NORTHWEST CROPS & SOILS PROGRAM

2015 Cool Season Annual Forage Mixtures Trial

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UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

2015 COOL SEASON ANNUAL FORAGE MIXTURES TRIAL

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In 2015, the University of Vermont Extension Northwest Crops and Soils Program evaluated yield and quality of five cool season annual forage species and five mixtures at Borderview Research Farm in Alburgh, VT. In the Northeast, cool season perennial grasses dominate the pastures and hay meadows farmers rely on throughout the season. In the fall, perennial pasture declines in yield and quality. The addition of cool season annual forages into the grazing system during this time, can help improve the quality and quantity of forage and potentially extend the grazing season. Recently, there has been a growing interest in utilizing multiple cool season forage species to maximize forage yield and quality. We compared five annual species alone and in three-and four-species mixtures to evaluate potential differences in forage production and quality. While the information presented can begin to describe the yield and quality performance of these forage mixtures in this region, it is important to note that the data represent results from only one season and one location.

MATERIALS AND METHODS

In 2015, 10 cool season annual forages alone and in mixtures were evaluated at Borderview Research Farm in Alburgh, VT. The plot design was a randomized complete block with four replications. Forage species and mixture information as well as seeding rates are summarized in Table 1.

Table 1. Cool season annual forage species and mixtures evaluated in Alburgh, VT, 2015.

Abbreviation	Species	Seeding rate	
		Alone	In mixture
O/P/T	Everleaf Oats	125	75
	Maxum Peas	60	60
	Appin Turnip	6	5
Tr/P/T	336 Triticale	125	75
	Maxum Peas	60	60
	Appin Turnip	6	5
Rye/P/T	Fria Ryegrass	30	30
	Maxum Peas	60	30
	Appin Turnip	6	5
Tr/O/P/T	336 Triticale	125	50
	Everleaf Oats	125	50
	Maxum Peas	60	50
	Appin Turnip	6	5
Tr/Rye/P/T	336 Triticale	125	60
	Fria Ryegrass	30	20
	Maxum Peas	60	30
	Appin Turnip	6	5

The soil type at the Alburgh location was a Benson rocky silt loam (Table 2). The seedbed was chisel plowed, disked, and finished with a spike tooth harrow. The previous crop was spring barley. Plots were 5' x 20' and replicated 4 times. The trial was planted with a cone seeder on 18-Aug. Plots were hand harvested on 8-Oct.

Table 2. Annual forage trial management, Alburgh, VT, 2015.

Location	Borderview Research Farm – Alburgh, VT
Soil type	Benson rocky silt loam
Previous crop	Spring barley
Tillage operations	Chisel plow, disk and spike tooth harrow
Planting equipment	Cone Seeder
Treatments (species/mixtures)	10
Replications	4
Plot size (ft)	5 x 20
Planting date	18-Aug
Harvest date	8-Oct

An approximate 1 lb subsample of the harvested material was collected, dried, ground, and then analyzed at the University of Vermont's Testing Laboratory, Burlington, VT, for forage quality. Dry matter yields were calculated.

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 lab 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), 30-hour digestible NDF (NDFD), and total digestible nutrients (TDN).

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.

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 mixtures were treated as fixed. Treatment 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, and other growing conditions. Statistical analysis makes it possible to determine whether a difference among hybrids 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 two hybrids 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 two hybrids. Hybrids that were not significantly lower in performance than the highest hybrid in a particular column are indicated with an asterisk. In this example, hybrid C is significantly different from hybrid A but not from hybrid 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 hybrids 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 hybrids were significantly different from one another. The asterisk indicates that hybrid B was not significantly lower than the top yielding hybrid C, indicated in bold.

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

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 (Table 3). From August through September, there were an accumulated 2194 GDDs, at a base temperature of 32° F. This is 194 more GDDs than the long term average.

Table 3. 2015 weather data for Alburgh, VT.

	August	September
Average temperature (°F)	69.7	65.2
Departure from normal	0.9	4.6
Precipitation (inches)	0.00	0.34
Departure from normal	-3.91	-3.30
Growing Degree Days (base 32°F)	1184	1010
Departure from normal	45	152

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.

