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Field Crops Research

Cereal Rye Cover Crop Termination Date Ahead of Soybeans

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

Web Link:
http://bit.ly/pfi_fieldcrops

Cooperators:
- **Bob Lynch – Gilmore City**
- **Jeremy Gustafson - Boone**
- **Jack Boyer - Reinbeck**

Funding by:
This project is supported in part by
Walton Family Foundation
Iowa Department of Agriculture and Land Stewardship - Division of Soil Conservation

In a Nutshell

- Delaying cover crop termination until soybean planting would allow for more biomass production by the cover crop in the spring presenting the opportunity for more environmental benefit.
- Farmer-cooperators seeded soybeans 10-14 days after terminating a cereal rye cover crop and within 1 day of terminating the cover crop.

Key findings

- Jeremy Gustafson and Jack Boyer saw no difference in soybean yields with the two cover crop termination dates while Bob Lynch saw a small reduction with the late termination date.
- Bob and Jack observed cereal rye residue in the late termination treatment to persist through the soybean growing season holding soil in place and reducing weed pressure.

Project Timline:
2014-2015

Strips of early (left) and late terminated cereal rye at Bob Lynch's farm near Gilmore City.

Background

Cover crops have been identified by the Iowa Nutrient Reduction Strategy as an effective in-field practice for reducing soil erosion and mitigating nonpoint source pollution of waterways (IDALS et al., 2012). The Iowa Nutrient Reduction Strategy and past on-farm research also stress that proper cover crop management is necessary to avoid any potential for cash crop yield drag (IDALS et al., 2012; Gailans and Juchems, 2014). To be eligible for crop insurance coverage, farmers in western Iowa (Zone 3) must terminate a cover crop before or at the time of cash crop planting; in the rest of the state (Zone 4) farmers must terminate a cover crop within five days after planting the cash crop but before cash crop emergence (USDA-NRCS, 2014). As a special consideration, farmers in no-till systems are afforded seven more days to terminate a cover crop. In Iowa, cover crops, such as cereal rye, are typically terminated 7-14 days prior to planting a cash crop of corn or soybeans to avoid the potential for yield drag. Recently, however, farmers have wondered if this period between cover crop termination and soybean planting could be narrowed and whether or not high levels of cover crop residue affect soybean yields. Preliminary anecdotal observations from farmers across the state seem to suggest that a cover crop allowed to grow until soybean planting does not negatively affect the crop. Delaying cover crop termination until soybean planting would allow for more biomass production by the cover crop in the spring than when terminating the cover crop 7-14 days prior to planting. Conceivably, this may present farmers with the opportunity to reap more environmental benefits from the cover crop such as physical suppression of weeds by cover crop residue (Anderson and Hartzler, 2014).

The objective of this research project was to quantify the agronomic performance of soybeans planted following two cereal rye cover crop termination dates—which results in planting into different levels of cover crop residue. Jeremy Gustafson adds, "I want to be able to know when is the best time to terminate my cereal rye cover crop ahead of my soybean crop." Farmer-cooperators Bob Lynch, Jeremy Gustafson and Jack Boyer made comparisons between soybeans seeded approx.10 days after cereal rye cover crop termination and seeded near the time of termination.

Methods

This research project was conducted by Bob Lynch near Gilmore City in Humboldt County in 2014 and Jeremy Gustafson near Boone in Boone County and Jack Boyer near Reinbeck in Tama County in 2015.

Each farmer-cooperator compared soybeans no-till planted or drilled following two cereal rye cover crop termination dates. This was achieved differently by each farmer-cooperator. Cereal rye cover crop and soybean management are presented in **Table 1**. Bob Lynch and Jeremy Gustafson followed corn and planted soybeans following a cereal rye cover crop that was terminated approx. 2 weeks prior (early termination) and 1 day after termination (late termination). The design of these trials was a randomized complete block with each of the two treatments replicated six times at Bob's and three times at Jeremy's in strips running the length of the field at each farm.

