Late Summer Cover Crop Trial

NORTHWEST CROPS & SOILS PROGRAM

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UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

2014 LATE SUMMER COVER CROP TRIAL

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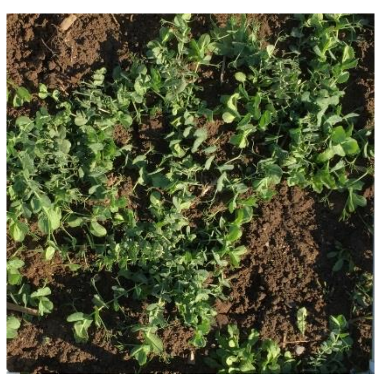
The Northwest Crops & Soils Program initiated a trial in Alburgh, VT to assess the potential for using annual ryegrass, oats, and winter peas as cover crops in Vermont. These species have not been commonly grown as cover crops in the region because they require an earlier establishment date compared to that of winter rye. Farmers are interested in finding alternative cover crops that may provide additional benefits over the standard practice. As an example, incorporating winter peas, a legume, would provide a nitrogen fixing cover crop to the system. Annual ryegrass may provide better soil cover and easier to manage levels of biomass in the spring compared to winter rye. Farmers are interested in oats as they would winter kill and hence, reduce the need for spring biomass management. In addition, these crops may provide a farm with an alternative feed source in the fall or early spring. To be successful with these alternative cover crops, it is important to know the proper planting date to provide the intended benefits. It is also essential to document if annual ryegrass and winter pea will survive the winter conditions of the region. Preliminary data collected in 2013 suggested that annual ryegrass must be planted earlier than winter grains to survive the winter. Only 8-11% of annual ryegrass planted in late September and/or mid-October survived the winter of 2013. Cover crop biomasses, percent soil cover, height, and forage quality of 2 varieties of winter peas, 3 varieties of annual ryegrass, and oats (Figure 1) were evaluated in 2014. Winter survival will be determined in the spring of 2015.


Green Farm ryegrass


Kospeed ryegrass


Tam 90 ryegrass


Austrian Winter pea


Lynx Pea

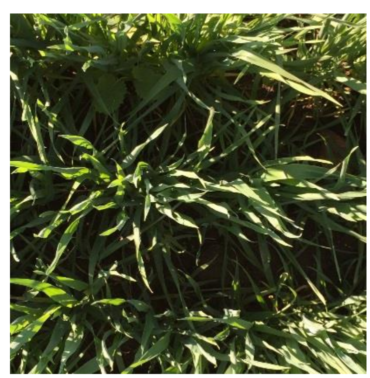

Oats

Figure 1. Cover crop establishment two months after planting (27-Oct), Alburgh, VT, 2014.

MATERIALS AND METHODS

The late summer cover cropping system was established at Borderview Research Farm in Alburgh, VT (Table 1). The experimental design was a randomized complete block with replicated treatments consisting of the following cover crops: Green Farm annual ryegrass, Kospeed annual ryegrass, TAM 90 annual ryegrass, Austrian winter pea, Lynx winter pea, and VNS oats. Annual ryegrass and winter pea varieties were supplied by Smith Seeds (Halsey, OR).

The soil type at the research site was a Benson rocky silt loam with 8-15% slopes (Table 1). Each cover cropping system was replicated three times in 5'x20' plots. All cover crops were planted with a Great Plains cone seeder on 27-Aug following recommended seeding rates (Table 2). Plots were previously planted with either barley or oats.

Table 1. Agronomic information for late summer cover crop trial, Alburgh, VT, 2014.

Location	Borderview Research Farm – Alburgh, VT
Soil type	Benson rocky silt loam, 8-15% slope
Previous crop	Barley/oats
Plot size (ft)	5 x 20
Replications	3
Planting equipment	Great Plains Cone Seeder
Planting date	27-Aug

Table 2. Seeding rate for late summer cover crop trial, Alburgh, VT, 2014.

Cover Crop	Seeding rate (lbs $acre^{-1}$)
Green Farm ryegrass	20
Kospeed ryegrass	20
Tam 90 ryegrass	20
Austrian winter peas	65
Lynx peas	65
VNS oats	75

Pictures for percent cover analysis were taken on 27-Oct following standard procedures for imaging analysis with Rasmussen and Nørremark's IMAGING Crop Response Analyser (Figure 1). Height measurements were measured on 27-Oct. Biomass samples of all cover crops were harvested with hand clippers in a $1m^2$ area on 27-Oct and dry matter yields were calculated based on biomass sample.