Temperatures were approximately average and slightly above average in August and September, respectively. Rainfall was significantly below average for both months as less than half an inch of rain was observed in both months combined. Despite this dry weather, the forages did not experience any difficulty germinating as exceptionally full stands were established.

Almost all forage treatments produced over 1000 pounds of dry matter per acre with the exception of the triticale and annual ryegrass treatments (Table 4). The highest yielding treatment was the triticale/ryegrass/pea/turnip mixture which produced 1973 lbs of dry matter per acre. Six other treatments performed statistically similar to this top performing mixture including oat/pea/turnip, ryegrass/pea/turnip, triticale/oat/pea/turnip, oats alone, peas alone, and turnips alone. Despite these high yields, the costs of these species and seeding rates in these mixtures varies quite a bit, making the costs per acre quite different. Based on the seeding rates, the lowest cost treatment was the annual ryegrass planted alone which cost $20.40 per acre. The most expensive was the triticale/oat/pea/turnip mixture. However, to truly capture the costs of these mixtures we should consider the dry matter yields they produced. When the cost is based on yield, the triticale alone has the highest cost per ton of dry matter at $173.32. The least expensive was the turnip alone treatment at only $25.69 per ton of dry matter. Six of the treatments cost under $100.00 per ton of dry matter and three are under $50.00 per ton of dry matter.

Table 4. Yield and cost of ten forage species/mixtures, 2015.

Abbreviation	DM yield	Cost	
	lbs ac^{-1}	dollars ac^{-1}	dollars DM ton^{-1}
O/P/T	1545*	100.75	130.39
Tr/P/T	1436	94.00	130.91
Rye/P/T	1720*	55.90	64.99
Tr/O/P/T	1851*	106.00	114.52
Tr/Rye/P/T	**1973**	81.50	82.59
Oats	1680*	78.75	93.77
Triticale	779	67.50	173.32
Ryegrass	882	**20.40**	46.24
Peas	1677*	36.00	42.94
Turnip	1635*	21.00	**25.69**
LSD (p = .10)	494	N/A	N/A
Trial Mean	1518	66.18	90.54

Treatments in **bold** are top performers for that parameter.
Treatments with asterisks* performed statistically similarly to the top performer.
Costs were not statistically analyzed.

These annual forages also differed in growth characteristics and forage quality (Table 5). The peas grew the tallest reaching 20.4 cm while the shortest treatments were the triticale and ryegrass around 10 cm. It is important to consider the height of the forage as this may influence management decisions.

Table 5. Height and quality of ten forage species/mixtures, 2015.

Abbreviation	Height	Crude protein	ADF	NDF
	Cm	% of DM	% of DM	% of DM
O/P/T	17.0	18.7	22.8	33.1
Tr/P/T	17.1	19.8	21.2	30.0
Rye/P/T	16.4	17.1	22.8	28.5
Tr/O/P/T	17.3	18.4	23.2	34.9
Tr/Rye/P/T	14.8	17.5	21.0	28.6
Oats	18.0	16.9	26.2	44.7
Triticale	10.1	21.8	20.1	39.4
Ryegrass	10.2	20.6	20.6	35.5
Peas	**20.4***	**34.6***	20.8	28.3
Turnip	13.1	12.4	**11.4***	**15.5***
LSD (p = .10)	2.4	2.2	1.8	2.9
Trial Mean	15.4	19.8	21.0	31.9

Treatments in **bold** are top performers for that parameter.
Treatments with asterisks* performed statistically similarly to the top performer.

The treatments also statistically differed in quality parameters including crude protein, ADF, and NDF. The peas had the highest protein at 34.6%, over 10% higher than the next highest treatments and 14.8% higher than the trial average. The lowest protein was found in the turnips with 12.4% (Figure 1). The lowest ADF was 11.4% in the turnip treatment. ADF ranged from 11.4 to 26.2% with an average for the trial of 21.0%. NDF also varied widely across treatments. The lowest NDF of 15.5% was found in the turnip treatment while the highest NDF of 44.7% was in the oat treatment.