Jack Boyer preceded his soybeans with seed corn in 2014. Jack also chose three seeding dates for his cereal rye cover crop: aerial seeding at the time of male row destruction, aerial seeding ten days after male row destruction, and drilled after seed corn harvest. He also included control strips that received no cover crop. The following spring, Jack planted soybeans after a cereal rye cover crop that was terminated 9 days prior (early termination) the day before termination (late termination). The result was a trial with a completely randomized design consisting of two replications of each cover crop seeding date-by-termination combination (12 strips total) and 12 replications of the no-cover control treatment.

Bob and Jeremy used Optill Pro herbicide to terminate the cover crops in both treatments. Jack used Roundup in the early termination treatment and Gramaxone+Zidua in the late treatment. By farm, soybeans were planted into all treatments on the same date.

Jeremy assessed spring cereal rye aboveground biomass at both termination dates by clipping shoot material from quadrats (one ft x one ft) placed in each strip. Jack collected aboveground biomass of cereal rye in the same manner but only on May 3, just before the early termination date. At both farms, replicate samples were combined, dried and weighed.

Data were analyzed using JMP Pro 10 (SAS Institute Inc., Cary, NC) and 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).

Table 1

Dates of cereal rye cover crop and soybean management at Bob Lynch's in 2014 and Jeremy Gustafson's and Jack Boyer's in 2015.

	Bob Lynch 2014	Jeremy Gustafson 2015	Jack Boyer 2015
Cereal rye cover crop planting date(s)	Oct. 2013	Nov. 2, 2014	Aug 19; Aug 29; Sept 25 , 2014
Cover crop planting rate	56 lb/ac	56 lb/ac	56 lb/ac
Cover crop seeding method	Drilled 7.5 in.	Planted 15 in.	Broadcast (Aug.); Drilled (Sept.), 10 in.
First cover crop termination date (early)	May 11	April 14	May 9
Second cover crop termination date (late)	May 21	May 8	May 19
Soybean planting date	May 22	May 9	May 18
Soybean row spacing	15 in.	30 in,	10 in.
Soybean planting population	145,000 seeds/ac	140,000 seeds/ac	150,000 seeds/ac
Soybean harvest date	Oct. 6	Oct. 1	Oct. 8

Jack drills soybeans into standing rye, May 18, 2015.

Jeremy (left) and Bob (right) plant soybeans into late-terminated rye.

Results and Discussion

Mean monthly temperature and total monthly rainfall in 2014 near Bob's farm and in 2015 near Jeremy's and Jack's farms compared to the long-term averages is presented in **Table 2**. Total growing degree-days (base 50 ˚F) for the period of April 1 – Sept. 30 were 2,746 in 2014, compared to the long-term average of 2,850 at Bob's; 2,925 in 2015 compared to the long-term average of 3,012 at Jeremy's; 2,866 in 2015 compared to the long-term average of 2,781 at Jack's (Iowa Environmental Mesonet, 2015). Temperature and moisture conditions were adequate for cover crop growth and winter survival and for soybean production at all farms.

Table 2

Mean Monthly Temperature and Total Monthly Rainfall for 2014, 2015 and Long-term Averages

	Bob Lynch, 2014				Jeremy Gustafson, 2015				Jack Boyer, 2015			
	Temperature (˚F)		Rainfall (in.)		Temperature (˚F)		Rainfall (in.)		Temperature (˚F)		Rainfall (in.)	
Month[a]	2013-14	Avg.	2013-14	Avg.	2014-15	Avg.	2014-15	Avg.	2014-15	Avg.	2014-15	Avg.
Sept	67	62	0.79	2.99	64	64	5.50	3.59	61	62	3.07	3.00
Oct	50	51	2.04	2.05	53	52	3.74	2.40	50	50	3.22	2.41
Nov	32	35	1.72	1.38	31	37	1.02	1.54	28	35	0.44	1.76
Dec	15	21	0.53	1.02	29	24	1.18	1.02	27	22	1.26	1.14
Jan	12	16	0.29	0.77	25	19	0.28	0.80	20	16	0.68	0.81
Feb	11	21	1.57	0.92	15	23	0.80	0.93	11	21	1.54	1.03
Mar	27	33	0.97	1.97	40	36	0.24	1.78	34	33	0.39	2.09
Apr	46	48	4.50	3.34	53	50	3.43	3.24	50	47	3.02	3.55
May	59	60	3.86	4.10	59	61	5.05	4.41	59	59	4.32	4.42
June	70	69	10.35	4.96	69	70	9.01	4.82	69	69	4.31	4.99
July	68	73	2.41	4.09	72	74	4.93	3.66	71	72	3.92	4.42
Aug	71	71	3.63	3.97	69	72	8.97	3.92	68	70	8.29	4.04
Sept	60	62	4.85	2.99	68	64	7.14	3.59	68	62	2.73	3.00
TOTAL	--	--	37.51	34.55	--	--	51.29	35.70	--	--	37.19	36.66

