



## 2018 Soybean Cover Crop Trial



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**2018 SOYBEAN COVER CROP TRIAL**  
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In 2018, the University of Vermont Extension Northwest Crops and Soils Program investigated the impact of various cover crop mixtures on a subsequent soybean crop's yield and quality at Borderview Research Farm in Alburgh, VT. 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. In an effort to support the local soybean market and to gain a better understanding of cover cropping in soybean production systems, the University of Vermont Extension Northwest Crop and Soils (NWCS) Program, as part of a grant from the Eastern Soybean Board, established a trial in 2018 to investigate the impacts on soybean yield and quality following annual cover crop mixtures with a soybean crop.

## MATERIALS AND METHODS

The trial was established at Borderview Research Farm, Alburgh, VT in the fall of 2017. The experimental design was a complete randomized block design with four replications (Table 1). The treatments were 18 cover crop mixtures planted on 24-Aug 2017. Treatments consisted of mixtures that would both be over-wintered and some that would be winter-killed. Cover crop treatments and seeding rates are listed in Table 2. Biomass was collected on 17-Oct 2017 from a 0.25m<sup>2</sup> area in each plot. Samples were weighed prior to and after drying to determine dry matter content and calculate yield. Cover crop biomass was measured again in the spring just prior to soybean planting (9-May 2018) using this same method. All cover crop treatments were terminated just prior to soybean planting using a moldboard plow and disc harrow.

**Table 1. Trial management details, 2017-2018.**

	<b>Borderview Research Farm-Alburgh, VT</b>
Soil types	Benson rocky silt loam 8-15% slope
Previous crop	Annual cover crop mixtures
Tillage operations	Moldboard plow and disc
Plot size (feet)	5 x 20
Row spacing (inches)	30
Replicates	4
Starter fertilizer (lbs ac <sup>-1</sup> )	5 gal ac <sup>-1</sup> 9-18-9
Planting dates	Cover crops: 24-Aug 2017 Soybeans: 22-May 2018
Weed control	1 qt. ac <sup>-1</sup> Roundup <sup>®</sup> applied 22-Jun 2018
Harvest date	10-Oct 2018

On 22-May, the soybeans were planted into the terminated cover crop treatments using a 4-row cone planter with John Deere row units fitted with Almaco seed distribution units (Nevada, IA) at 185,000 seeds ac<sup>-1</sup> with 5 gal ac<sup>-1</sup> starter fertilizer (9-18-9). The variety SW1055 (maturity group 1.0, Genuity<sup>®</sup> RoundUp Ready 2 Yield) soybean was obtained from Seedway, LLC (Hall, NY) for the trial. Soybeans were sprayed

with Roundup herbicide on 22-Jun to control weeds. On 10-Oct, the soybeans were harvested using an Almaco SPC50 small plot combine. Seed was cleaned with a small Clipper M2B cleaner (A.T. Ferrell, Bluffton, IN). 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.

**Table 2. Annual cover crop mixture treatments grown in 2017 prior to soybean in 2018.**

Mix	Species	Variety	Over-winters?	Seeding rate lbs ac <sup>-1</sup>	Mix	Species	Variety	Over-winters?	Seeding rate lbs ac <sup>-1</sup>
1	Annual ryegrass	unknown	No	24	7	Forage oats	Everleaf	Yes	40
	Crimson clover	unknown		(NRCS mix)		Red clover	Duration		5
	Tillage radish	Arifi		Forage turnip		Appin	2		
2	Winter triticale	Fridge	Yes	40	8	Annual ryegrass	Bruiser	No	15.2
	Tillage radish	Eco-till		2		Forage turnip	Appin		2.11
	Red clover	Freedom		5	9	Annual ryegrass	Fria	No	22
	Winter pea	Lynx		20		Tillage radish	Eco-till		3
3	Winter rye	unknown	Yes	40	10	Forage oats	Everleaf	No	70
	Red clover	Dynamite		1	11	Tillage radish	Eco-till	No	8
	Forage turnip	Appin		2	12	Crimson clover	Dixie	No	10
4	Winter triticale	Hyoctane	Yes	60	13	Forage oats	Everleaf	No	70
	Red clover	Dynamite		3		Tillage radish	Eco-till		3
	Forage turnip	Appin		2		Crimson clover	unknown		10
5	Forage oats	Everleaf	No	60	14	Winter rye	unknown	Yes	75
	Tillage radish	Groundhog		3		Winter rye	unknown	Yes	70 (farm mix)
6	Winter triticale	Trical815	Yes	60	15	Hairy vetch	unknown	No	30
	Rape	Dwarf Essex		3	16	Annual ryegrass	Fria	No	24
					17	Hairy vetch		Yes	24
					18	No cover		No	N/A

