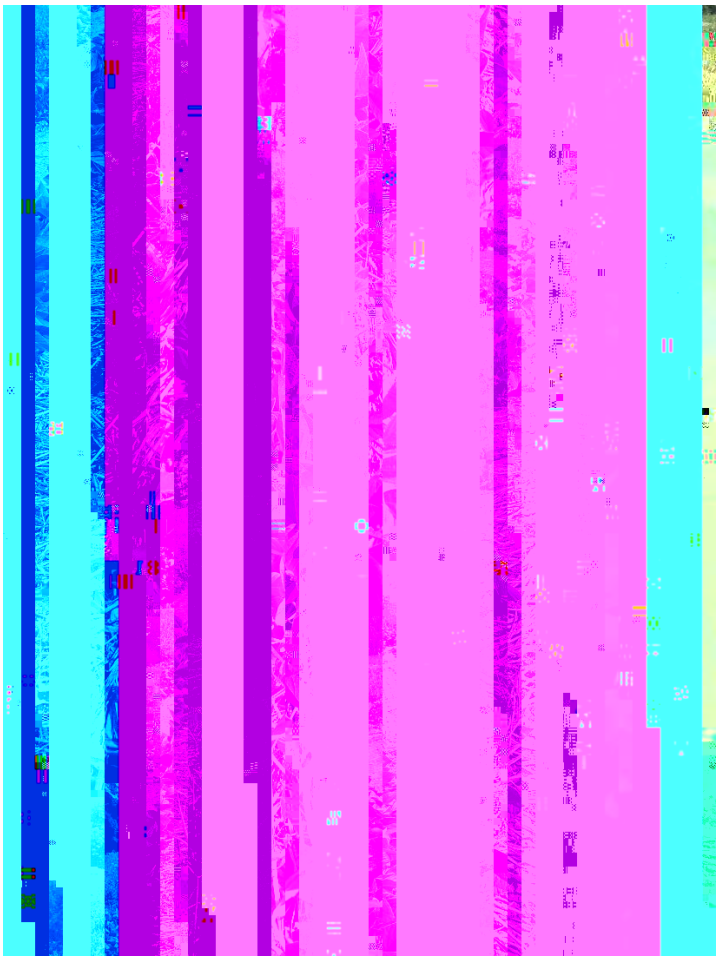
2020 Cover Crop Termination Trial



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2020 COVER CROP TERMINATION TRIAL

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In 2020, the University of Vermont Extension Northwest Crops and Soils Program investigated the impact of spring cover crop termination methods 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, conducted a trial in 2020 to investigate the impacts of different cover crop termination methods on the yield and quality of the subsequent soybean crop.

MATERIALS AND METHODS

The trial was conducted at Borderview Research Farm, Alburgh, VT in 2019-2020. The experimental design was a complete randomized block design with split plots and four replications (Table 1). The main plot was spring termination method including tillage, herbicide termination before planting, and herbicide termination after planting (Table 2). Subplots were 2 cover crop treatments, winter rye (WR) and triticale (Tr) which were planted on 20-Aug 2019 (Table 3). On 28-Apr 2020, cover crop height and ground cover were measured in each plot. The beaded string method (Sloneker and Moldenhauer, 1977) was employed so that cover could be attributed to living and/or dead plant biomass.

Table 1. Trial management details, 2019-2020.

Location	Borderview Research Farm-Alburgh, VT
Soil type	Benson rocky silt loam
Previous crop	Winter wheat
Plot size (feet)	5 x 20
Row spacing (inches)	30
Replicates	4
Cover crop planting date	20-Aug 2019
Soybean variety	SG0975 (maturity group 0.9, Genuity® RoundUp Ready 2 Yield)
Starter fertilizer	9-18-9 (5 gal ac^{-1})
Soybean planting date	20-May 2020
Soybean harvest date	15-Oct 2020

Cover crop biomass was measured prior to termination in the tillage and pre-spray treatments on 5-May and in the post-spray treatment on 19-May. A 0.25m^2 area in each plot was harvested and samples were weighed prior to and after drying to determine dry matter content and calculate yield. To understand the nutrient release rates of the different cover crop treatments and how this is impacted by termination method,

soil samples were collected from all plots and analyzed for soil nitrate-N (NO_3) concentration, approximately every two weeks, starting from mid-May through the end of June. Soil moisture and temperature was measured approximately every other week from planting through the season.