[a] Rainfall and temperature data were accessed from the Humboldt (10 mi. from Bob), Ames (5 mi. from Jeremy), and Grundy Center (10 mi. from Jack) weather stations (Iowa Environmental Mesonet, 2015).

Bob Lynch's, 2014 and Jeremy Gustafson's, 2015

Prior to each cover crop termination in 2015, Jeremy collected samples of aboveground cereal rye biomass. The cereal rye in the early termination treatment (Apr. 14) produced 178 lb/ac of biomass while the late termination treatment (May 8) produced 2,684 lb/ac. Recall that Jeremy seeded his cover crop in 15-in. rows with a no-till planter (**Table 1**). Bob did not collect biomass samples.

Soybean yields for each strip and treatment means for both Bob's and Jeremy's farms are presented in **Figure 1**. At Bob's the mean yield was greater in the early termination treatment compared to the late termination (71 vs. 66 bu/ac). At Jeremy's, mean yields were statistically equivalent (62 vs. 64 bu/ac) despite 2,500 more pounds of cereal rye biomass per acre ahead of the soybeans in the late termination treatment. Mean yields for both treatments at both farms exceeded the 5-year soybean yield averages for Humboldt (46 bu/ac) and Boone (47 bu/ac) counties (USDA-NASS, 2015). Bob took that slight reduction in soybean yield with the

Figure 1

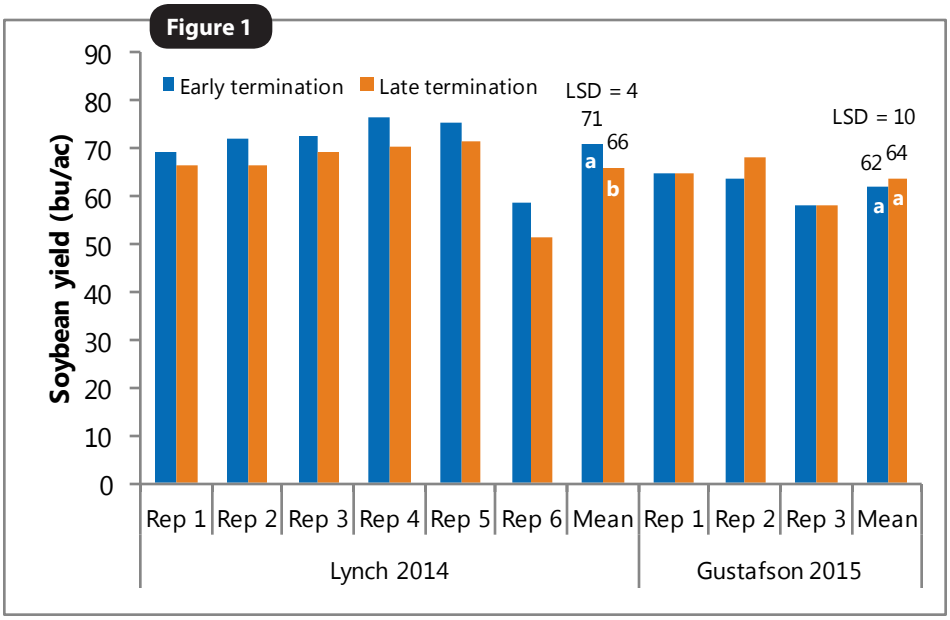


Figure 1. Soybean yields for each rep as well as the means for the early and late cover crop termination treatments at Bob Lynch's in 2014 and Jeremy Gustafson's in 2015. For the means, columns with different letters are significantly different at $P \leq 0.05$. The least significant difference (LSD) is indicated above both pairs of mean columns for both years.

late cover crop termination in stride. Rainfall at his farm in June 2014 was over twice the historical average (**Table 2**) and saw a lot of water wash over his farm. "The cover crop (in the late termination) might have gotten too big but without that high level of cereal rye residue I would have had a gully and loss of big time soil."

