ER2016-01

Eastern Region Soybean Board - Final Report

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Project Title: Maximizing Soybean Production in a Changing Climate.

To be successful in today's challenging economic and environmental climate farmers need region specific information that will lead to high yields and minimum impact on the environment. This project met the ESRB priority of high yielding soybeans–varieties, production methods, and soil health.

Objective 1 was to identify varieties/maturity that lead to maximum soybean production. Twenty-30 varieties in maturity groups 000 to 2.0 will be evaluated for yield.

Objective 2 was to investigate the integration/ impacts of cover crops on soybeans.

2016 SOYBEAN VARIETY TRIAL

In 2016, the University of Vermont Extension Northwest Crops and Soils Team evaluated yield and quality of short season soybean varieties at Borderview Research Farm in Alburgh, VT. Due to the short growing season in Vermont, little research has been conducted on soybeans and the insects and diseases that can affect their harvest yield and quality. In an effort to support and expand the local soybean market throughout the northeast, the University of Vermont Extension Northwest Crop and Soils (NWCS) Program, as part of a grant from the Eastern Region Soybean Board, established a trial in 2016 to evaluate soybean varieties to see which varieties and characteristics thrive in our northern climate.

MATERIALS AND METHODS

Several seed companies submitted varieties for evaluation (Table 1). Twenty-six soybean varieties were evaluated from maturity groups 0, 1, and 2. Details for the varieties including company, genetic traits, and maturity group are listed in Table 2.

Table 1. Participating companies and contact information.

Albert Lea Seed	Channel	Dyna-Gro (Crop Production Services)	Seedway LLC
1414 W. Main, POB 127 Albert Lea, MN 56007	800 N. Lindbergh Blvd. St. Louis, MO 63167	Tom Barber East Aurora, NY	171 Ledgemere Point Bomoseen, VT 05732

800-352-5247	814-571-8600	(716) 912-5494	802-338-6930

Table 2. Soybean varieties evaluated in Alburgh, VT, 2016.

Variety	Company	Traits	Maturity group
00717R2X	Channel	RR2X	0.07
0209R2	Channel	RR2	0.2
0317R2X	Channel	RR2X	0.3
S06RY47	Dyna-Gro (CPS)	RR2Y	0.6
0807R2	Channel	RR2	0.8
0906R2	Channel	RR2	0.9
S09RY64	Dyna-Gro (CPS)	RR2Y	0.9
0916R2X	Channel	RR2X	0.9
1017R2X	Channel	RR2X	1.0
1055	Seedway LLC	RR	1.0
1117R2X	Channel	RR2X	1.1
S12RY44	Dyna-Gro (CPS)	RR2Y	1.2
1311	Seedway LLC	RR	1.3
1405R2	Channel	RR2	1.4
S14RY95	Dyna-Gro (CPS)	RR2Y	1.4
1517R2X	Channel	RR2X	1.5
975	Seedway LLC	RR	1.5
Viking 1518N	Albert Lea Seed	None	1.5
S17RY06	Dyna-Gro (CPS)	RR2Y	1.7
S17RY67	Dyan-Gro (CPS)	RR2Y	1.7
1776	Seedway LLC	RR	1.7
Viking 1722N	Albert Lea Seed	None	1.7
1808R2	Channel	RR2	1.8
1816R2X	Channel	RR2X	1.8
Viking 1922N	Albert Lea Seed	None	1.8
2716R2X	Channel	RR2X	2.7

RR; RR2 – Roundup Ready soybeans are glyphosate herbicide (Roundup®) tolerant.
RR2X – Roundup Ready 2 Xtend soybeans are glyphosate and dicamba herbicide tolerant.
RR2Y – Roundup Ready 2 Yield soybeans are genes to increase the number of 3, 4, and 5-bean pods per plant.

The soil type at the Alburgh location was Benson rocky silt loam (Table 3). The seedbed was prepared using a moldboard plow and then disked prior to seeding. The previous crop was dry beans. Plots were planted on 27-May with a Monosem NG-Plus 2-row precision air planter (Edwardsville, KS). Starter fertilizer (10-20-20) was applied at a rate of 200 lbs ac^{-1}. Plots were 20' long and consisted of two rows spaced at 30 inches. The seeding rate was 150,000 seeds ac^{-1}. The plot design was a randomized complete block with three replications. The treatments were 26 varieties that ranged in maturity group from 0.07 to 2.7.

Table 3. Soybean trial specifics for Alburgh, VT, 2016.