Table 2. Cover crop termination treatments, Alburgh, VT, 2020.

Treatment	Cover crop termination details
Tillage (5-May)	Tilled under with moldboard plow and disc harrow prior to soybean planting
Pre-spray (13-May)	Sprayed with Roundup PowerMAX® at 1qt ac^{-1} prior to soybean planting
Post-spray (27-May)	After soybeans were planted, cover crop was sprayed with Roundup PowerMAX® at 1qt ac^{-1}

On 20-May, the soybeans were planted into each of the termination 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^{-1} with 5 gal ac^{-1} starter fertilizer (9-18-9). The variety SG0975 (maturity group 0.9) soybean was obtained from Seedway, LLC (Hall, NY) for the trial. An herbicide application error caused the replanting of the soybeans in the tillage terminated plots on 12-Jun 2020.

Table 3. Overwintering cover crop mixtures grown prior to soybean crop, Alburgh, VT, 2019- 2020.

On 15-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.

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. HybriddTm0 g4 612 792 reW*nBT/W*nBT/F1 1165BT/.97 TmreW*Tf1 o12 792q0.00000912 0 612.oced

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 t

Table 5. Cover crop and soybean harvest characteristics by termination method, Alburgh, VT, 2020.

Termination method	Prior to cover crop termination				Soybean harvest		
	Spring soil coverage			Cover crop dry matter yield	Yield at 13% moisture		Test weight
	Living biomass	Dead biomass	Total				
				tons ac^{-1}	lbs. ac^{-1}	bu. ac^{-1}	lbs. bu^{-1}
Tillage	90.7	4.90	**95.6**	**2.24^{a}**	3952^{a}	65.9^{a}	56.5
Pre-spray	84.1	**8.33**	92.4	1.31^{b}	**4287^{a}**	**71.5^{a}**	**56.6**
Post-spray	**90.9**	1.23	92.2	2.16^{a}	2555^{b}	42.6^{b}	56.4
LSD (p = 0.10)‡	NS§	NS	NS	0.618	687.8	11.5	NS
Trial mean	88.6	4.82	93.4	1.90	3597	60.0	56.5

†Within a column, treatments marked with the same letter were statistically similar (p=0.10). Highest treatment shown in **bold**.
‡LSD; Least significant difference at the p=0.10.
§NS; No significant difference between treatments.

