2014 Summer Cover Crop Mix Trial

Dr. Heather Darby, UVM Extension Agronomist
Katie Blair, Erica Cummings, Susan Monahan, Julian Post and Sara Ziegler
UVM Extension Crop and Soil Technicians
(802) 524-6501

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Dr. Heather Darby, University of Vermont Extension
heather.darby[at]uvm.edu

Many farmers have realized the multitude of benefits cover crops provide in terms of soil health and fertility. Most farmers, however, plant cover crops in the fall to protect their soils from erosion through the winter into spring while they do not have a crop planted. Summer cover cropping may be another option for growers interested in building soil health. Summer cover crops could be planted throughout the season and offer a wide range of species to select from so benefits are maximized. Another benefit to growing cover crops during the summer is increased whole plant above and belowground biomass. Maximizing biomass can help improve soil quality far quicker than cover crops grown during fall months. Although some of the investigated crops are planted in the northeast as forage crops, little is known about the potential for combining multiple species with the goal of maximizing soil health benefits. In 2014, the University of Vermont Extension conducted a summer cover crop mix trial. This is the first trial evaluating summer cover crop species mixes in the northeast. The trial was established at the Borderview Research Farm in Alburgh, Vermont.

MATERIALS AND METHODS

The experimental plot design was a randomized complete block with three replications. There were ten different mixes created and two non-mixed treatments (Table 1). The number in the mix name refers to the number of plant varieties in that mix. The cover crop mixtures 6C and 4A are commercially available mixtures.

Table 1. 2014 summer cover crop mixes planted in Alburgh, VT.

8A		**8B**		**3A**		**3B**	
species	lbs/ac	species	lbs/ac	species	lbs/ac	species	lbs/ac
Soybean	10	Sudangrass	10	Millet	15	Millet	10
Sudangrass	10	Buckwheat	5	Vetch	10	Clover	6
Annual Ryegrass	5	Annual Ryegrass	5	Flax	5	Radish	4
Rahab Flax	5	Flax	5	**3C**		**3D**	
Sunflower	5	Millet	5	species	lbs/ac	Species	lbs/ac
Sunhemp	3	Vetch	5	Sudangrass	20	Sudangrass	20
Crimson Clover	2	Sunhemp	3	Clover	10	Sunflower	10
Tillage Radish	2	Chicory	2	Chicory	5	Sunhemp	5

6A		**6B**		**6C**	
species	lbs/ac	species	lbs/ac	species	lbs/ac
Sudangrass	10	Sudangrass	10	Dixie Crimson Clover	6
Millet	5	Clover	5	KB Royal Annual Ryegrass	4
Sunflower	5	Flax	5	MO1 Annual Ryegrass	4
Clover	3	Millet	5	VNS Medium Red Clover	3
Sunhemp	3	Vetch	5	Daikon Radish	2
Radish	2	Chicory	3	Yellow Blossom Sweet Clover	1

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4A		Sudangrass	
Species	lbs/ac	species	lbs/ac
Jerry Oats	12	Sudangrass	50
Dixie Crimson Clover	4	**Crimson Clover**	
Marshall Annual Ryegrass	2	species	lbs/ac
MO1 Annual Ryegrass	2	Crimson Clover	20

The seedbed was prepared by conventional tillage methods. All plots were managed with practices similar to those used by producers in the surrounding areas (Table 2). The previous crop planted at the Alburgh site was grass forage. The field was fall plowed, disked and spike tooth harrowed to prepare for planting. The plots were seeded with a Great Plains Cone Seeder on 11-Jun. Plots were hand harvested on 17-Sep to evaluate total aboveground biomass. Heights were measured at the tallest point of the sample. A subsample of the material was taken to determine dry matter.

Table 2. General plot management of the 2014 summer cover crop mix trial.