	Borderview Research Farm Alburgh, VT
Soil types	Benson rocky silt loam 8-15% slope
Previous crop	Dry beans
Tillage operations	Moldboard plow and disc
Plot size (feet)	5 x 20
Row spacing (inches)	30
Replicates	3
Starter fertilizer (lbs ac^{-1})	200 lbs ac^{-1} 10-20-20
Planting date	27-May
Harvest date	12-Oct

The plots were also scouted for insect pests and disease symptoms on 7-Jul and 10-Aug using a 0.25 m^2 quadrat placed randomly in a plot. On 12-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, tested for harvest moisture using a DICKEY-John M20P moisture meter, and evaluated for test weight using a Berckes Test Weight Scale.

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. Variety means comparisons were made using the Least Significant Difference (LSD) procedure when the F-test was considered significant ($p<0.10$).

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. Missing precipitation data from 17-Aug through 31-Oct was supplemented using data provided by the NOAA from Highgate, VT. May through September was unusually dry, accumulating 7.27 inches less rain than in a usual year (Table 4). Despite the lack of rain, June and July were close to the average temperature. However, late summer and early fall were hotter than the average. Overall, there were an accumulated 2708 GDDs this season, approximately 302 more than the historical 30-year average.

Table 4. Weather data for Alburgh, VT, 2016.

Alburgh, VT	May	June	July	August	September	October
Average temperature (°F)	58.1	65.8	70.7	71.6	63.4	50.0
Departure from normal	1.80	0.00	0.10	2.90	2.90	1.90
Precipitation (inches)	1.5	2.8	1.8	3.0	2.5	5.0

Departure from normal	-1.92	-0.88	-2.37	-0.93	-1.17	1.39
Growing Degree Days (base 50°F)	340	481	640	663	438	146
Departure from normal	74	7	1	82	104	34

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. Alburgh precipitation data from 8/17/16-10/31/16 was missing and was replaced by data provided by the NOAA for Highgate, VT.

Soybean Scouting

The plots were scouted twice during the growing season to identify pest pressure on soybeans in the region (Table 5). Japanese beetles and their feeding damage were found on all varieties in this trial. Heavy leaf feeding and defoliation characterize the Japanese beetle feeding damage. Red headed flea beetles and potato leafhoppers were found on the majority of plots. Many varieties showed symptoms of sunscald, which is caused by excessive exposure to sunlight, and bacterial leaf blight. Downy mildew and frogeye leaf spot were also observed on plants in the trial, but were less prevalent. Only the presence of pests were recorded and based on observation, the overall severity was low and likely did not contribute to yield loss. Further assessment would need to be conducted to determine pest impact on yields.

Table 5. 2016 soybean pests and diseases identified over two scouting dates in Alburgh, VT.

Variety	Company	Red Headed Flea Beetle	Potato Leafhopper	Japanese Beetle	Sunscald	Bacterial Leaf Blight	Frogeye Leaf Spot	Downy Mildew
00717R2X	Channel	X	X	X	X			
0209R2	Channel	X	X	X			X	
0317R2X	Channel	X		X	X	X		
S06RY47	Dyna-Gro (CPS)	X	X	X				
0807R2	Channel	X	X	X		X		
0906R2	Channel	X	X	X				
0916R2X	Channel	X	X	X		X		
S09RY64	Dyna-Gro (CPS)	X	X	X		X		
1017R2X	Channel	X		X	X			
1055	Seedway LLC	X	X	X	X	X		
1117R2X	Channel	X	X	X	X			
S12RY44	Dyna-Gro (CPS)	X	X	X				
1311	Seedway LLC	X	X	X	X	X		
1405R2	Channel	X	X	X				
S14RY95	Dyna-Gro (CPS)	X	X	X	X	X		
1517R2X	Channel	X	X	X	X	X		
975	Seedway LLC	X	X	X	X	X		
Viking 1518N	Albert Lea Seed	X	X	X	X	X		
S17RY06	Dyna-Gro (CPS)	X	X	X		X		
S17RY67	Dyna-Gro (CPS)			X				
1776	Seedway LLC	X	X	X	X			

Viking 1722N	Albert Lea Seed	X	X	X	X		
1808R2	Channel	X	X	X			
1816R2X	Channel	X	X	X	X		X
Viking 1922N	Albert Lea Seed	X	X	X		X	
2716R2X	Channel	X	X	X			

Soybean Harvest

Soybeans were harvested on 12-Oct, harvest results are shown in Table 6. The average harvest moisture was 13.2%, which is very close to the optimal 13.0%. No varieties reached the optimal test weight of 60 lbs bu^{-1}; the average test weight was 57.6 lbs bu^{-1}. The top performing variety was Seedway LLC variety 1776, which yielded 5541.3 lbs ac^{-1}, or 92.5 bu ac^{-1}. Varieties that were not statistically significant from the top performing variety were Channel varieties 1405R2, 1808R2, and 2716R2X (Figure 1).