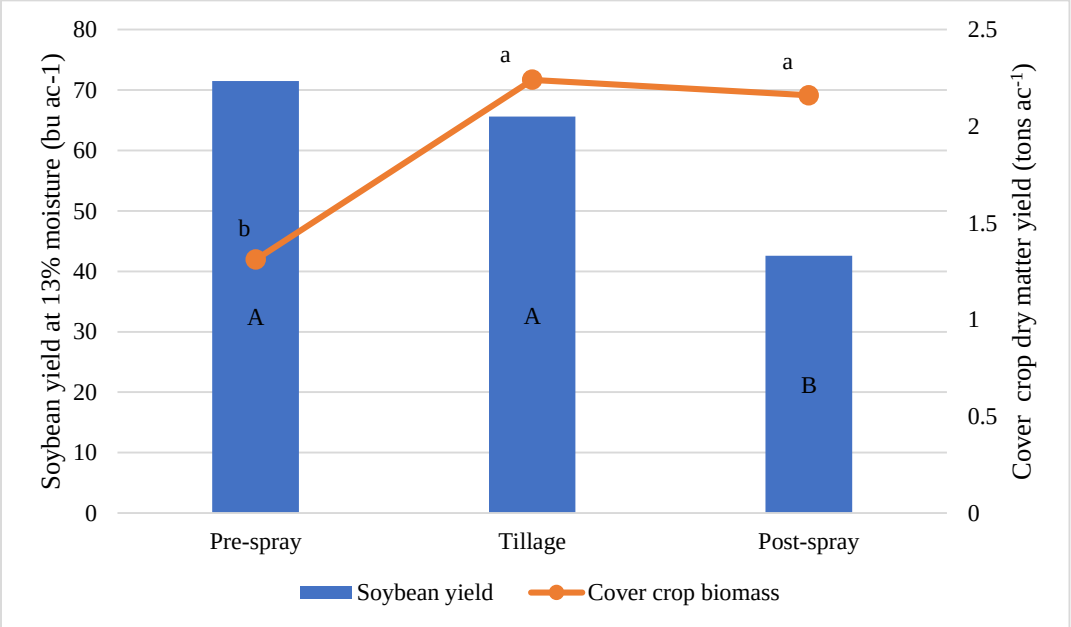

Figure 1. Soybean yield and spring cover crop biomass by cover crop termination method, Alburgh, VT, 2020. Different letters indicate a statistically significant difference between treatments (p=0.10).

Prior to cover crop termination, there was no significant impact of cover crop treatment on spring soil cover or cover crop dry matter yield (Table 6). The average living biomass, dead biomass, and total spring soil coverage were 85.6%, 4.82%, and 93.4% respectively. The average cover crop dry matter was 1.90 tons ac^{-1}. There was also no significant impact of cover crop treatment on the subsequent soybean harvest. Average soybean yield for this season was 3598 lbs. ac^{-1} or 60.0 bu. ac^{-1} and test weight was 56.5 lbs. bu^{-1}.

Table 6. Cover crop and soybean harvest characteristics by cover crop mixture, Alburgh, VT, 2020.

Treatment	Species	Prior to cover crop termination				Soybean harvest		
		Spring soil coverage			Cover crop dry matter yield	Yield at 13% moisture		Test weight
		Living biomass	Dead biomass	Total				
					tons ac^{-1}	lbs. ac^{-1}	bu. ac^{-1}	lbs. bu^{-1}
Tr	Triticale	**90.7**	3.60	**94.3**	1.73	3499	58.3	56.4
WR	Winter rye	86.4	**6.05**	92.5	**2.07**	**3696**	**61.6**	**56.6**
LSD (p = 0.10)‡		NS§	NS	NS	NS	NS	NS	NS
Trial mean		85.6	4.82	93.4	1.90	3598	60.0	56.5

†Within a column, treatments marked with the same letter were statistically similar (p=0.10). Highest treatment shown in **bold**.
‡LSD; Least significant difference at the p=0.10.
§NS; No significant difference between treatments.

About one week after soybeans were planted, soil moisture and temperature were measured every week for eight weeks. Soil moisture was significantly higher in the tillage treatment than in the pre-spray and post-spray treatment (Table 7). The pre-spray treatment had significantly higher soil moisture than the post-spray treatment on 2-, 9-, and 15-Jun. There were no differences in soil moisture between the pre-and post-spray treatments on the remaining five dates. It is possible that the s /P <</MCID 122.19 Tm0 g0 G[s /P <</MCID 122.19 T

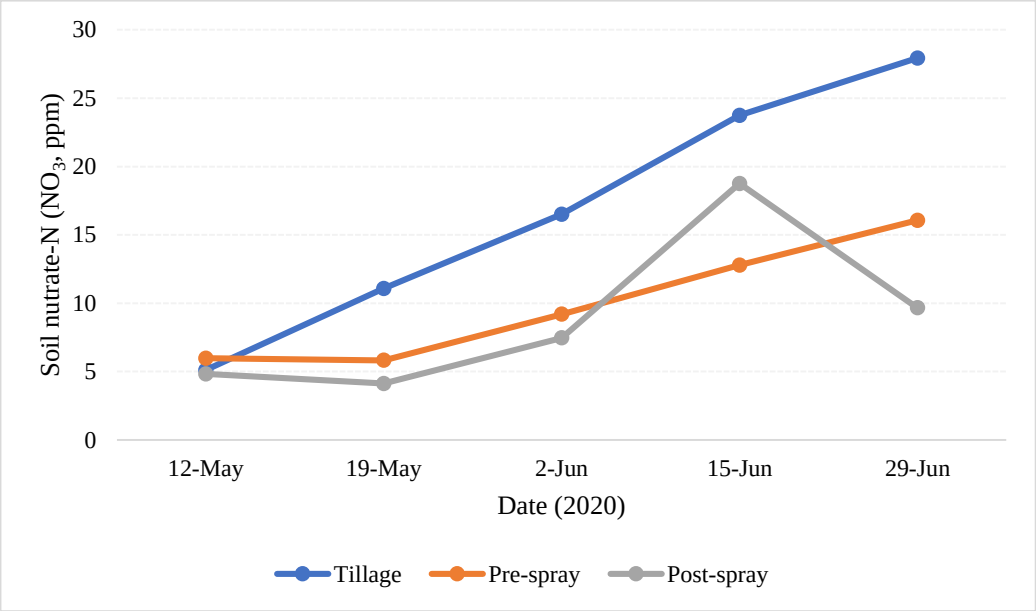

Figure 2. Soil nitrate-N (NO_3) concentration by cover crop termination method, 2020.

DISCUSSION

In 2020, while the season started out cooler than normal, it quickly became warmer than average for most of the season. Rainfall was below average throughout the growing season, and the precipitation came in short duration storms. The cover crop species did not have an impact on the spring soil coverage or cover crop dry matter yield prior to termination, nor did the cover crop type impact soybean yield or quality. Prior to cover crop termination, there were no significant differences in spring soil coverage amongst the plots that would be tilled, sprayed prior to, or sprayed after soybean planting. However, cover crop dry matter was statistically different. The plots that would be tilled had the greatest dry matter yield prior to termination, and the plots that would be sprayed prior to soybean planting, statistically had the lowest dry matter yield. The pre-spray treatment had the greatest soybean yield, and the post-spray treatment had the lowest. The large cover crop biomass prior to termination may have impacted soybean yields in the post-spray treatment, and inversely the lack of spring biomass in the pre-spray treatment may have allowed for a more successful soybean yield. These differences in cover crop biomass prior to termination may have added to the significant difference in soybean yield, in addition to any effects from the termination methods. Soil moisture and temperature were highest in the tillage treatment, as well as overall soil nitrate-N. The tillage and the pre-spray treatment both had gradual increase in soil nitrate-N from 12-May to 29-Jun, although overall soil nitrate-N levels were much lower in the pre-spray treatment. The post-spray treatment also consistently had lower soil nitrate-N levels until a spike on 15-Jun, but then a drop in soil nitrate-N on 29-Jun. The additional available nitrogen in the tillage treatment did not appear to have an impact on soybean yield since the tillage treatment was statistically similar to the pre-spray treatment in terms of soybean yield. It should be noted that soybeans were replanted later (12-Jun) in the tillage treatment due to herbicide application error.

Overall, soybean yields in this trial were comparable to the yield of soybeans in other trials conducted at Borderview Research Farm in 2020. These data suggest that soybeans can successfully be grown following an overwintering cover crop and but may be negatively impacted by the amount of cover crop biomass prior to spring termination. For comparison, in the 2019 trial, there was no significant difference in soybean yield between termination methods, even though the overall spring cover crop biomass was significantly different. However, soybean yields last year were impacted by the cover crop type. Soybean yields were lowest where there was winter rye likely because the winter rye had the most spring soil coverage and biomass. These data indicate the need for more research on integrating cover crops into a soybean production system in order to make it a viable option for farmers. 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 performances. UVM Extension Northwest Crops and Soils Program plans to repeat this trial in 2021.

REFERENCES

Sloneker, L. L. and W. C. Moldenhauer, 1977. Measuring the amounts of crop residue remaining after tillage. J. Soil Water Conserv. 32:23 l-236.

ACKNOWLEDGEMENTS

UVM Extension Northwest Crops and Soils Program would like to thank Eastern Soybean Region Board for the funding for this trial. We would also like to thank Roger Rainville and the staff at Borderview Research Farm for their generous help with this research trial. We would like to acknowledge Henry Blair, John Bruce, Catherine Davidson, Hillary Emick, Rory Malone, and Lindsey Ruhl for their assistance with data collection and entry. We would also like to thank the seed companies for their seed and cooperation in this study.