2017

Forage Brassica Variety Trial

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University of Vermont Extension
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Forage brassicas are very cold hardy and can extend the grazing season late into the fall. They grow extremely fast and provide very nutrient dense feed at times when growth is limited for many other species. Brassicas fit well into some annual crop rotations such as small grains or summer annual forages. Adding brassicas to a grazing plan can not only extend the grazing season but can also reduce the reliance on expensive feed inputs. There are many different species of forage type brassicas on the market today including mustards, turnips, radishes, and kales. In 2017, the University of Vermont's Northwest Crops & Soils Program conducted a forage brassica variety trial to evaluate yield and quality of commercially available forage brassica varieties.

MATERIALS AND METHODS

In 2017, a variety trial was conducted at Borderview Research Farm in Alburgh, VT, to evaluate eight forage brassica varieties (Table 1, Image 1).

Table 1. Eight forage brassica varieties, 2017.

Variety	Species
Appin	Turnip
Barkant	Turnip
Barsica	Rape
Dwarf Essex	Rape
Eco-Till	Radish
Groundhog	Radish
Purple Top	Turnip
T-Raptor	Brassica hybrid

Image 1. Two brassica varieties, 2017.

The seedbed was prepared using standard local practices, including incorporating previous crop residue with a moldboard plow and finishing with disk and spike tooth harrows (Table 2). The soil was a Benson silt loam. The experimental design was a randomized complete block with four replications. Plots were 5' x 20' and were planted with a Great Plains grain drill at a rate of 6 lbs ac^{-1} on 27-Aug.

Table 2. Agronomic and trial information, 2017.

Location	Borderview Research Farm-Alburgh, VT
Soil type	Benson silt loam
Previous crop	Spring barley
Tillage operations	Moldboard plow, disking, spike tooth harrow
Plot size (ft.)	5 x 20
Planting date	27-Aug
Seeding rate	6 lbs ac^{-1}
Harvest date	20-Oct

All plots were hand harvested in a 0.25m^2 area on 20-Oct to determine dry matter yields. At the time of harvest, heights were measured at three random locations in each plot. Dried vegetation was ground to 1mm using a UDY Corporation cyclone mill. Forage quality was analyzed by Dairy One Forage Laboratory (Ithaca, NY) for crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF) and 30-hour digestible NDF (NDFD) via wet chemistry procedures.

The bulky characteristics of forage come from fiber. High fiber is negatively associated with forage feeding values 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. Recently, forage testing laboratories have begun to evaluate forages for NDF digestibility (NDFD). Evaluation of forages and other feedstuffs for NDFD is being conducted to aid prediction of feed energy content and animal performance. Research has demonstrated that lactating dairy cows will eat more dry matter and produce more milk when fed forages with optimum NDFD. Forages with increased NDFD will result in higher energy values and, perhaps more importantly, increased forage intakes. Forage NDFD can range from 20-80% NDF.

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 treatments is real or whether it might have occurred due to other variations in the field. All data was analyzed using a mixed model analysis where replicates were considered random effects. At the bottom of each table, a LSD value is presented for each variable (e.g. yield). Least Significant Differences (LSDs) at the 10% level (0.10) of probability are shown. Where the difference between two treatments 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 values. Treatments listed in bold had the top performance in a particular column; treatments that did not perform significantly worse than the top-performer in a particular column are indicated with an asterisk. In the example, treatment A is significantly different from treatment C, but not from treatment B. The difference between A and B is equal to 400, which is less than the LSD value of 500. This means that these treatments did not differ in yield. The difference between A and C is equal to 650, which is greater than the LSD value of 500. This means that the yields of these treatments were significantly different from one another.

Variety	**Yield**
A	**1600***
B	1200*
C	950
LSD (0.10)	500

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 October, there were an accumulated 2044 growing degree days (GDDs), at a base temperature of 41° F. This is 340 more than the long term average and 101 more than 2016.

Table 3. 2017 weather data for Alburgh, VT.

	August	September	October
Average temperature (°F)	67.7	64.4	57.4
Departure from normal	-1.07	3.76	9.20
Precipitation (inches)	5.5	1.8	3.30
Departure from normal	1.63	-1.80	-0.31
Growing Degree Days (base 41°F)	829	699	516
Departure from normal	-33	111	257

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.

At the time of planting, temperatures were slightly below normal and 3.6 inches of rain had already been accumulated for August, much of this precipitation coming in a 1.69-inch rain event just prior to planting. Temperatures increased after August with September and October seeing average temperatures that were 3.76 and 9.20 degrees above normal respectively. Rainfall also tapered off during this time. September was particularly dry seeing only 1.8 inches of precipitation, half the normal amount for that month. Furthermore, about 90% of the total accumulated for the month of September fell during the first week of this month. October was much warmer than normal with slightly below average precipitation. The excessively warm temperatures and moderate rainfall allowed the brassicas to greatly proliferate before harvest.