Table 6. Harvest characteristics of soybean varieties – Alburgh, VT, 2016.

Variety	Company	Maturity Group	Harvest moisture %	Test weight lbs bu^{-1}	Yield @ 13% moisture lbs ac^{-1}	Yield @ 13% moisture bu ac^{-1}
00717R2X	Channel	0.07	13.5*	**58.5**	2361	39.4
0209R2	Channel	0.2	**13.0**	57.3	3695	61.7
0317R2X	Channel	0.3	13.1*	57.2	3481	58.1
S06RY47	Dyna-Gro (CPS)	0.6	13.2*	58.5*	3707	61.9
0807R2	Channel	0.8	**13.0**	57.6	3765	62.9
0906R2	Channel	0.9	12.8*	57.1	3570	59.6
0916R2X	Channel	0.9	13.3*	57.1	3107	51.9
S09RY64	Dyna-Gro (CPS)	0.9	**13.0**	58.2*	4239	70.8
1017R2X	Channel	1.0	13.2*	57.1	3905	65.2
1055	Seedway LLC	1.0	13.3*	57.5	3780	63.1
1117R2X	Channel	1.1	**13.0**	58.2	3962	66.2
S12RY44	Dyna-Gro (CPS)	1.2	12.9*	58.3*	4124	68.9
1311	Seedway LLC	1.3	12.6*	58.4*	4143	69.2
1405R2	Channel	1.4	12.9*	57.1	5074*	84.7*
S14RY95	Dyna-Gro (CPS)	1.4	13.2*	57.2	3590	60.0
1517R2X	Channel	1.5	13.1*	56.7	4147	69.3
975	Seedway LLC	1.5	**13.0**	57.1	4315	72.1
Viking 1518N	Albert Lea Seed	1.5	13.1*	57.3	3469	57.9
S17RY06	Dyna-Gro (CPS)	1.7	**13.0**	57.0	3651	61.0

S17RY67	Dyan-Gro (CPS)	1.7	13.1*	58.1	3741	62.5
1776	Seedway LLC	1.7	12.7*	58.2*	**5541***	**92.5***
Viking 1722N	Albert Lea Seed	1.7	12.9*	57.6	2113	35.3
1808R2	Channel	1.8	13.6	57.6	4931*	82.4*
1816R2X	Channel	1.8	13.5*	56.7	4533	75.7
Viking 1922N	Albert Lea Seed	1.8	13.3*	58.3*	2534	42.3
2716R2X	Channel	2.7	14.7	56.8	4609*	77.0*
	LSD (0.10)		0.55	1.79	964	16.1
	Trial Mean		13.2	57.6	3850	64.3

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

*Varieties that did not perform significantly lower than the top performing variety are indicated with an asterisk.

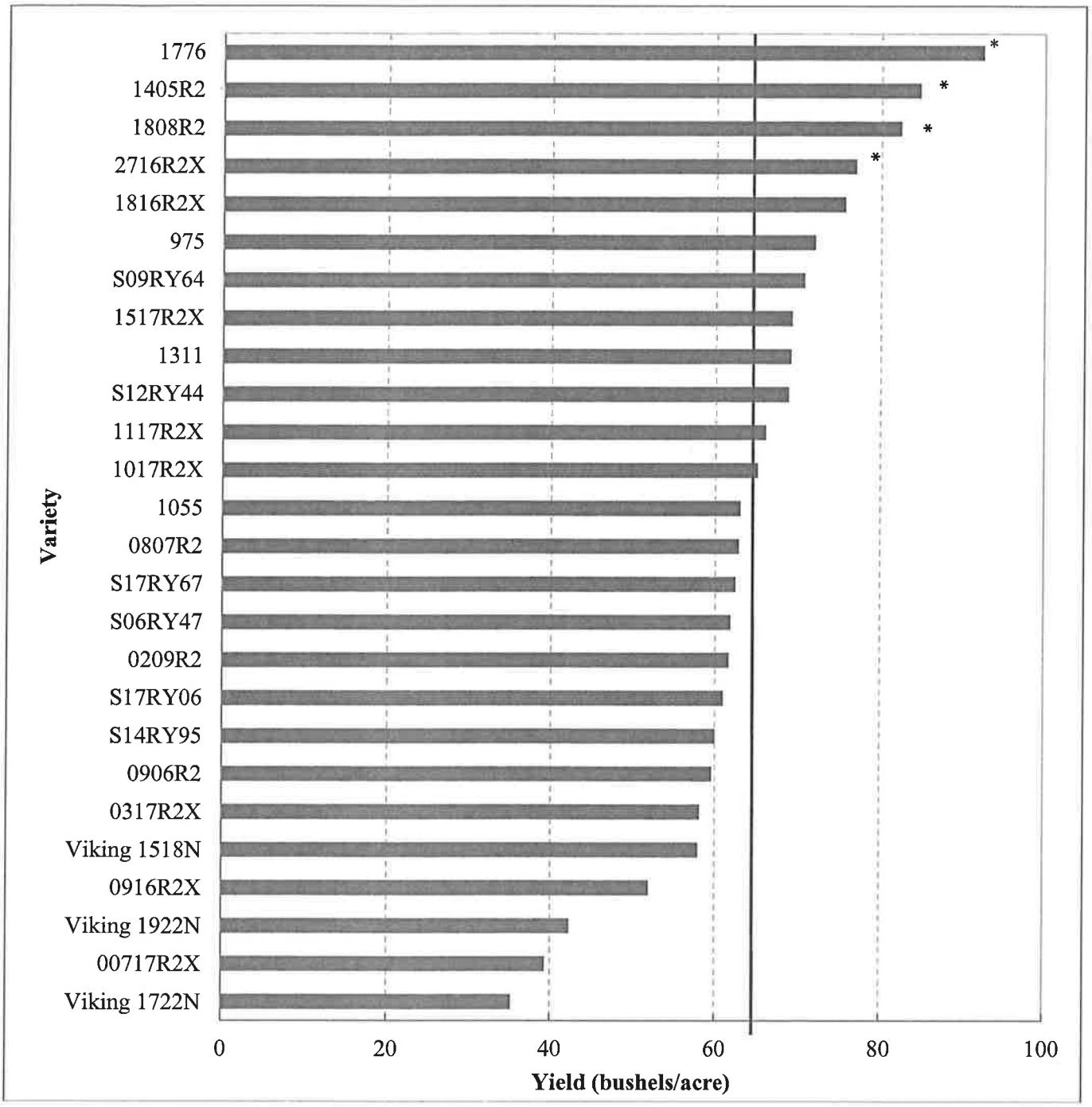

Figure 1. Yield at 13% moisture for 26 soybean varieties. The red line indicates the average yield. **Varieties that did not perform significantly lower than the top performing variety are indicated with an asterisk.*

DISCUSSION

It is important to remember that the results only represent one year of data. The lack of rain during the 2016 growing season was very challenging to the growth of field crops. These soybeans yielded very well, however test weight may have been impacted by dry conditions. Varieties differed significantly in yield and ranged from a low of 35.3 and a high of 92.5 bushel per acre, which indicates the importance of varietal selection to maximize yield for the growing region and seasonal conditions. Pest pressure was present in the trial but severity was observed to be low and likely had little influence on yields.

2016 Soybean Cover Cropping Trial

The goal of the second research project was to identify strategies for establishing cover crops in to soybeans. Due to the later harvest date of soybeans in Vermont, establishing cover crops after soybean harvest is likely not feasible. Cover crops, particularly legumes, have difficultly establishing after the late soybean harvest and are not able to develop enough biomass to protect the otherwise bare soil during the winter. This project evaluated performance of seeding 2 types of cover crops into soybeans at two different dates and with two seeding methods.

MATERIALS AND METHODS

The soil type at the Alburgh location was Benson rocky silt loam. The seedbed was prepared using a moldboard plow and then disked prior to seeding. The previous crop was corn. The soybean variety 1017R2X was planted on 27-May with a Monosem NG-Plus 2-row precision air planter (Edwardsville, KS). Starter fertilizer (10-20-20) was applied at a rate of 200 lbs ac^{-1}. Plots were 20' long and consisted of two rows spaced at 30 inches. The seeding rate was 150,000 seeds ac^{-1}.

The experimental design was a randomized complete block with split-split plots. The main plot was date of seeding (6-Sep and 22-Sep). The first split plot was cover crop type. The first type was winter rye seeded at 100 lbs ac^{-1}. The second cover crop treatment was a more complex mixture that included annual ryegrass, crimson clover, and tillage radish seeded at 20 lbs ac^{-1}. The second split was method of seeding including broadcast or seeding with the Penn State Interseeder ™.

On 12-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, tested for harvest moisture using a DICKEY-John M20P moisture meter, and evaluated for test weight using a Berckes Test Weight Scale.

