Fact Sheet Series

OGRAIN

20-2 SOYBEANS AND SPRING PLANTED RYE

Introduction

With a wet fall in 2019 through the Midwest, many farmers missed the window to implement organic no-till soybean "Plan A" – planting cereal rye in the fall prior to the beginning of October. As an alternative reduced soil disturbance strategy, interseeding cereal rye with soybeans in the spring is a technique that is frequently discussed by farmers as a possible "Plan B". While these practices do not allow for a complete elimination of soil disturbance during the soybean phase of the crop sequence, it does allow for the reduction of soil disturbance by reducing the need for some cultivation activities while increasing diversity and carbon inputs in the field.

Figure 1 - Drilling soybeans in spring planted rye 2017

At the University of Wisconsin Arlington Agricultural Research Station we have been trialing this practice since 2017.

The following summary is not meant to be a recommendation, but a roadmap to design trials on your own farm. Through our replicated research experiences, as well as feedback received from farmers, the only certainty in this system is that results are variable from year-to-year and from farm-to-farm, and we still have a lot to learn to develop more reliable best management practices.

For all the trials described below, winter annual cereal rye was planted with a John Deer 1590 no-till drill on 7.5" spacing, ¾" depth and at a seeding rate of 2 million seeds/ac (100 lbs/ac with a 20,500 seed count, 130 lbs/ac with a 15,000 seed count). The seeding rate and planting depth of the soybeans were 225,000 seeds/ ac and 1 to 1½".

2017

We prepared the seedbed with a field cultivator and planted the rye on April 12. The fields were tine-weeded once, on May 10, when the rye was at the three to four-leaf stage. On May 26 we drilled the soybeans on 7.5" row spacing, at which time the rye had reached about 8" tall, covering the ground (see Figure 1). Soybean establishment was poor, with a final stand count of 16,521 plants/ ac (7% of the planting population).

This publication is made possible by a grant from the USDA Beginning Farmer and Rancher Development Program. OGRAIN is housed in the Organic and Sustainable Agriculture Research and Extension Program within the UW-Madison Department of Plant Pathology under the leadership of associate professor Dr. Erin Silva. Léa Vereecke is a research associate working with the program.

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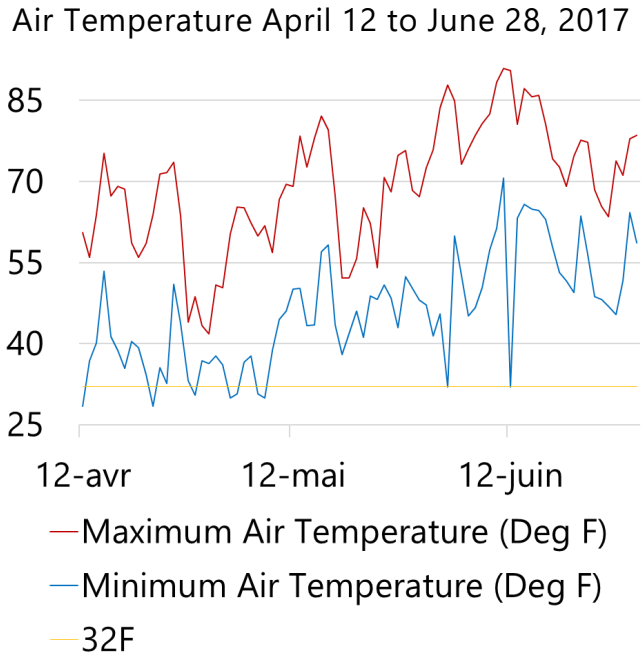
Some of the rye reached anthesis in early July, leading us to the conclusion that the early planting date led to long enough rye exposure to low temperatures to cause vernalization (see graph below for temperature summaries). The weed pressure in the field was significant, with foxtail as the dominant weed. Soybeans were harvested in October, yielding 21 bu/ac.



2018

In 2018, the field was prepared for planting using a field cultivator on April 26 and May 7. On May 8, we drilled the rye at the rates described above. On May 31, weed pressure (e.g., foxtail, velvet leaf, pigweed and lambsquarter) was significant and weeds too large to be affected by tine weeding (see Figure 2). Thus, the field was tilled, and the trial ended, anticipating weed pressure would have significantly compromised soybean yields while adding to the weed seedbank, affecting subsequent crops.

2019

In 2019, we compared two planting dates for cereal rye in relation to planting dates of the soybeans: winter annual cereal grain planted 5 days before soybean planting and winter annual cereal grain planted same day as the soybeans. Two species of winter annual cereal grains were compared (cereal rye and winter wheat), at the seeding rates, row spacing and with the equipment described in the introduction. The soybeans were planted with a John Deere 1750 MaxEmerge Plus planter on 30".