Jack Boyer's, 2015

Prior to the early termination date, Jack collected aboveground biomass of the cereal rye cover crop in each strip on May 3, 2015. There was no difference in the amount of biomass produced between the two August seedings (4,310 vs. 4,245 lb/ac for Aug. 19 and 29, respectively) but there was less biomass produced with the September seeding (2,394 lb/ac). Even though biomass samples were not taken at late termination, it was obvious that there was considerably more growth. "I would estimate two times the amount observed at the early termination," Jack notes.

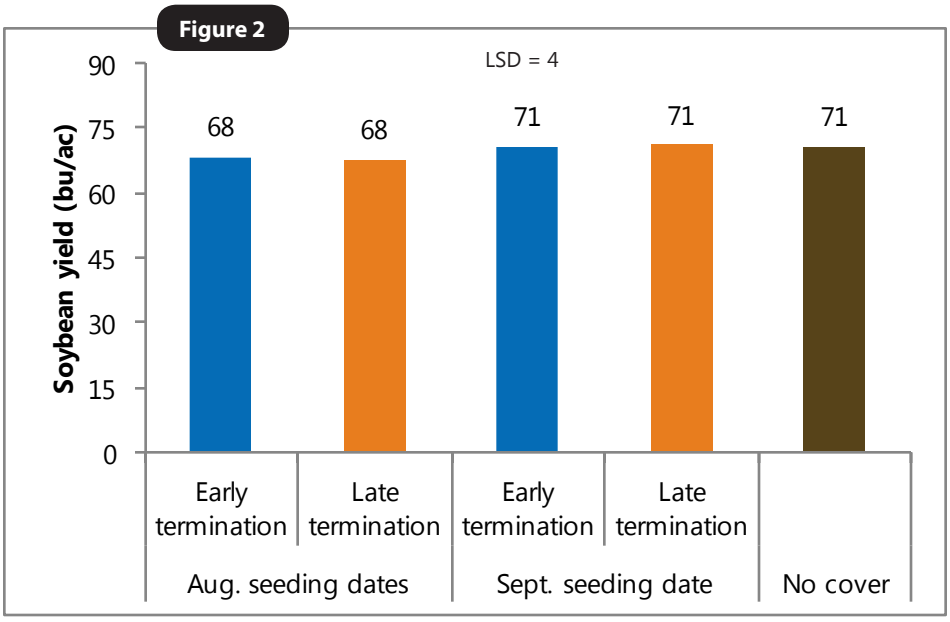


Figure 2. Mean soybean yields for the cover crop seeding month x termination date and no-cover treatments at Jack Boyer's in 2015. The least significant difference (LSD) is indicated at the $P \leq 0.05$ level.

Mean soybean yields for all treatments at Jack's are also presented in **Figure 2**. Because the amount of cereal rye biomass produced with the two August seedings were equivalent, these two treatments were combined so that soybean yield comparisons were only made among seeding month-by-termination treatment combinations and the no-cover control. Mean soybean yields were no different across the treatments—neither the cover crop seeding date nor the termination date had any effect on soybean yield compared to the no-cover control. From these results, Jack observes, "I am not sure that the variation in planting date is significant for any observation other than the amount of biomass generated." Additionally, mean yields for all treatments exceeded the 5-year soybean yield average for Tama County: 53 bu/ac (USDA-NASS, 2015).

Strips of cereal rye vs. no cover at Jack Boyer's farm, May 3, 2015.

