2015 Forage Brassica Variety Trial

Dr. Heather Darby, UVM Extension Agronomist
Hillary Emick, Lily Calderwood, Erica Cummings, Abha Gupta, Julian Post, and Sara Ziegler
UVM Extension Crops and Soils Technicians
Visit us on the web at: http://www.uvm.edu/extension/cropsoil

2015 FORAGE BRASSICA VARIETY TRIAL

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

Forage brassicas can provide a near-concentrate type diet late in the grazing season. This allows for an extra grazing opportunity after summer annuals are harvested or to supplement perennial cool season pasture during the fall months. These crops can provide a high-quality feed in a short period of time, fitting well into rotations of other crops, extending the grazing season, and reducing reliance on expensive commercial feed inputs. In 2015, the University of Vermont's Northwest Crops & Soils Program conducted a forage brassica variety trial to evaluate yield and quality of this annual crop.

MATERIALS AND METHODS

In 2015, a variety trial was conducted at Borderview Research Farm in Alburgh, VT, in order to evaluate twelve forage brassica varieties (Table 1, Figure 1). Seven brassica varieties had been grown successfully in previous trials, and five additional brassica varieties were added to this year's trial.


Figure 1. Appin turnip just before harvest.

Table 1. Forage brassica varieties, 2015.

Variety	Species
AC Pennent	Mustard
Appin	Turnip
Barkant	Turnip
Barsica	Rape
Bonar	Rape
Daikon	Radish
Dwarf Essex	Rape
Kestrel	Kale
Major Plus	Swede
Purple Top	Turnip
T-Raptor	Brassica hybrid
Vivant	Brassica hybrid

The seedbed at Borderview Research Farm was prepared using standard local practices, including incorporating previous crop residue with a moldboard plow and finishing with disk and drag harrows (Table 2). Liquid manure was applied at a rate of 6000 gallons ac^{-1}. The soil was a Benson silt loam. The experimental design was a randomized complete block with four replications. Each plot was 5' by 20', and a Great Plains grain drill was used to plant brassicas at a rate of 6 lbs per acre on 17-Aug.

Table 2. Agronomic and trial information for the 2015 forage brassica variety trial.

Location	Borderview Research Farm-Alburgh, VT
Soil type	Benson silt loam
Previous crop	Spring barley
Tillage operations	Moldboard plow, disking, drag harrow
Plot size (ft.)	5 x 20
Replicates	4
Planting date	17-Aug
Seeding rate	6 lbs ac^{-1}
Harvest date	8-Oct

Height and vigor were assessed on 8-Oct. Three heights were measured per plot and then averaged. Vigor was based on a visual rating with a 0–5 scale, where 5 represents excellent stand density and 0 represents no stand. All plots were hand harvested on 8-Oct to determine dry matter yields. A 0.25 m^2 quadrat was harvested per plot. Dried vegetation was ground with a Wiley laboratory mill. The coarsely-ground plot samples were brought to the lab where they were reground using a cyclone sample mill (1mm screen) from the UDY Corporation. A subsample of each was retained and analyzed at the University of Vermont's Testing Laboratory in Burlington, VT. Plot subsamples were analyzed for crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF) and 30-hour digestible NDF (NDFD). 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. 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 following 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 collected with an onsite Davis Instruments Vantage Pro2 Weather Station at Borderview Research Farm in Alburgh, VT, are summarized for the 2015 forage brassica growing season (Table 3). August and September were warmer than the historical average (1981-2010), while October was slightly cooler. The warm fall overall resulted in 159 more growing degree days than the 30-year average, as calculated with a base temperature of 32°F. The 2015 fall growing season was also very dry, with 8.31 fewer inches of rain than normal between August and October.

Table 3. Summarized weather data for 2015 – Alburgh, VT.

Alburgh, VT	August	September	October
Average temperature (°F)	69.7	65.2	46.5
Departure from normal	0.9	4.6	-1.7
Precipitation (inches)	0.00	0.34	2.51
Departure from normal	-3.91	-3.30	-1.09
Growing Degree Days (base 32°F)	1184	1010	464
Departure from normal	45	152	-38

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.

Average plant height ranged from 9.9 inches to 15.9 inches and differed significantly between varieties (Table 4, Figure 2). The tallest variety was the Daikon radish at 15.9 inches. Only the two shortest varieties (AC Pennent mustard at 11.1 inches and Major Plus swede at 9.9 inches) were significantly shorter than the tallest variety.

