Eastern Region Soybean Board - Midterm Report

Project Title: Developing Soybean Production Practices that Maximize Yield and Enhance Environmental Stewardship in Northern Climates.

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Due to extended periods of low milk prices and high input costs, farmers in the Northeast are looking for ways to increase on-farm feed production and diversity their operations to increase profitability. Soybeans could be grown for human consumption, animal feed, and biodiesel in Vermont. However, due to the relatively short growing season soybeans have not been a crop of major focus for yield or quality research. The purpose of our trials is to evaluate soybean yield and quality under conventional and organic growing conditions, when planting dates are varied, and under various tillage regimes following fall planted cover crops. Understanding how crops are impacted by varying planting dates can help producers make important management decisions. With a growing concern of agriculturally related water quality implications in Vermont waterways, farmers are now required in some instances to cover crop their annually cropped fields. However, with this increase in cover cropping there is a need to investigate potential impacts on following cash crops and best practices for establishing cover crops into and following soybeans. Similarly, with the concerted effort to reduce nutrient loading in waterways due to soil erosion, farmers are becoming more interested in adoption reduced and no-till practices. Understanding how to best combine these two practices into soybean cropping systems specifically for the Northeast is critical to the success of soybean crops in Vermont.

This year we initiated several soybean trials at Borderview Research Farm in Alburgh, VT. These trials include a conventional variety trial, a planting date trial, and a cover crop trial in which soybeans follow fall planted cover crops under varying tillage regimes. This report will summarize our research and outreach activities around these trials thus far this season.

Objective 1 is to identify soybean varieties that produce maximum yields in the far north.

The variety trial includes 25 varieties from four different seed companies spanning maturity groups 0.90 to 2.4. The trial was planted on 31-May 2018 into a Benson rocky silt loam at a rate of 185,000 seeds ac^{-1} treated with soybean inoculant and with 5 gal ac^{-1} 9-18-9 liquid starter fertilizer. Throughout the season the trial was inspected for insect and disease issues however due to extremely hot and dry conditions very little disease and insect pressure was seen until late August. Tissue samples were collected from potentially diseased plants and taken to the UVM Plant Diagnostic Clinic for identification. Two diseases were found in the trial, soybean downy mildew caused by *Peronospora manshurica* (Figure 1) and soybean bacterial blight caused by *Pseudomonas syringae* pv. *glycinea* (Figure 2). To capture varietal differences in infection, the trial was scouted on 8-23-19. Each plot was rated on a 0-5 scale where 0 indicated no visible infection and each subsequent rating corresponded to increments of 20% of leave surface infection (Figure 3). During this scouting we also noted leaf damage caused by Japanese beetles using the same scale. We will continue to monitor the trial and will conduct additional assessment if warranted. The trial will also be evaluated for populations, yield, and quality upon harvest.

Figure 1. Soybean leaf infected with downy mildew

Figure 2. Soybean leaf infected with bacterial blight

Figure 3. Soybean disease/insect damage rating scale (left to right 1, 2, 3, 4 ratings)

Objective 2 is to determine the impact of planting date on soybean yield and quality.

Optimal planting dates have yet to be determined for the far north region. The planting date trial includes two varieties, one early and one mid-group 1 maturity, planted approximately weekly from 17-May through 13-Jun. Plots were planted at a rate of 185,000 seeds ac^{-1} into a Benson rocky silt loam. Seeds were treated with soybean inoculant and planted with 5 gal ac^{-1} 9-18-9 liquid starter fertilizer. One of the goals of this planting date study is to determine how late soybeans can be planted in Vermont while still reaching maturity and producing adequate yields. In addition, we would like to determine how soybeans respond to shifting planting dates in terms of other characteristics such as pest and disease pressure. In a planting date study in sunflowers we have instituted, we have found that shifting planting dates can be a tool for farmers to avoid certain insect or bird pest pressures. This year there has been very little insect or disease pressure on the soybeans. Soybeans were also scouted for downy mildew presence as in the other variety trials, however, there was much less disease pressure in this trial. We will continue to monitor this trial for damage and will measure populations, yield, and quality at harvest. As more producers in the region look for additional crops to diversify their operations with, we hope to provide this type of additional management information to these producers in order to increase the number of soybean producers in the region.

Figure 4. Soybean planting dates increase from left to right.

Objective 3 is to develop cover cropping strategies for soybean production systems that maximize yield, protect soil health, and minimize pest and disease pressure.