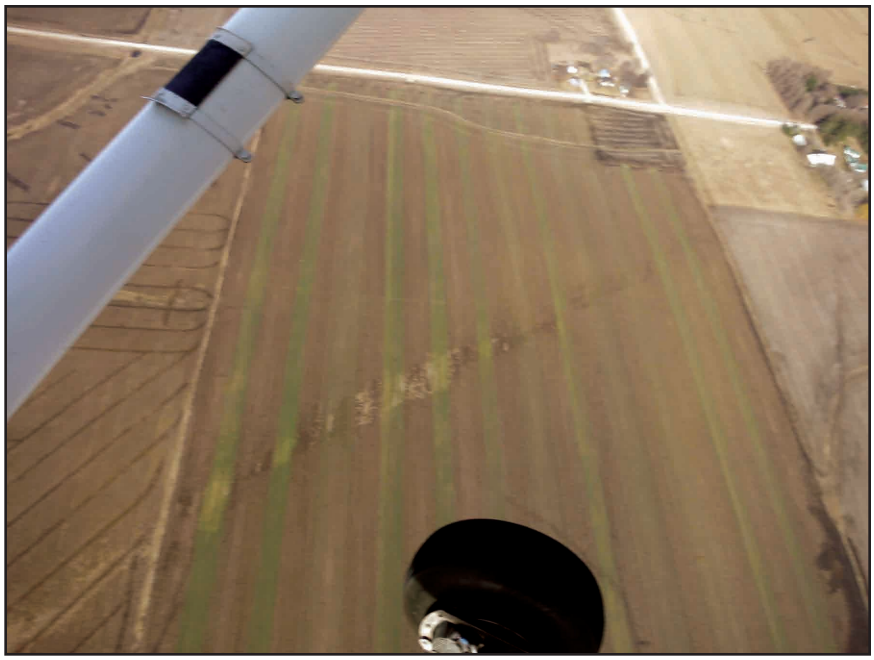
One advantage Jack saw with the late termination of the cereal rye was the amount of residue that persisted through the growing season and acted as mulch. Early in the season, Jack noticed that the strips with cover crops (early and late termination) had far less weeds than those without. As a result, he decided to only spray the no-cover strips with a post-emergence herbicide on July 3 (Cobra and Roundup PowerMax). By Aug. 26 Jack noticed: "The cover crop areas have continued to be as clean or cleaner than the no-cover areas. They have not had a late flush to make them worse than the sprayed no-cover." The cover crop areas remained mostly free of weeds through the end of the season. This observation aligns with previous findings by researchers in central Iowa who found reduced and delayed weed germination

in soybeans from a cereal rye cover crop producing 3,200 lb biomass/ac (Anderson and Hartzler, 2014). The cereal rye cover crop at Jack's reached biomass levels well about this mark and had no adverse affect on soybean yield.

Jack also realized an effect on his pocketbook from not having to spray the cover crop strips: "That's about $40/ac of herbicide savings to pay for seeding the covers."

Conclusions and Next Steps

The trials conducted by farmer-cooperators Bob Lynch, Jeremy Gustafson and Jack Boyer compared soybeans seeded 10-14 days after cereal rye cover crop termination with soybeans seeded within one day of cover crop termination. The farmer-cooperators wanted to know if narrowing the time between cover crop termination and soybean planting (and thus increasing the amount of residue they were planting into) would have any detriment to soybean yield.



An aerial view of Jack's cover vs. no cover strips.

At Bob's in 2014, he saw yield reduced by 5 bu/ac where he terminated the cover crop just prior to planting soybeans. Bob did point out, however, that despite the yield reduction he values the residue produced by the late terminated cereal rye cover crop in preventing soil erosion.

Jeremy and Jack, however, saw no difference in soybean yield between the early and late termination treatments in 2015. Jeremy saw much more cereal rye biomass produced with the late termination (178 vs. 2,684 lb/ac). Jack saw more cereal rye biomass when it was seeded in Aug. compared to Sept. (4,278 vs. 2,394 lb/ac) and more biomass with the late termination (twice as much as early termination by visual estimation). Furthermore, soybean yields in the cover crop treatments at Jack's were also no different than in the no-cover control treatment.

"The most interesting part of the trial," Jack says, "was the improved control of waterhemp in the cover areas versus the no covers. I get the impression, that with soybeans, you have considerable flexibility with termination date for the cover crop." In the future, Jack plans on improving his no-till drill performance when seeding into high residue environments to improve soybean stands.

Based on the observations from his farm, Jeremy is convinced: "I plan to do more late termination of my cover crop ahead of soybeans."

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