One month following harvest the percentage of ground covered with cover crop biomass was determined using a web based IMAGING crop response analyzer. Digital images were taken with a compact digital camera, Canon PowerShot G12 (Melville, NY) (10.4 Megapixels). One picture covering approximately 1/2 m^2 was taken in each plot before weeding and one picture was taken after weeding. Digital images were analyzed with the automated imaging software, which was programmed in MATLAB (MathWorks, Inc., Natick, MA) and later converted into a free web-based software (www.imaging-crop.dk). The outcome of the analysis is a leaf cover index, which is the proportion of pixels in the images determined to be green. Total plant cover (1st picture) – cover crop only (second picture)/ total plant cover = cover crop (%).

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. Cover crop mean comparisons were made using the Least Significant Difference (LSD) procedure when the F-test was considered significant ($p<0.10$).

RESULTS

Yields of soybeans were compared between cover crop treatments (Table 7). Soybeans with cover crops yielded significantly higher than soybeans without cover crops. The trial average was 64.8 bu ac^{-1}. Visually the cover crop did not appear to interfere with soybean harvest however our combine does not have a flex head and may produce different results than the standard combine equipment.

Table 7. Yields of soybeans with and without cover crops, Alburgh, VT, 2016.

Cover crop presence	Soybean yield @ 13% moisture bu ac^{-1}
With cover crop	**65.1**
No cover crop	64.5
Trial mean	64.8
p-value	0.0003

Cover crop establishment was compared between the two planting dates (Table 8). The cover crop planted on 6-Sep was able to cover 43.3% of the soil with cover crop biomass. The cover crop seeded on the 22-Sep was only able to cover 18.6% of the soil with cover crop biomass. Earlier planting led to a cover crop that would likely prevent soil erosion and improve soil health.

Table 8. Cover crop establishment by planting date, Alburgh, VT, 2016.

Cover crop planting date	Ground cover %
6-Sep	43.4
22-Sep	18.6
Trial mean	33.5

p-value	0.098

Two cover crop treatments were assessed on their ability to provide ground cover. The more complex mix of cover crop species provided slightly more ground cover than the winter rye, however, these values were not statistically significant from each other (Table 9). The average ground cover was 33.2%.

Table 9. Cover crop establishment by type, Alburgh, VT, 2016.

Cover crop	Ground cover %
Winter rye	31.5
Cover crop mixture	34.8
Trial mean	33.2
p-value (0.10)	0.860

Two seeding methods were used to plant cover crops into the growing soybeans (Table 10). The cover crops planted using the Penn State Interseeder™ established more successfully compared to broadcast seeding. The interseeded cover crops provided 72.8% ground cover versus those broadcasted only providing 23.2% ground cover. Overall the lack of moisture likely reduced cover crop germination especially for broadcast applied treatments.

Unfortunately the use of the Penn State Interseeder™ in soybeans may not always be feasible for commercial production. In some cases the tall soybeans often became caught in the interseeder causing damage to the soybeans rendering them not harvestable at the end of the season. Additional research needs to be conducted to determine commercial applicability of the interseeder in soybeans. The impact of the cover crops on soil health will be determined in the spring of 2017.

Table 10. Cover crop establishment by seeding method, Alburgh, VT, 2016.

Seeding method	Ground cover %
Penm State Interseeder™	**72.8**
Broadcast seeding	23.2
Trial mean	41.8
p-value	0.042

Outreach

We delivered soybean production and research information to over 500 farmers and stakeholders through our extensive outreach program.

Variety trial information was presented to growers and other attendees at the UVM Extension Northwest Crops and Soils annual field day in July 2016. Varieties were labeled and attendees were encouraged to walk through the research plots and examine differences in varietal stature, maturity, and performance (Figure 6). In addition attendees were able to learn about the cover crop experiment (Figure 7). Growers expressed interest in learning more about this study and potential applications on their farms. Their main concerns regarded the effect of cover crops on soybean quality and how prevalent the risk of staining their crop was. There were over 250 attendees at the field day.

Reports detailing the results of these experiments were on display at the Vermont Farm Show, which was a trade show running from January 31 through February 2. The soybean variety trial and cover crop experiments were shared with 65 certified crop consultants (CCAs) at their annual conference held in Portsmouth, NH in early February. The information from the cover cropping trial was presented to 188 attendees at the UVM No-till and Cover Crop Symposium on February 16. These materials will be continually available to growers and other interested parties at field days and conferences throughout 2017. Reports are also available on the UVM Extension Northwest Crops and Soils website at http://www.uvm.edu/extension/cropsoil/research.

Figure 2. Field day attendees peruse variety trial plots, Alburgh, VT, 2016.

Figure 3. Field day attendees observe cover crops planted at the R1 soybean stage, Alburgh, VT, 2016.