn in early June. Both mixes survived below the seed corn canopy and produced similar amounts of biomass by October (**Table 2**). "In my search for cover crop species that can be established early in corn or seed corn, I learned that in seed corn most covers will survive due to the shorter plant height [than commercial corn] that permits more light to the covers," Boyer says. The interseeded cover crops had no effect on seed corn yield relative to where no cover crops were interseeded (**Figure 2**).

"I will continue to look for cover crop varieties that will over winter when interseeded," Boyer says. "Next step will be to try cowpeas in a mix in commercial corn to evaluate its performance. I will also evaluate different corn hybrids that may permit more light to reach the covers."

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