Vigor was assessed on a scale of 1-5. The Daikon radish and Bonar rape both had a vigor of 4.5, which was statistically similar to Vivant brassica hybrid (4.25), Kestral kale (4), Barsica rape (4), Dwarf Essex rape (3.75), Barkant turnip (3.5), T-Raptor brassica hybrid (3.5), and Appin turnip (3.5).

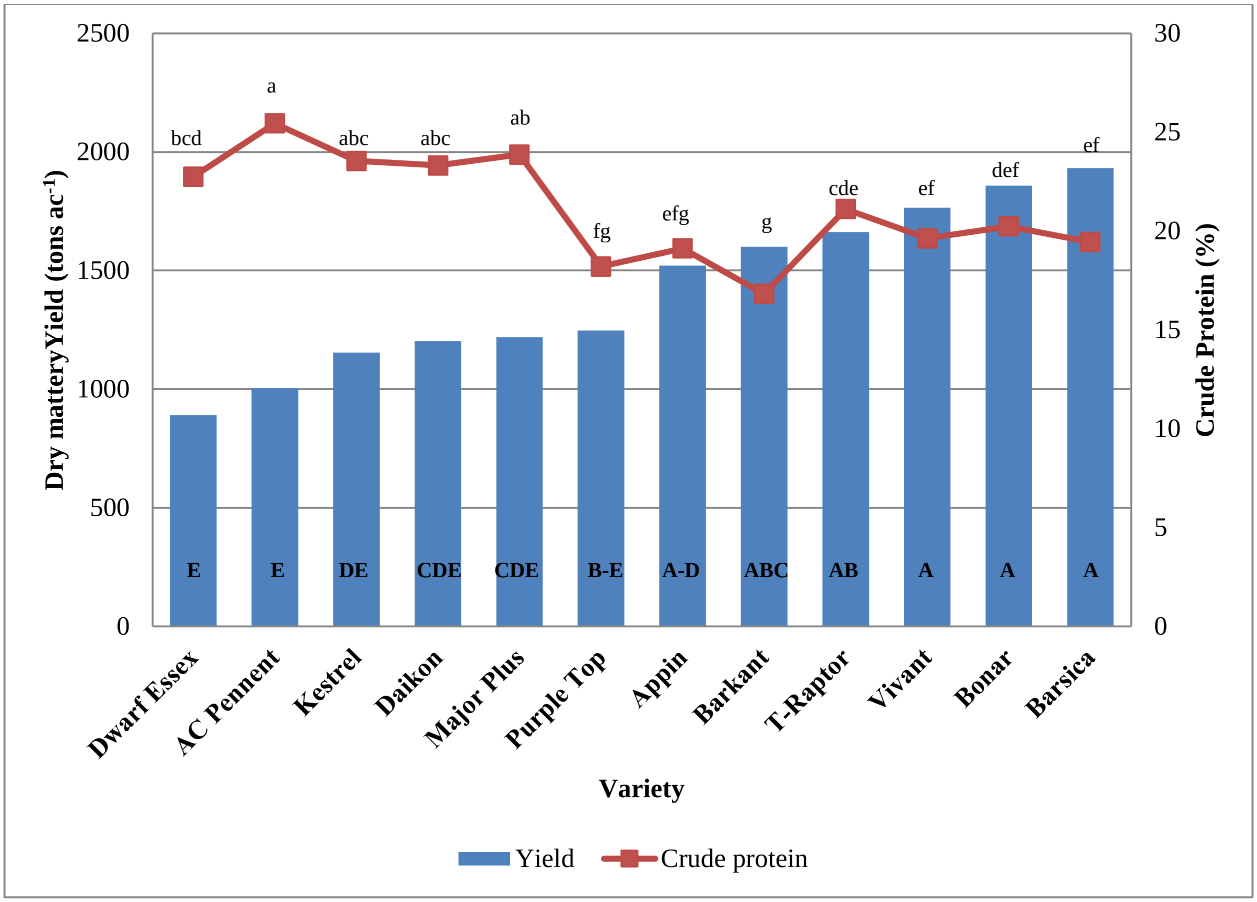

Figure 2. Average yield and crude protein concentrations for 12 forage brassica varieties, Alburgh, VT, 2015. Treatments with the same letter did not differ significantly from one another (p=0.10).