Forage quality was analyzed using the FOSS NIRS (near infrared reflectance spectroscopy) DS2500 Feed and Forage analyzer. Dried and coarsely-ground plot samples were brought to the UVM's Cereal Grain Testing Laboratory where they were reground using a cyclone sample mill (1mm screen) from the UDY Corporation. The samples were then analyzed using the FOSS NIRS DS2500 for crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), and 30-hour digestible NDF (NDFD).

Mixtures of true proteins, composed of amino acids, and non-protein nitrogen make up the CP content of forages. The CP content of forages is determined by measuring the amount of nitrogen and multiplying by 6.25. The bulky characteristics of forage come from fiber. Forage feeding values are negatively associated with fiber since the less digestible portions of plants are contained in the fiber fraction. The detergent fiber analysis system separates forages into two parts: cell contents, which include sugars, starches, proteins, non-protein nitrogen, fats and other highly digestible compounds; and the less digestible components found in the fiber fraction. The total fiber content of forage is contained in the neutral detergent fiber (NDF). Chemically, this fraction includes cellulose, hemicellulose, and lignin. Because of these chemical components and their association with the bulkiness of feeds, NDF is closely related to feed intake and rumen fill in cows. In recent years, the need to determine rates of digestion in the rumen of the cow has led to the development of NDFD. This in vitro digestibility calculation is very important when looking at how fast feed is being digested and passed through the cow's rumen. Higher rates of digestion lead to higher dry matter intakes and higher milk production levels. Similar types of feeds can have varying NDFD values based on growing conditions and a variety of other factors. In this research, the NDFD calculations are based on 30-hour in vitro testing.

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

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 cover crops 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 cover crops 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 cover crops. Cover crops that were not significantly lower in performance than the highest cover crop in a particular column are indicated with an asterisk. In the example to the right, cover crop C is significantly different from cover crop A but not from cover crop B. The difference between C and B is equal to 1.5, which is less than the LSD value of 2.0. This means that these cover crops 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 cover crops were significantly different from one another. The asterisk indicates that cover crop B was not significantly lower than the top yielding cover crop C, indicated in bold.

Treatment	**Yield**
A	6.0
B	7.5*
C	**9.0***
LSD	**2.0**

RESULTS

Weather Data

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 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 late summer of 2014 was warmer by 1.3°F and dryer with 1.57 inches less rain than the average year. The dry conditions following planting likely slowed the overall growth of the cover crops in September. However, a warmer than normal October helped the cover crops gain biomass prior to winter. Overall there were 90 more GDDs for wheat/grains than the 30-year average (Table 3).

Table 3. Consolidated weather data and GDDs for wheat/grains, Alburgh, VT, 2014.

Alburgh, VT	August	September	October
Average temperature (°F)	67.6	60.6	51.9
Departure from normal	-1.2	0.0	3.7
Precipitation (inches)	3.98	1.33	4.27
Departure from normal	0.07	-2.31	0.67
Wheat/grains GDDs (base 32°F)	1108	860	622
Departure from normal	-31	2	119

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.

Cover Crop Characteristics

Pictures for percent cover analysis were taken two months after planting, on 27-Oct. At the same time height measurements and a 1m^2 subsample was collected from each plot to determine biomass yields (Table 4, Figure 2).

Kospeed ryegrass had the highest percent cover (71.5%), but did not significantly outperform Green Farm ryegrass, Tam 90 ryegrass, and Austrian winter peas. Lynx peas had the lowest percent cover at 34.7%.

Oats produced more biomass as seen in height (49.0 inches) and yield (730 lbs $acre^{-1}$). Oats were over 17 inches taller than the second highest cover crop, Green Farm ryegrass (31.3 inches). The winter peas had a prostrate growth habit and hence were much shorter in height when compared to the grasses. This trend was mirrored in yield as well. Oats produced 251 lbs $acre^{-1}$ more dry matter than the second highest yielding cover crop, Green Farm ryegrass (478 lbs $acre^{-1}$).

Table 4. Percent cover, height, and yield of cover crop treatments, Alburgh, VT, 2014.

