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2012 Summer Annual Variety Trial

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2012 SUMMER ANNUAL VARIETY TRIAL

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Warm season grasses are a high-yielding summer annual. They can provide quality forage in the hot summer months, when cool season grasses are not as productive. The addition of this crop into your rotation can allow you to harvest high-quality forage for stored feed or pasture. As with any crop though, summer annuals have their advantages and disadvantages. Some advantages include, fast germination/emergence, rapid growth, high productivity and flexibility in utilization. Some disadvantages include high cost of annual establishment and increased risk of stand failure when presented with variable weather patterns. In 2012, UVM Extension conducted a summer annual variety trial to evaluate the yield and quality of several types and varieties of warm season grasses.

MATERIALS AND METHODS

A summer annual variety trial was initiated at Borderview Research Farm in Alburgh, VT, to evaluate ten varieties of sorghum, sudangrass, sorghum sudangrass hybrids and millet (Table 1). All plots were managed with conventional tillage practices, including moldboard plow, disking and field finishing with a drag harrow. The experimental design was a randomized complete block with three replicates. The treatments were ten commercially available summer annual varieties. Plots were seeded with a Sunflower grain drill on 13-Jun. The plots were 4' x 25' and replicated three times. Varied seeding rates were applied, depending on regional recommendations for that specific forage. The first harvest occurred on 23-Jul, and a second on 30-Aug. Trial management can be found in Table 2.

Table 1. Summer annuals variety trial seed information for Borderview Research Farm in Alburgh, VT.

Seed Source	Species	Variety	Characteristics	Seeding Rate (lbs. ac^{-1})
Alta Seeds	Forage sorghum	AF7101	BMR-6	55
Alta Seeds	Sorghum Sudangrass	AS6401	BMR-6	55
Alta Seeds	Sudangrass	AS9301	BMR-6	55
Alta Seeds	Sorghum Sudangrass	AS6501	BMR-6	55
Alta Seeds	Sorghum Sudangrass	AS6402	BMR-6	55
Alta Seeds	Forage sorghum	AS7301	BMR-6	30
Hancock Seeds	Pearl Millet	Elite	BMR-6	28
King's Agriseeds	Pearl Millet	Wonderleaf	Non-BMR	28
King's Agriseeds	Millet	Summer Feast	Non-BMR	30
King's Agriseeds	Sudangrass	Hayking	Non-BMR	55

Table 2. Agronomic and trial information for summer annuals. Borderview Research Farm in Alburgh,VT.

	Borderview Research Farm Alburgh, VT
Soil type	Benson rocky silt loam
Previous crop	Winter wheat
Tillage operation	Fall plow, disc, spike-toothed harrow
Plot area (ft.)	4 x 25
Seeding Rate (lbs. ac^{-1})	28,30,55
Replicates	3
Planting Date	13-Jun
1st Harvest	23-Jul
2nd Harvest	30-Aug

All plots were harvested with a BCS sickle bar mower. Once the plots were harvested, all plant material was collected and weighed on a platform scale. A subsample was taken to determine moisture and quality. All data was analyzed using a mixed model analysis where replicates were considered random effects. Several analyses were conducted to answer certain specific questions:

1) What is the yield and quality of commercially available sorghum and sudangrass varieties?
2) What is the yield and quality of commercially available millet varieties?
3) How do sorghum and sudangrass varieties compare with yield and quality of millet varieties?

Silage quality was analyzed by Cumberland Valley Analytical Forage Laboratory in Hagerstown, Maryland. Plot samples were dried, ground and analyzed for crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF) and various other nutrients. The Nonstructural Carbohydrates (NSC) and Total Digestible Nutrients (TDN) were calculated from forage analysis data. Performance indices, such as Net Energy Lactation (NEL), were calculated to determine forage value. Mixtures of true proteins, composed of amino acids, and non-protein nitrogen make up the crude protein (CP) content of forages. The bulky characteristics of forage come from fiber. Forage feeding values are negatively associated with fiber since the less digestible portions of the plant 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. The NSC or non-fiber carbohydrates (NFC) include starch, sugars and pectins.

Data were analyzed using mixed model analysis procedure of SAS (SAS Institute, 1999). Replications were treated as random effects, and treatments were treated as fixed. 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 hybrids is real or whether it might have occurred due to other variations in the field. Least Significant Differences (LSDs) at the 0.10 level of significance are shown. At the bottom of each table a LSD value

is presented for each variable (i.e. yield). 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 that for 9 out of 10 times, there is a real difference between the two treatments. Treatments that were not significantly lower in performance than the highest hybrid in a particular column are indicated with an asterisk. In the example below, 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 is based on data from an onsite Davis Instruments Vantage Pro2 weather station with Weatherlink data logger and Northeast Regional Climate Center data from cooperative observer stations in close proximity to Borderview Research Farm. Historical averages are for 30 years of data (1981-2010). In mid-summer 2012, drought-like conditions were experienced, with the overall growing season seeing 2.0 fewer inches of precipitation and warmer than normal temperatures (Table 3). Although summer annuals are relatively drought-tolerant, growers should stay vigilant to recognize and prevent nitrate poisoning (which is considered relatively safe for feed up to 5000 ppm). Nitrates can accumulate in grasses when prolonged dry periods are followed by rainfall and plants have rapid uptake of nutrients from the soil. Nitrate accumulation is especially problematic in soils with manure applications. The summer annual growing season consisted of 1948 GDD's, which was 253 GDD's more than the 30 year average.