Yield data and stand characteristics were analyzed using mixed model analysis using the mixed procedure of SAS (SAS Institute, 1999). Replications within trials were treated as random effects, and hybrids were treated as fixed. Hybrid mean comparisons were made using the Least Significant Difference (LSD) procedure when the F-test was considered significant ( $p < 0.10$ ).

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 hybrids is real or whether it might have occurred due to other variations in the field. At the bottom of each table a 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 hybrids 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 hybrids. In this example, hybrid C is significantly different from hybrid A but not from hybrid B. The difference between C and B is equal to 1.5,

Hybrid	Yield
A	6.0
B	7.5*
C	<b>9.0*</b>
LSD	2.0

which is less than the LSD value of 2.0. This means that these hybrids 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 hybrids were significantly different from one another.

## RESULTS

Weather data was recorded with a Davis Instrument Vantage Pro2 weather station, equipped with a WeatherLink data logger at Borderview Research Farm in Alburgh, VT (Table 3). Overall, the season was hotter and dryer than normal. A total of 15" of rain fell during the soybean growing season. Precipitation was approximately 60% of normal. During the growing season, there were only six rain events that resulted in greater than 0.75 inches of accumulation. These six events constituted approximately 36% of the total rainfall. Consequently, there were several extended periods with very little to no rainfall. The longest period was approximately 25 days with less than 0.25 inches of accumulated rainfall. Temperatures were above normal Jul-Sep. Overall, 2731 growing degree days (GDDs) were accumulated May-October, 520 above the 30-year normal.

**Table 3. Weather data for Alburgh, VT, 2018.**

<b>Alburgh, VT</b>	May	June	July	August	September	October
Average temperature (°F)	59.5	64.4	74.1	72.8	63.4	45.8
Departure from normal	3.10	-1.38	3.51	3.96	2.76	-2.36
Precipitation (inches)	1.94	3.74	2.43	2.96	3.48	3.53
Departure from normal	-1.51	0.05	-1.72	-0.95	-0.16	-0.07
Growing Degree Days (base 50°F)	352	447	728	696	427	81
Departure from normal	154	-27	88	115	109	81

Based on weather data from a Davis Instruments Vantage Pro2 with WeatherLink data logger. Historical averages are for 30 years of NOAA data (1981-2010) from Burlington, VT.

The top yielding cover crop treatment in the fall was mixture 7 (forage oat/red clover/turnip) which produced approximately 2 tons ac<sup>-1</sup> (Table 4). This treatment performed statistically similar to mixture 3 (winter rye/red clover/turnip) and mixture 8 (annual ryegrass/turnip). As many of the treatments consisted of species that do not overwinter, the top yielding treatments in the spring, producing just under 1.5 ton ac<sup>-1</sup>, were mixtures 14 and 15, which included winter rye and winter rye/vetch respectively. None of the top treatments in the fall were top yielding in the following spring. This was true even for the treatments that included overwintering species. Soybean yield and test weight did not differ significantly by the preceding cover crop treatments. Yields averaged 3758 lbs ac<sup>-1</sup> or 62.6 bu ac<sup>-1</sup> and test weight averaged 55.2 lbs bu<sup>-1</sup>. These were consistent with the averages observed in our other soybean trials in 2018.