Brassica varieties differed significantly in forage quality characteristics and yield (Table 4, Figure 2). The average yield for the brassica trial was 1421 lbs of dry matter per acre. The Barsica rape had the highest yield (1932 lbs ac^{-1}), which was statistically similar to Bonar rape (1858 lbs ac^{-1}), Vivant brassica hybrid (1764 lbs ac^{-1}), T-Raptor brassica hybrid (1662 lbs ac^{-1}), Barkant turnip (1599 lbs ac^{-1}), and Appin turnip (1520 lbs ac^{-1}). The CP concentrations average 21.1%. The highest CP concentrations were the AC Pennent mustard at 25.4%. This was statistically similar to the Daikon radish (23.3%), Kestral kale (23.5%), and Major Plus swede (23.9%). The Barsica rape had the highest digestible fiber at 84.9% of NDF. This was statistically similar to Appin turnip (82.5%), Barkant turnip (82.5%), Bonar rape (83.2%), Major Plus swede (79.4%), and Purple Top turnip (81.2%). The low fiber levels and high fiber digestibility are characteristic of these crops.

Table 4. Yield, dry matter content and forage quality characteristics for twelve forage brassica varieties, Alburgh, VT, 2015.

Variety	Plant height	Harvest dry matter	Dry matter yield	Forage quality characteristics			
				CP	ADF	NDF	NDFD
				% of	% of	% of	% of
	inches	%	lbs/ac^{-1}	DM	DM	DM	NDF
AC Pennent	11.1	12.6	1004	**25.4***	17.9	21.9	68.8
Appin	15.2*	9.8	1520*	19.1	14.8*	**15.7***	82.5*
Barkant	14.8*	12.0	1600*	16.8	**13.8***	17.0*	82.5*
Barsica	13.1*	12.1	**1932***	19.4	15.5*	16.4*	**84.9***
Bonar	15.8*	11.8	1858*	20.2	15.2*	16.0*	83.2*
Daikon	**15.9***	8.4	1203	23.3*	16.5	17.2*	76.2
Dwarf Essex	14.1*	13.0	890	22.7	14.9*	19.4*	75.0
Kestrel	12.4*	12.2	1154	23.5*	15.4*	19.7	76.2
Major Plus	9.9	12.6	1219	23.9*	16.7	23.7	79.4*
Purple Top	13.6*	**14.1**	1247	18.2	13.9*	17.0*	81.2*
T-Raptor	14.3*	11.0	1662*	21.1	16.5	17.4*	76.5
Vivant	15.0*	9.4	1764*	19.6	15.5*	16.6*	76.8
LSD (0.10)	3.8	NS	423	2.5	2.1	4.0	6.9
Trial mean	13.8	11.6	1421	21.1	15.5	18.2	78.6

Treatments indicated in **bold** had the top observed performance.
* Treatments indicated with an asterisk did not perform significantly lower than the top-performing treatment in a particular column.
NS – No significant difference was determined between treatments.

DISCUSSION

Forage brassicas have great potential as an additional grazing crop in the Northeast. While yields in this dry fall season were lower than in previous years of the forage brassica variety trials (an average of 1421 lbs ac^{-1} in the 2015 trials compared to an average of 2243 lbs ac^{-1} in the 2013 forage brassica trials), this study demonstrated that any of the trialed forage brassica varieties could be a strong addition to a feeding plan, providing valuable nutrition during seasonal feed shortages and reducing the need for imported feed.

Forage brassicas are known for the high CP content, energy and level of digestibility. Generally, higher yielding varieties had lower crude protein concentrations. While no variety was a top performer in terms of both yield and CP, several varieties were in the top performing category for both yield and fiber digestibility (Appin turnip, Barkant turnip, Barsica rape, and Bonar rape).

Yield and quality should both be taken into consideration before selecting a variety. The high overall levels of crude protein show that most forage brassicas have the potential to be a welcome addition to a fall grazing system. This highly digestible feed should be complemented with a more fibrous feed. The brassica crops would likely be grazed in short time increments to reduce the potential for herd health issues associated with highly digestible feed. It is important to note that the data presented here reflect results from only one season and one location. This research should be combined with experience managing dairy animals and research from other regions and across years, as well as recommendations from nutritionists.

ACKNOWLEDGEMENTS

UVM Extension would like to thank Roger Rainville at Borderview Research Farm in Alburgh and his staff for their generous help with this research trial. We would also like to acknowledge Katie Blair, Julija Cubins, Lindsey Ruhl, and Dan Ushkow for their assistance with data collection and entry. The research was funded in part by the USDA NIFA Organic Research and Education Initiative and Critical Agriculture Research and Education grants. This information is presented with the understanding that no product discrimination is intended and no endorsement of any product mentioned, nor criticism of unnamed products, is implied.

UVM Extension helps individuals and communities put research-based knowledge to work.

UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES