NORTHWEST CROPS & SOILS PROGRAM

2023 Interseeding Winter Rye in Soybeans

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THE UNIVERSITY OF VERMONT EXTENSION

2023 INTERSEEDING WINTER RYE IN SOYBEANS

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Soybeans are grown for human consumption, animal feed, and biodiesel and can be a useful rotational crop in corn silage and grass production systems. As cover cropping expands throughout Vermont, it is important to understand the potential benefits, consequences, and risks associated with growing cover crops in various cropping systems. With the short growing season in Vermont, it is often difficult to get an adequate cover crop established following soybean harvest. Being successful with this practice will likely require changes to other aspects of the cropping system, such as the timing of cover crop planting date. Interseeding techniques may allow farmers to establish cover crops into soybeans prior to harvest. To support the local soybean market, the University of Vermont Extension Northwest Crop and Soils (NWCS) Program, as part of a grant from the Eastern Soybean Board, conducted a trial in 2023 to investigate the impact that interseeding winter rye into soybeans has on cover establishment and soybean yield.

MATERIALS AND METHODS

The trial was conducted at Borderview Research Farm, Alburgh, VT in the 2023 growing season. The experimental design was a complete randomized block with split plots and four replications. Trial management details can be found in Table 1 below. The main plots were two soybean varieties: SG 0720XT (maturity group 0.7) and SG 1708GTLL (maturity group 1.7). Both varieties were obtained from Seedway LLC (Hall, NY) for this trial. The sub-plots were four winter rye planting dates: 21-Sep, 28-Sep, 5-Oct, and 15-Oct. The cover crop could not be interseeded on 21-Sep in the later maturing variety (SG 1708GTLL), because the plants had not begun to dry down yet. The variety *Progas* hybrid winter rye was obtained from Albert Lea Seed (Albert Lea, MN) for this trial and planted with a PennState Interseeder®. Soybeans were planted on 26-May using a John Deere 1750 four-row planter fitted with bean cups at a rate of 180,000 seeds ac^{-1}. Soybeans were harvested on 10-Oct using an Almaco SPC50 small plot combine. They were then weighed for plot yield and tested for harvest moisture and test weight using a DICKEY-John Mini-GAC Plus moisture/test weight meter. Approximately one month after soybean harvest, percent ground cover from the cover crop was measured by processing photographs using the Canopeo© smartphone application on 16-Nov. The same day, the cover crop was harvested by collecting and weighing the biomass within a $0.25m^2$ quadrat. A representative sample was collected, dried, and weighed to calculate dry matter yield.

Table 1. Trial management details, Alburgh, VT, 2023.

	Borderview Research Farm-Alburgh, VT
Soil type	Benson rocky silt loam, 3 to 5% slopes
Previous crop	Winter grains
Tillage operations	Pottinger TerraDisc®
Plot size (feet)	10 x 20
Soybean planting date	26-May
Soybean varieties	SG 0720XT (maturity group 0.7, RR®2Xtend) SG 1708 GTLL (maturity group 1.7, LibertyLink®)

Soybean seeding rate (seeds ac^{-1})	180,000
Soybean harvest date	10-Oct
Cover crop variety	*Progas* hybrid winter rye
Cover crop seeding rate (lbs. ac^{-1})	150
Cover crop planting dates	21-Sep*, 28-Sep, 5-Oct, and 15-Oct
Cover crop harvest date	16-Nov

*****The cover crop could not be interseeded on 21-Sep in the later maturing variety (SG 1708GTLL), because the plants had not begun to dry down yet.

Soybean yield were analyzed using a general linear model procedure of SAS (SAS Institute, 1999). Replications were treated as random effects, and treatments were treated as fixed. Mean comparisons were made using the Least Significant Difference (LSD) procedure where the F-test was considered significant, at $p<0.10$. Cover crop data were analyzed using the mixed model procedure in SAS (SAS Institute, 1999) with the Tukey-Kramer adjustment, which means that each main effect was analyzed with a pairwise comparison (i.e. 'planting date 1' statistically outperformed 'planting date 3', 'planting date 2' statistically outperformed 'planting date 4', etc.). Replications were treated as a random effect and planting dates were treated as fixed. Treatments were considered different at the 0.10 level of significance. For each metric, the level of significance (p value) is listed at the bottom of the table and treatments marked with the same letter are statistically similar.

Variations in yield and quality can occur because of variations in genetics, soil, weather, and other growing conditions. Statistical analysis makes it possible to determine whether a difference among treatments is real or whether it might have occurred due to other variations in the field. At the bottom of each table, an LSD value is presented for each variable (i.e. yield). Least Significant Differences (LSDs) at the 0.10 level of significance are shown. Where the difference between two treatments within a column is equal to or greater than the LSD value at the bottom of the column, you can be sure that for 9 out of 10 times, there is a real difference between the two treatments. In this example, treatment C is significantly different from treatment A but not from treatment B. The difference between C and B is equal to 1.5, which is less than the LSD value of 2.0. This means that these treatments did not differ in yield. The difference between C and A is equal to 3.0, which is greater than the LSD value of 2.0. This means that the yields of these treatments were significantly different from one another.

Treatment	**Yield**
A	6.0^{b}
B	7.5^{ab}
C	**9.0^{a}**
LSD	2.0

RESULTS

Weather data were recorded throughout the season with a Davis Instrument Vantage Pro2 weather station, equipped with a WeatherLink data logger at Borderview Research Farm in Alburgh, VT (Table 2). Temperatures were cooler than average for most of the soybean growing season. August was particularly cool with an average temperature of 67°F which is 3.73 degrees cooler than the 30-year average. Temperatures were much warmer later in the season, especially in October where the monthly average temperature, 54.4°F, was 4.11 degrees warmer than normal. Heavy rainfall during the season resulted in a total of 31.2 inches of rain. Precipitation was 8.06 inches higher than the 30-year average. There was a period of dry weather in September, but heavy rainstorms continued in October.

Table 2. Weather data for Alburgh, VT, 2023.

Alburgh, VT	May	Jun	Jul	Aug	Sep	Oct	Nov
Average temperature (°F)	57.1	65.7	72.2	67.0	63.7	54.4	36.5
Departure from normal	-1.28	-1.76	-0.24	-3.73	1.03	4.11	-2.80
Precipitation (inches)	1.98	4.40	10.8	6.27	2.40	5.38	2.03
Departure from normal	-1.78	0.14	6.69	2.73	-1.27	1.55	-0.67
Growing Degree Days (50-86°F)	303	483	712	540	449	225	9.00
Departure from normal	1.00	-41.0	17.0	-101	62.0	87.0	5.00

Based on weather data from a Davis Instruments Vantage Pro2 with WeatherLink data logger.
Historical averages are for 30 years of NOAA data (1991-2020) from Burlington, VT.

Yields of soybeans were collected to determine if interseeding a cover crop impacted soybean performance. There was no significant difference in yield of soybeans that had been interseeded and soybeans that had not been interseeded (Table 3). The trial average yield was 3576 lbs or 59.6 bu ac^{-1}, which is comparable to other conventional soybean varieties grown at Borderview Research Farm this season.

Table 3. Soybean harvest characteristics, Alburgh, VT, 2023

Soybean treatment	Soybean harvest			
	Harvest moisture	Yield at 13% moisture		Test weight
	%	lbs. ac^{-1}	bu. ac^{-1}	lbs. bu^{-1}
Interseeded	14.0	3418	57.0	55.7
Not interseeded	13.6	3734	62.2	55.8
LSD (p = 0.10)‡	NS§	NS	NS	NS
Trial mean	13.8	3576	59.6	55.7

‡LSD; Least significant difference at the p=0.10.
§NS; No significant difference between treatments.

Approximately one month after soybean harvest, fall ground cover and rye biomass was measured to see if either of these metrics were impacted by the cover crop planting date (Table 4). The cover crop harvest characteristics represent rye that had been interseeded into both soybean varieties. Fall ground cover and rye dry matter yield were both statistically greater in the first planting date (21-Sep) than the third and fourth planting dates (5-Oct and 15-Oct). Ground cover and biomass were statistically similar on 21-Sep and 28-Sep. Ground cover and rye biomass decreased as the fall planting date went from mid-September to mid-October.

Table 4. Cover crop harvest characteristics, Alburgh, VT, 2023.

Rye planting date	Cover crop harvest	
	Ground cover	Dry matter yield
	%	lbs. ac^{-1}
21-Sep*	**38.2[a]†**	**772[a]**
28-Sep	25.5[ab]	461[ab]
5-Oct	13.7[bc]	284[bc]
15-Oct	1.62[c]	39[c]
Level of significance¥	0.0002	0.0007
Trial mean	19.1	372

*The cover crop could not be interseeded on 21-Sep in the later maturing variety (SG 1708GTLL), because the plants had not begun to dry down yet.

†Within a column, treatments with the same letter performed statistically similar.

¥Treatments were significantly different at the p value listed within each column.

DISCUSSION

Incorporating cover crops into soybeans can be challenging because the crop is generally harvested in October and November. Interseeding soybeans into the growing crop might be an option to incorporate cover crops into this late season crop. Interseeding soybeans prior to canopy closure may result in variable cover crop stands. Soybeans form a dense canopy before drying down and interseeding equipment may cause damage to the developing plants as well. Waiting to interseed until later in the season may also result in damage to the cash crop. Once soybeans have dried down, interseeding equipment might cause pod shatter and loss of yields right before harvest. The goal of this project was to interseed a cover crop into soybeans at later development stages. Often this time frame also coincides with optimum planting dates for cover crops. In 2023, there was no impact on soybean yield or quality when soybeans were interseeded with a cover crop prior to harvest. Fall ground cover and rye biomass after the soybean harvest was highest when the rye was planted on 21-Sep, but was not statistically different when planted on 28-Sep. Ground cover and rye biomass was significantly reduced however when planted in early to mid-October. In 2023, soybean yields were good, with an average yield of 3576 lbs ac^{-1} and were not negatively impacted by cover crop interseeding. Winter rye performed best when interseeded mid to late September). Rye established well after being planted into the soybean crop and continued to grow after soybean harvest. The trade-offs of interseeding cover crops must be considered when making management decisions, and more research needs to be done to better understand the impact of interseeding into a soybean cropping system. It is important to remember that these data represent only one year of research at one location.

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