**Table 4. Cover crop and soybean harvest characteristics, 2017-2018.**

Mix	Overwinters?	Fall 2017	Spring 2018	Soybean harvest 2018	
		Dry matter yield		Yield at 13% moisture	Test weight
		lbs ac <sup>-1</sup>			
1	No	3126	490	3695	55.0
2	Yes	2992	1075	3702	55.0
3	Yes	3562*	720	3573	55.1
4	Yes	3297	768	3820	55.4
5	No	2808	1383	4058	55.1
6	Yes	2221	1378	3847	55.4
7	Yes	<b>4388</b>	1229	3886	<b>55.9</b>
8	No	3438*	805	<b>4150</b>	55.3
9	No	3165	486	4028	55.1
10	No	2961	1288	3703	55.3
11	No	2890	323	3670	55.6
12	No	1590	796	3531	55.1
13	No	2964	1463	4074	55.2
14	Yes	2076	2720*	3325	55.1
15	Yes	1088	<b>2862</b>	3512	55.4
16	No	3122	1557	4140	55.6
17	Yes	1104	1714	3662	55.4
Control	No	643	1488	3269	55.1
LSD ( <i>p</i> = 0.10)	N/A	984	583	NS	NS
Trial mean	N/A	2635	1252	3758	55.2

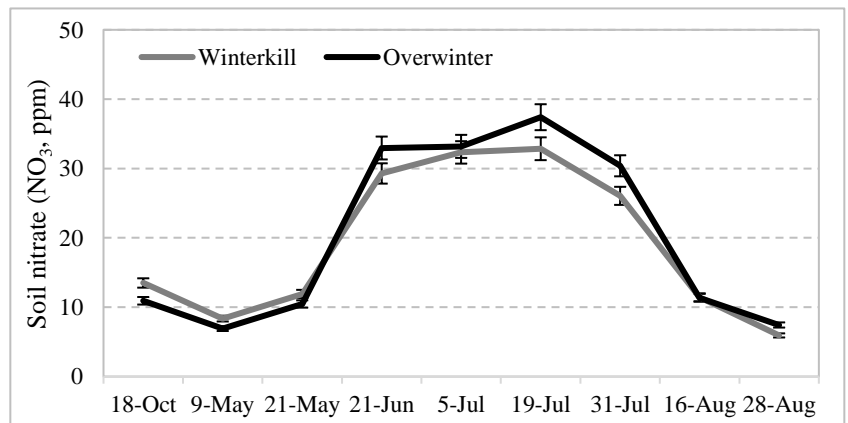
\*Varieties that did not perform significantly lower than the top performing variety in **bold** are indicated with an asterisk. NS, no significant difference. N/A, not applicable.

In 2017, we saw a significant decrease in soybean yields when following an overwintering cover crop. This year, the trend was much less pronounced (Table 5). Soils were analyzed for nitrate (NO<sub>3</sub>) content multiple times between the fall biomass harvest and soybean harvest (Figure 1). In the fall, soil nitrate levels were approximately the same in overwinter vs winterkilled cover crop treatments. The following spring when biomass was collected again, the soil nitrate level was approximately 1.54 ppm lower in the overwinter treatments.

**Table 5. Soybean yields by cover crop type.**

Overwinter	Soybean yield (bu ac <sup>-1</sup> )	
	2017	2018
Yes	60.4	60.0
No	<b>67.9</b>	<b>62.6</b>
<i>p</i> value	0.007	0.132
Trial mean	64.2	55.2

The top performing treatment is indicated in **bold**.

**Figure 1. Soil NO<sub>3</sub> content by cover crop treatment type, 2017-2018.**

This trend continues through the end of May at which point the soybeans are planted. It is not until the end of June when soil nitrate levels in the overwinter plots exceed that of the winterkill plots. This trend holds through the end of July. This suggests that the nitrogen in the living cover crop material that was incorporated into the soil prior to planting soybeans was mineralized in mid-July. The extra nitrogen released from the overwintered cover crops did not appear to impact soybean yield. It is important to recognize that starter fertilizer was applied at planting to all soybean plots. A greater impact may have been seen, had starter not been used. We plan to continue to investigate nitrogen cycling in these cover crop treatments and its potential impacts on subsequent soybean productivity.

## DISCUSSION

In 2018, soybean establishment and ultimate yields were not significantly impacted by previous cover crop treatments (Figure 2). These data suggest that soybeans can successfully follow high yielding cover crop mixtures without experiencing yield depressions. As this is contrary to our observations in 2017, we will continue to investigate cover cropping practices in soybeans in this region to gain a better understanding of successful cover cropping practices and their impacts on soybean performance.