Forage brassica heights at harvest and dry matter yields did not statistically vary (Table 4). Brassicas averaged 47.8 cm at harvest with the tallest variety, Barsica, reaching 52.6 cm. Dry matter yields ranged from 1.20 to 2.05 tons of dry matter ac^{-1}. The highest yielding variety was Groundhog, a tillage radish variety, which produced 2.05 tons ac^{-1}. The lowest yielding variety was Eco-Till, another tillage radish variety, which produced only 1.20 tons ac^{-1}.

Table 4. Yield and height of eight forage brassica varieties, 2017.

Variety	Type	Height cm	Dry matter (DM) yield tons ac^{-1}
Appin	Turnip	48.2	1.38
Barkant	Turnip	48.2	1.51
Barsica	Rape	**52.6**	1.40
Dwarf Essex	Rape	48.1	1.42
Eco-Till	Radish	45.3	1.20
Groundhog	Radish	46.1	**2.05**
Purple Top	Turnip	45.3	1.35
T-Raptor	Hybrid	48.8	1.86
LSD (p = 0.10)		NS	NS
Trial mean		47.8	1.52

Treatments indicated with an asterisk* performed similarly to the top performer in **bold.**
NS- No significant difference.

Although these differences appear drastic, due to variation within each treatment, these yields are not statistically different from one another. Brassicas did differ statistically in some quality parameters (Table 5). Dry matters ranged from 7.19 to 9.88% with the highest dry matter produced by Dwarf Essex rape. Rapes are typically less leafy than the other brassica types producing tougher stems higher in fiber and thus higher dry matter content. Similarly, ADF and NDF levels increase with increasing fiber content. The lowest fiber concentrations were observed in the Purple Top turnip treatment with 14.4 and 20.7% ADF and NDF respectively. This ADF content was statistically similar to all other varieties except for Barsica and T-Raptor, while NDF content did not differ statistically from any of the varieties. Protein varied greatly across varieties. The highest protein level was 34.1% produced by the Eco-Till variety tillage radish. This was statistically similar to all other varieties except for Appin and Barkant turnips. Treatments averaged 69.6% TDN and .0770 Mcal of energy but did not differ significantly.

Table 5. Quality of eight forage brassica varieties, 2017.

Variety	Type	Dry matter	Crude protein	ADF	NDF	TDN	NE_L
		%	-------------------	---% of DM---	-------------------		Mcal lb^{-1}
Appin	Turnip	7.67	27.4	15.5*	22.5	69.3	0.765
Barkant	Turnip	8.48*	25.9	15.6*	21.7	69.3	0.768
Barsica	Rape	8.83*	29.6*	16.7	22.5	69.3	0.763
Dwarf Essex	Rape	**9.88**	32.6*	15.3*	21.2	70.0	0.778
Eco-Till	Radish	7.19	**34.1**	15.9*	21.5	**70.3**	0.775
Groundhog	Radish	8.77*	32.8*	16.0*	21.3	70.0	**0.778**
Purple Top	Turnip	9.13*	29.3*	**14.4**	**20.7**	70.0	0.778
T-Raptor	Hybrid	8.77*	32.0*	17.5	24.2	68.8	0.758
LSD (p = 0.10)		1.55	5.5	1.71	NS	NS	NS
Trial mean		8.59	30.4	15.9	22.0	69.6	0.770

Treatments indicated with an asterisk* performed similarly to the top performer in **bold.**
NS- No significant difference.

DISCUSSION

Forage brassicas can provide high yields of high quality forage late in the year extending the grazing season and protecting stored feed reserves needed for winter feeding. All of the varieties in this trial produced over 1 ton of dry matter per acre after 54 days of growth. Although brassica forages can grow quickly, in our region planting needs to occur by mid-August in order to produce adequate biomass. Due to their high digestibility, care should be taken when incorporating brassicas into animals' diets; they should be treated like a concentrate, not a forage. An additional fiber source, such as dry hay, should be fed in conjunction with brassicas to avoid nutritional and digestive issues. Similarly, brassicas could be planted in combination with grasses, such as annual ryegrass or cereal grains, to provide a more balanced forage. Some of these varieties or types, namely the radishes and turnips, can produce taproots or bulbs that may provide additional soil compaction reducing benefits. These additional benefits were not explored in this trial but should be considered in addition to the information presented here when choosing a forage brassica that best fits your operation's needs. These data only present one year of data and should not alone be used to make important management decisions.

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