Trial information	Alburgh, VT Borderview Research Farm
Soil type	Benson rocky silt loam
Previous crop	Sod
Row spacing (in)	6
Replicates	3
Plot area (ft)	5 x 20
Planting date	11-Jun
Harvest date	17-Sep
Harvest area (m^2)	1
Tillage operations	Fall plow, spring disk & spike tooth harrow

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 varieties 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 (e.g. yield). Least Significant Differences at the 10% level of probability are shown. Where the difference between two varieties within a column is equal to or greater than the LSD value at the bottom of the column, you can be sure in 9 out of 10 chances that there is a real difference between the two varieties. Wheat varieties that were not significantly lower in performance than the highest variety in a particular column are indicated with an asterisk. In the following example, variety A is significantly different from variety C but not from variety B. The difference between A and B is equal to 725 which is less than the LSD value of 889. This means that these varieties did not differ in yield. The difference between A and C is equal to 1454 which is greater than the LSD value of 889. This means that the yields of these varieties were significantly different from one another. The asterisk indicates that variety B was not significantly lower than the top yielding variety.

Variety	Yield
A	3161
B	3886*
C	**4615***
LSD	**889**

RESULTS

Weather data was collected with an onsite Davis Instruments Vantage Pro2 weather station equipped with a WeatherLink data logger. Temperature, precipitation, and accumulation of Growing Degree Days (GDDs) are consolidated for the 2013-2014 growing season (Table 3). Historical weather data are from 1981-2010 at cooperative observation stations in Burlington, VT, approximately 45 miles from Alburgh, VT. The growing season this year was marked by lower than normal temperatures in July and August. There was higher than normal rainfall from June to August, and less than average rainfall in September. In Alburgh, there was an accumulation of 4180 GDDs, which is 29 degrees below the 30 year average.

Table 3. Temperature and precipitation summary for Alburgh, VT, 2014.

Alburgh, VT	Jun	Jul	Aug	Sep
Average temperature (°F)	66.9	69.7	67.6	60.6
Departure from normal	1.1	-0.9	-1.2	0
Precipitation (inches)	6.1	5.2	4.0	1.3
Departure from normal	2.4	1.0	0.1	-2.3
Growing Degree Days (base 32°F)	1041	1171	1108	860
Departure from normal	27	-27	-31	2

*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.

Harvest characteristics varied statistically across cover crop mix treatments (Table 4). Dry matter ranged from 26.4% to 33.9%. The highest dry matter was produced by the 3D mix, although this did not statistically differ from the other mixes. The 3A mix had the highest yield, 13,776 lbs ac^{-1}, but this was statistically similar to Sudangrass, 6B, 3B, 6A, and 3C. The lowest yielding treatment was the Crimson clover (not a mix) which only yielded 3985 lbs. ac^{-1} and was not statistically different than 4A, 6C, and 8A. The tallest treatment was Sudangrass (not a mix), which stood 109 inches tall. This was not significantly taller than eight of the other mixes. The only three treatments that were significantly shorter than the tallest treatment were the 6C mix, 4A mix, and crimson clover.

Table 4. Harvest results of cover crop treatments, Alburgh, VT, 2014.

Mix	Dry Matter %	DM Yield lbs. ac^{-1}	Height in
3A	31.2	**13776***	88.3*
Sudangrass	31.8	12312*	**109***
6B	31.5	11387*	95.0*
3B	31.8	10940*	89.7*
6A	30.8	10555*	102*
3C	29.7	9922*	95.7*
8B	32.2	8931	96.0*
3D	**33.9**	8926	90.0*
8A	32.3	8203	103*
6C	26.5	5199	54.7

4A	33.4	5137	58.0
Crimson Clover	26.4	3985	52.7
LSD (0.10)	NS	4676	23.2
Trial Mean	30.9	9106	86.1

Treatments indicated in **bold** had the top observed performance.
* Treatments that did not perform significantly lower than the top performer.
NS- no significant difference at the .10 level.

Summer cover crop mixtures yielded between 6.8 and 2.3 tons of dry matter per acre. It is interesting to note that the three shortest treatments (Crimson clover, 4A mix, and 6C mix) were about half the height of the other nine treatments (Figure 1). However, the yields for these shorter treatments did not statistically differ from three other, much taller mixes (8A, 3D, and 8B). Hence, cover crop height is not always a good indicator of biomass yield. As an example, the 3A mix yielded statistically similar to five other treatments (3C, 6A, 3B, 6B, and Sudangrass) but was 10-20 inches shorter than most of those other treatments. Although those height differences are not statistically different, 20 inches could be a significant height difference in terms of crop management and harvest.