Figure 2 - Spring planted rye and weeds, May 31st 2018

Figure 4 - Soybeans and spring planted rye July 31 (left) and September 5 (right) 2019

Treatment 1 – Winter annual cereal grain planted 5 days prior to soybean planting

- Field cultivation x 3 (May 12, 23 and 31)
- Small grain (wheat or rye) drilled on May 31
- Soybeans planted on June 5
- Tine weeding x 2 (June 14 and June 21

- see Figure 5)

Treatment 2 – Winter annual cereal grain planted same day as soybean planting

- Field cultivation x 4 (May 12, 23, 31; June 5)
- Small grain (winter annual wheat or rye) AND soybeans planted on June 5 (one pass with the planter, one pass with the drill)
- Tine weeding x 1 (June 21)

Treatment 3 – Early planting of cultivated organic soybeans

- Field cultivation x 2 (May 12 and 23)
- Soybeans planted on May 23
- Mechanical weeding x 7 (rotary hoe June 3,6,14 and 20; row cultivator June 10,26 and July 3)

Treatment 4 – Late planting of cultivated organic soybeans

- Field cultivation x3 (May 12, 23 and 31)
- Soybeans planted on June 5
- Mechanical weeding x 5 (tine-weeder June 7 and July 2; rotary hoe June 21; row cultivator June 26 and July 23)

Cover crop and weed biomass were measured on August 19. Cover crop biomass was not impacted by small grain planting date (1,600 lbs DM/ac on average); however, winter wheat produced significantly more biomass than rye (1,816 vs. 1,424 lbs DM/ac).

The final stand count of soybeans tended to be higher in the plots with rye or wheat compared to the control treatments (164 vs. 180 thousand plants per acre or 72 and 80% of planting population respectively). The difference was not significant, but if confirmed by further research, it could indicate that the seeding rate could be lowered compared to organic soybeans that are cultivated.

	Weed Biomass (lbs DM/ac)	Stand Count (thousand plant/ac)	Yield (bu/ac)
Control early	445 b	167	54 a
Rye same day	116 b	179	52 ab
Control late	105 b	160	50 ab
Wheat same day	392 b	179	46 ab
Rye 5 days	1913 a	181	41 ab
Wheat 5 days	873 ab	181	35 b

Figure 3 - Weed biomass (August), soybean stand count and soybean yields 2019

Finally, the yields of the interseeded winter cereal grain/soybean plots were comparable to the control plots, except for the plots with wheat planted 5 days before the soybeans (see Figure 3). The difference between cover crop species was not significant; however, the plots interseeded with winter annual cereal rye planted the same days as the soybeans yielded the same as the average of the control treatments (52 bu/ac).

The system does not require any management of the cover crop, as can be seen in Figure 4, the small grain naturally desiccates in August, thus not impacting harvest.

Recommendations for implementing a research trial on your farm

As stated above, we are still researching best management practices for this system of interseeding winter annual cereal grains with soybeans to reduce the need for cultivation in organic systems. We recommend if you experiment with this practice, *use caution with respect to the number of acres devoted to experimentation*. Risk still remains with this practice, and while other weed management practices could still be implemented as "Plan B's" (row cultivation, weed zapping), they likely would not mitigate all the impacts of high weed pressure from an interseeding failure.

From our three years of experiments, as well as input from farmers experimenting with the technique, we would suggest the following practices as a starting point:

- This will not be a good technique to employ in fields with high grass weed pressure, particularly perennial grasses.
- A seeding rate of 2 million seeds per acre of the winter annual cereal grain seems to be sufficient. While any winter annual cereal grain could work, from our experiments winter annual cereal rye provides superior weed suppression, likely due to allelopathy.
- Planting date of the winter annual cereal grain must be sufficiently late to ensure that vernalization does not occur (i.e., temperatures should be consistently above 40 F).
- The employment of false seedbedding to deplete the seedbank for summer annual weeds could be a beneficial practice in this system, depending on weed pressure and types of

Figure 5 - Soybeans and rye, Treatment 1, June 12 (two days before tine weeding)

weeds present. False seedbedding (working the soil prior to a rain, and then shallowly incorporating the weed seedlings in after emergence) will encourage these weeds to germinate before crop planting. Waiting to false seedbed until the later part of May will make this technique more effective for common ragweed, lambsquarters, and foxtail.

- While our studies drilled cereal rye on 7.5 inch rows, farmer experience has shown the benefit of seeding the rye in narrower rows or by broadcasting. With broadcasting, best practices should be followed to ensure an even stand and germination of the rye.
- While soybeans may be drilled in this system, planting soybeans on 30" rows allows for additional weed management to be implemented if necessary.
- Optimization of planting rate of the soybeans has not been studied, but likely planting at typical organic soybean seeding rates (180K seeds per acre) is sufficient.
- Tine weeding can be used to knock down later germinating weeds but should not be used until the soybeans are between VE and VC* and the cereal grain has reached the three-leaf stage.
- While the cereal grain does not achieve significant growth, there could be more risk in these systems in dry years, particularly where early season precipitation is limited.
- While in typical years the cereal grain will die back leaving a dead mulch, thus not interfering with combining of the beans, in excessively wet years, there could be a risk of the cover crop remaining green and staining the soybeans; thus, caution should be taken when growing soybeans for a food grade market.

*see Figure 5 and the "Visual Guide to Soybean Growth Stage" from UW-Madison and UW Extension available here - https://ipcm.wisc.edu/download/pubsGuides/UW_SoybeanGrowthDev.pdf

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OGRAIN is an educational framework to support the development of organic grain production in the upper Midwest. We host a variety of field days during the growing season, winter and summer seminars, support a producer listserv (join by emailing join-ograin@lists.wisc.edu) and have educational materials available on the OGRAIN website at https://ograin.cals.wisc.edu, including educational videos.

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