Cover cropping system	Percent cover (%)	Height (inches)	Yield (lbs ac^{-1})
Green Farm ryegrass	63.6*	31.3	478
Kospeed ryegrass	**71.5***	27.9	451
Tam 90 ryegrass	68.5*	27.3	348
Austrian winter peas	66.1*	26.1	248
Lynx winter peas	34.7	15.9	176
VNS Oats	54.8	**49.0***	**730***
LSD (0.10)	0.16	3.7	215
Trial mean	59.9	29.6	405

Treatments shown in **bold** are top-performing in a particular column.
* Treatments with an asterisk did not perform significantly lower than the top-performing treatment in a particular column.

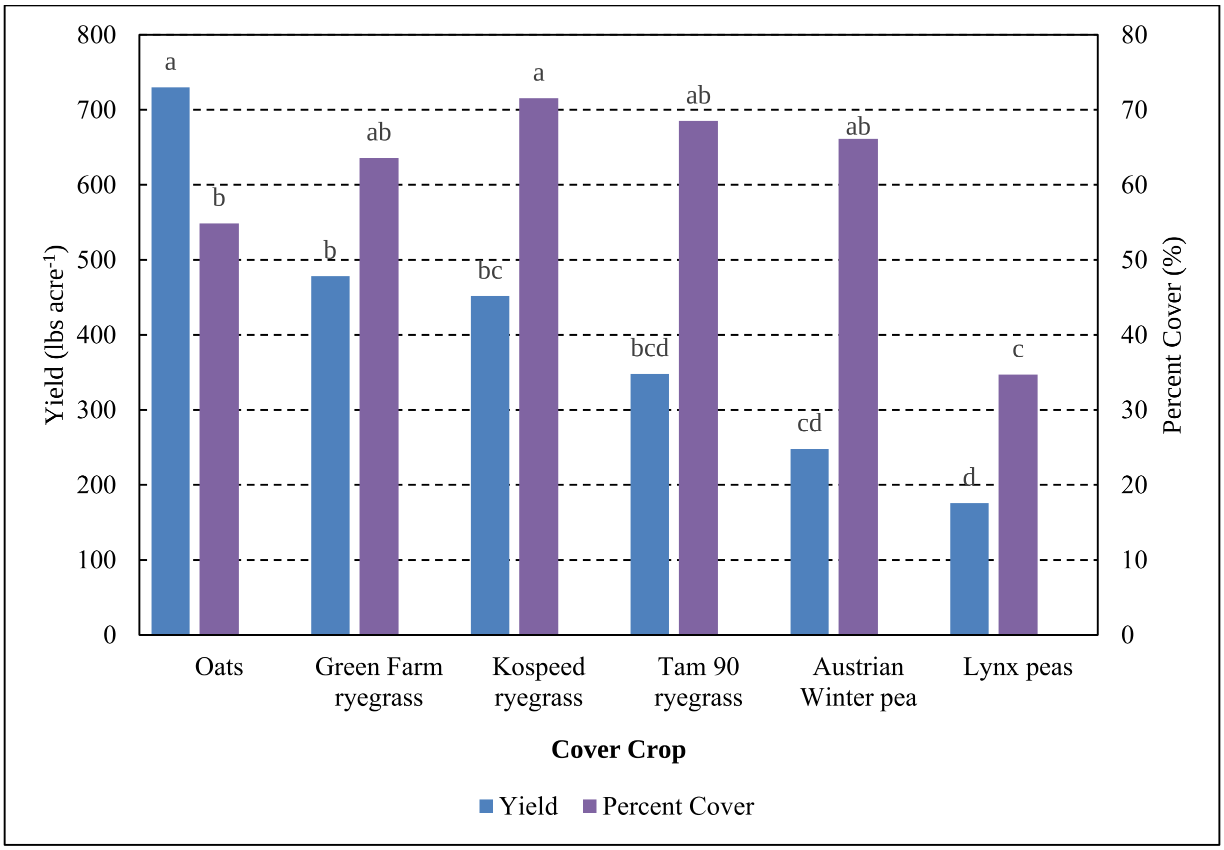


Figure 2. Yield and percent soil cover of cover crops, Alburgh, VT, 2014. Treatments, by variable (yield or percent cover) that share a letter were not significantly different from one another (p=0.10).

Forage Quality of Cover Crops

Biomass samples collected on 27-Oct was analyzed for forage quality using NIR (Table 5). Annual ryegrass by far outperformed winter pea and oats in terms of overall forage quality. As we might expect crude protein was highest in the winter peas but not statistically different than the annual ryegrass varieties. The fiber digestibility of peas was significantly lower than all annual ryegrass and oat varieties. Oats had the highest fiber concentrations and the lowest protein compared to the other cover crops.