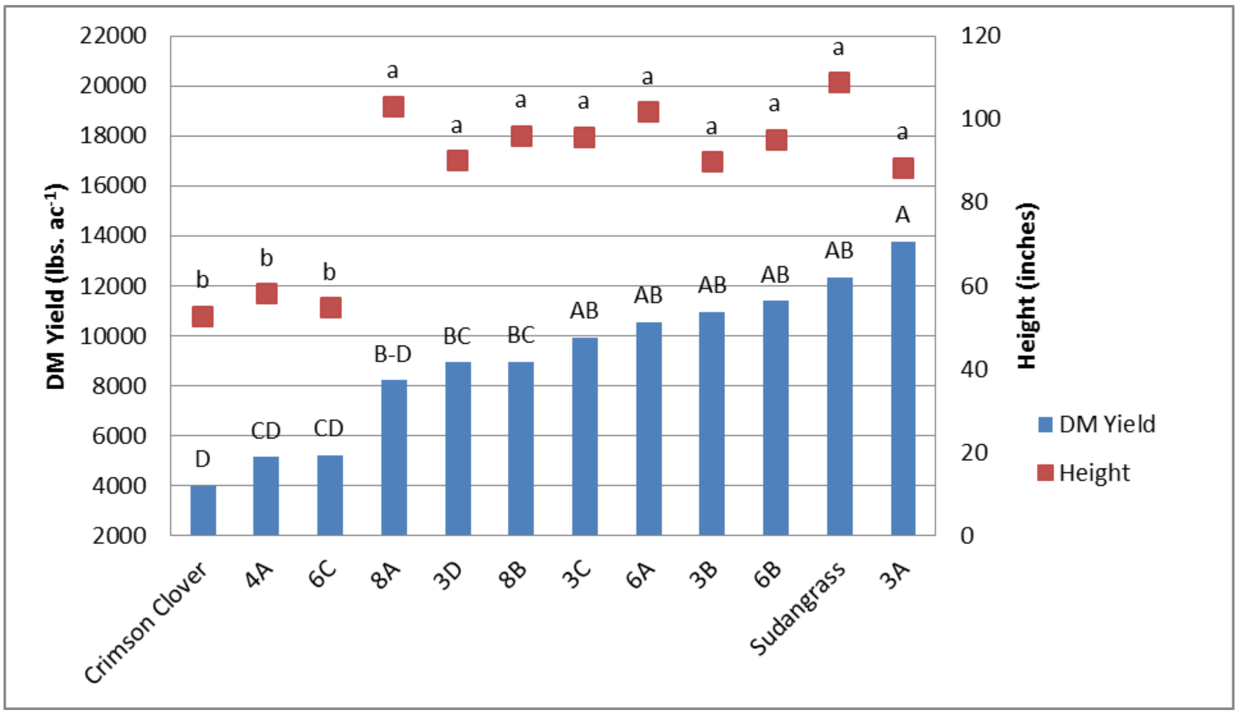

Figure 1. Yield and height of 12 summer cover crop treatments, Alburgh, VT.
Varieties with the same letter did not differ significantly height (lower case letter) or yield (capital letter).

DISCUSSION

It is important to remember that these results only represent one year of data. This trial was conducted to begin to evaluate the potential for utilizing summer cover crop mixtures to increase biomass production and soil health. When planting cover crops, it is important to take into consideration the height of the species and the method of harvest. Even though greater height usually means higher yield, harvesting something as tall as Sudangrass (108.7 in) is complicated. Sudangrass yielded statistically similar to the 3A mix, which was over 20 inches shorter. Evaluating such differences will allow for the selection of cover crop mixtures that not only produce desirable yields but are compatible with current farm management systems. At this point, it is unclear how the aboveground biomass relates to the belowground biomass produced by the cover crop. Further evaluation of summer cover crop mixtures on soil health will be important to fully understand the benefits of these cover crop systems. It is important, as you make variety choices on your farm, that you evaluate data from test sites that are as similar to your region as possible.

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