In the fall of 2018, 10 cover crop treatments, summarized in table 1 below, were planted at Borderview Research Farm in Alburgh, VT on 24-Aug, 7-Sep, and 19-Sep. Four of the treatments included an overwintering species (red clover, winter rye, or hairy vetch) and were intended to provide both fall and spring living soil coverage. The other treatments included species that regularly winterkill in our region and were intended to provide living fall coverage and winterkilled spring coverage. We also included a control treatment in which no cover crop was planted.

Table 1. Fall cover crop mixtures planted in Alburgh, VT, 2018.

Mix	Species/variety	Rate (lbs/ac)
1	Centurion ryegrass	15
2	Dixie crimson clover	8
	Eco-till radish	2
	Shelby oats	70
3	Dixie crimson clover	15
	Eco-till radish	3
	VNS winter rye	50
4	Medium red clover	12
	Eco-till radish	3
	VNS winter rye	50
5	Hairy vetch	20
	VNS winter rye	75
6	Centurion ryegrass	25
7	Eco- till radish	6
8	Dixie crimson clover	15
9	Medium red clover	15
10	Control	

On 22-Oct, 2018, biomass was collected in all plots in all planting dates within a 0.25m^2 quadrat. The material was dried to determine dry matter content and yield. Ground cover provided by the cover crops was also measured at this time using the Canopeo phone application. In the spring on 1-May, 2019, biomass was collected in plots in which there was living material within a 0.25m^2 quadrat. Ground cover

was also measured at this time using the beaded string method to capture ground cover from both living and winterkilled cover crop residue. Cover crop height was also measured and the plots were assessed for survival by estimating the percentage of the area that had overwintered material. Table 2 below summarizes the biomass and ground cover data collected in this trial preceding the planting of soybeans.

Table 2. Dry matter yields and ground cover of 10 cover crop treatments, PD 1.

Cover Crop Treatment	Dry matter yield		Percent ground cover		Height	Survival
	Fall 2018	Spring 2019	Fall 2018	Spring 2019	Spring 2019	
	lbs ac^{-1}		%		cm	%
1	1318	N/A	88.2	43.8	2.56	1.25
2	2039	N/A	95.8	68.8	8.17	16.3
3	2430	918	96.5	69.4	20.4	30.0
4	1390	1314	96.4	89.4	22.7	70.8
5	1315	1352	96.0	93.8	22.6	73.3
6	626	N/A	73.3	51.3	7.54	28.8
7	2296	N/A	95.9	35.6	2.75	21.3
8	655	N/A	58.1	30.0	0.854	2.50
9	545	N/A	40.5	31.3	2.31	7.50
10	617	N/A	45.9	26.3	4.00	7.50

At this time these data have not been statistically analyzed nor have any quality analyses (nutrient content) performed.

Cover crop residue was incorporated into the soil in the first planting date with disc harrows and the soil finished for planting with a spike-tooth harrow and a field finisher. In the second planting date, cover crops were terminated using an application of Roundup® herbicide at a rate of 1 qt. ac^{-1}. In the third planting date, cover crops were terminated with a post-planting application of Roundup®. Soybeans were planted into the previously existing cover crop treatments into the three planting dates on 23-May at a rate of 185,000 seeds ac^{-1}, treated with soybean inoculant, and planted with 5 gal ac^{-1} 9-18-9 liquid starter fertilizer. To understand the nutrient release rates of the different cover crop treatments and how this is impacted by termination method, soil nitrate content was assessed in each plot approximately weekly for 2 samplings following planting, and then approximately biweekly for 2 samplings after that. At this time these analyses have not yet been completed. Soybeans will be evaluated for populations, yield, and quality at the time of harvest.

Outreach to Farmers has begun and over 300 attendees from all over Vermont and New England have attended our events. Attendees came from VT, NH, MA, RI, NY, CT, ME, and Quebec. In February we held our No-Till & Cover Crop Symposium which attracted 122 attendees. At this event, soybean cover cropping research results and experiences were shared with attendees and copies of outreach materials were made available. In July we hosted our 12th annual Field Day at Borderview Research Farm in which 237 farmers and technical service providers attended. During this event we presented our findings from last year's soybean trials and shared information about our current trials. Time was made available for growers to ask questions and to view the soybean trials in person (Figure 4). Copies of our soybean research reports from 2018 can be found at the links below.

https://www.uvm.edu/sites/default/files/media/2018_Soybean_PD_x_Var_Report.pdf

Figure 4. Visitors investigate the soybean trials during the field day.