Table 5. Forage quality of late summer cover crops, Alburgh, VT, 2014.

Cover crop	CP % of DM	ADF % of DM	NDF % of DM	NDFD % of NDF
Green Farm ryegrass	24.6*	18.9	36.8	61.3*
Kospeed ryegrass	22.8*	17.5	35.3	63.2*
Tam 90 ryegrass	24.4*	19.2	38.7	**64.0***
Austrian Winter peas	28.2*	17.3	29.4	49.0
Lynx peas	**30.6***	17.1	27.5	48.6
VNS Oats	21.0	**25.5***	**44.4***	62.7*
LSD (0.10)	2.7	2.4	3.7	3.5
Trial Mean	25.3	19.3	35.4	58.1

Treatments shown in **bold** are top-performing in a particular column.
* Treatments with an asterisk did not perform significantly lower than the top-performing treatments.

DISCUSSION

It is important to note that the results of this trial represent only one year of data and only in one location. The goal of this project was to assess biomass, soil cover, and forage quality of alternative cover crops including annual ryegrass, winter pea, and oats. With the exception of Lynx winter peas, all cover crops established adequately and produced over 50% soil coverage. This indicates that a late August or early September planting date for these crops produces acceptable growth. Variety did have an impact on overall performance supporting the need for cover crop variety trials. As seen in 2013, regardless of variety, annual ryegrass did not survive the winter when planted in late September to mid-October (Table 6). A complimentary study evaluating early fall cover crop mixtures indicated that planting annual ryegrass and/or winter pea resulted in soil cover below 25% (Table 7). Hence a mid-August to early September planting date appears to be ideal for establishment and crop productivity of annual ryegrass, winter pea, and oats. Early planting of these crops could be accomplished through interseeding the cover crop into a standing crop of corn. It should be noted that oats can produce adequate soil coverage when planted in mid-September. However, it is unclear if the soil cover will remain in place once the crop has been terminated by winter temperatures.

Table 6. Winter survival of 8 annual ryegrass varieties planted on 17-Sep or 10-Oct, Alburgh, VT, 2013.

Annual ryegrass variety	Planting date 17-Sep	Planting date 10-Oct
	winter survival	winter survival
	%	%
B41-13-KOWINNER	12.5	8.75
FLMAR EARLY 12	11.3	8.75
SARG-GRF-LA20-12-10736	5.00	9.00
SARG-GRFLA20-12-10736	5.00	0.00
SARG-KOSP-LA20-12-10753	11.3	6.67
SARG-KOWE-B41-12-K6	10.0	5.00
SARG-RGED-L165-12-232	12.5	10.0
SARG-RGT90-B41-12TM3	7.50	8.75
LSD (0.10)	NS	NS
Trial mean	10.0	8.21

Oats produced the tallest plants and greatest biomass but had lower soil coverage when compared to annual ryegrass. Overall, the annual ryegrass had the highest forage quality and would make exceptional late season pasture. Peas also had high forage quality but the prostrate growth and low yield would make them difficult to graze. They obviously would perform better if mixed with one of the grasses.

Table 7. Percent cover and yield of cover cropping treatments planted on 15-Sep, Alburgh, VT, 2014.

Cover cropping system	Percent cover (%)	Yield lbs ac^{-1}
VNS Oats	**51.9***	**382***
Lynx Peas	6.40	265
Kospeed ryegrass	8.10	262
WinEarly ryegrass	24.9	142
LSD (0.10)	14.7	272
Trial mean	34.3	300

Treatments shown in **bold** are top-performing in a particular column.
* Treatments with an asterisk did not perform significantly lower than the top-performing treatment in a particular column.

ACKNOWLEDGEMENTS

UVM Extension would like to thank Smith Seeds (Halsey, OR) for supporting this cover crop research. We would also like to thank Roger Rainville and the staff at Borderview Research Farm for their generous help with this research trial, as well as the UVM Food Systems Initiative (Vermont Agricultural Resilience in a Changing Climate Initiative) and Friends of Northern Lake Champlain for funding. We would like to acknowledge Conner Burke, Lily Calderwood, Julija Cubins, Hannah Harwood, Ben Leduc, Laura Madden and Dana Vesty for their assistance with data collection and entry. Any reference to commercial products, trade names, or brand names is for information only, and no endorsement or approval is intended.

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