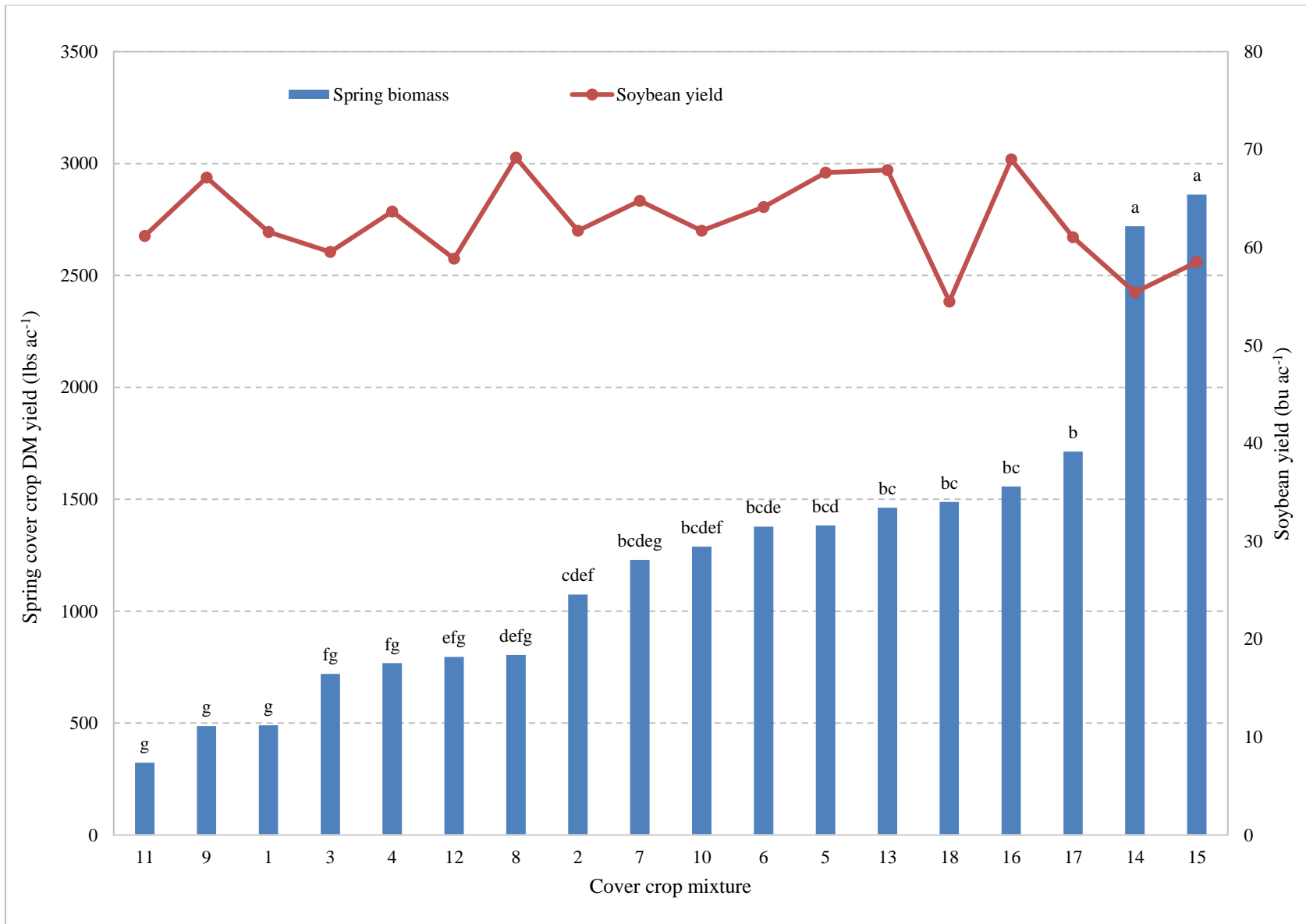
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**Figure 2. Soybean and spring cover crop biomass by cover crop mixture treatment, 2018.**

Treatments that share a letter performed statistically similarly to one another. Soybean yields did not differ statistically across treatment.