DISCUSSION

These annual forage mixtures vary considerably in their cost, yield, and quality. Two important aspects that were not explored in this trial are regrowth potential (and perhaps the potential for multiple grazes/harvests) and overwintering of the triticale in some of the mixtures allowing for spring harvests as well potentially. The cost per ton of dry matter for the triticale alone treatment and mixtures that include triticale are high due to the relatively high cost of triticale seed and the low yield we observed. However, if the triticale alone treatment produced at least the same yield as in the fall, the total cost per ton of dry matter would then decrease to about $87.00. If yields in the spring are even higher, the cost continues to decrease. These additional harvests could affect the cost effectiveness of some of these treatments.

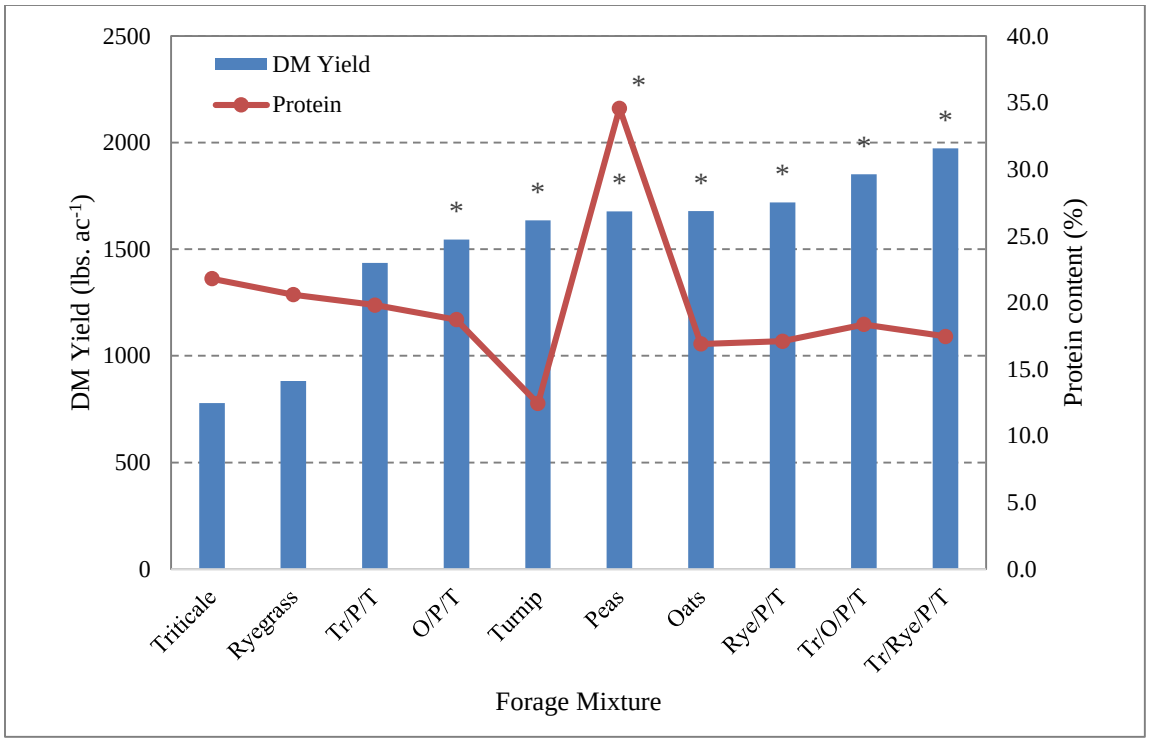

Figure 1. DM yield and protein content of 10 forage treatments, 2015.
Treatments with an asterisk* above the yield bar performed statistically similar to the top performer.

Overall, it is important to consider how these annual forages fit into your operation and the goals of growing them as they each offer slightly different benefits. For example, if high protein is very important, including peas in a mixture or planting peas alone may be a better fit compared to some of the other mixtures or species. Likewise, if having early spring forage is important, a mixture with triticale may be beneficial. In addition, it is always important to remember that these data only represent one year and other information should be considered before making a decision.

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