Table 3. Weather data for summer annuals variety trial in Alburgh, VT 2012.

Alburgh, VT	June	July	August
Average temperature (°F)	67.0	71.4	71.1
Departure from normal	1.2	0.8	2.3
Precipitation* (inches)	3.2	3.8	2.9
Departure from normal	-0.5	-0.4	-1.0
Growing Degree Days (base 50°F)	539	721	688
Departure from normal	65	81	107

Based on weather data from Davis Instruments Vantage Pro2 with Weatherlink data logger.
Historical averages for 30 years of NOAA data (1981-2010).
*Precipitation data is based on Northeast Regional Climate Center data from an observation station in Burlington, VT.

At the first harvest on 23-Jul, many plant characteristics and forage quality indicators were impacted by variety (Table 4). Sudangrass variety Hayking BMR sudan was significantly taller than all other summer annuals. Dry matter content of the summer annuals averaged 15.3%, indicating that it contains a lot of moisture and can be difficult to dry properly for stored feed. The highest dry matter yield occurred in the sudangrass AS9301 variety (4172 lbs per acre), although it was significantly similar to all other varieties except BMR sorghum sudan AS6402 and sorghum AS7301. The sorghumxsudangrass variety AS6402 performed best for crude protein (21.5%), although it was significantly similar to all other varieties except hayking BMR sudan, sorghum AF7101, sorghum sudan AS6501 and sudangrass AS9301. The millet variety Elite had the lowest fiber concentrations and the highest fiber digestibility. The summer annuals did not differ statistically in TDN, NeL or NFC.

Table 4. Impact of varietal selection on forage quality of summer annual grasses, first harvest, 2012.

Species	Plant height	Dry matter	DM yield	CP	ADF	NDF	dNDF	TDN	NEL	NFC	NSC
	cm	%	lbs. ac^{-1}	% of DM	% of DM	% of DM	% of NDF	% of DM	Mcal lb^{-1}	% of DM	% of DM
AS6402	36.0	15.0	2746	**21.5***	33.3*	53.8*	65.9*	62.6	0.65	12.9	8.9
Hayking	**54.2***	15.9	3779*	18.4	35.2	55.8	58.5	61.9	0.64	**16.1**	9.1
AF7101	43.2	**16.1**	4124*	18.9	34.1*	55.5	62.8	62.3	0.64	14.5	9.6
AS7301	37.6	14.9	2909	19.8*	33.6*	54.0*	64.4*	62.1	0.64	14.4	9.9
AS6501	44.2	15.9	3403*	19.5	33.2*	53.6*	63.7	62.1	0.64	15.4	**10.5***
AS6401	43.8	15.3	3948*	20.3*	33.5*	53.8*	62.5	61.9	0.64	14.1	9.7
AS9301	45.2	15.8	**4172***	19.4	33.3*	54.2*	64.2*	**62.8**	0.65	15.4	9.8
Elite Pearl Millet	35.7	14.5	3864*	21.3*	**33.2***	**53.5***	**66.1***	62.6	**0.65**	14.3	8.9
Summer Feast	36.9	15.0	4002*	19.9*	34.7	55.2	63.7	61.8	0.64	14.2	9.1
Wonderleaf Pearl Millet	38.4	15.1	4094*	21.0*	33.5*	54.0*	65.8*	62.4	0.64	14.2	9.2
LSD (0.10)	4.0	NS	834	1.7	1.1	1.4	2.0	NS	NS	NS	0.6
Trial mean	41.5	15.3	3704	20.0	33.8	54.3	63.8	62.2	0.64	14.6	9.5

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.

At the second harvest on 30-Aug, all forage quality measurements, with the exception of NDF, varied significantly by variety (Table 5). Hayking was the tallest and also yielded significantly more than the other summer annuals. The variety AS6402 has the highest crude protein (19.5%) concentration, and was statistically different from all other varieties except AS7301. Summer annuals did not differ in NDF concentrations at the second harvest. The variety AS6401 had the highest dNDF (73.2% of NDF), but was statistically similar to AS6402, AF7101 and AS7301. The variety AS6402 had the highest NEL (0.66 Mcal lb^{-1}) and was statistically different than the millets and Hayking sudangrass.

Table 5. Impact of varietal selection on forage quality of summer annual grasses, second harvest, 2012.

Species	Plant height	Dry matter	DM yield	CP	ADF	NDF	dNDF	TDN	NEL	NFC	NSC
	cm	%	lbs. ac^{-1}	% of DM	% of DM	% of DM	% of NDF	% of DM	Mcal lb^{-1}	% of DM	% of DM
AS6402	52.6	15.7	3428	**19.5***	33.0*	59.1	71.6*	**63.7***	**0.66***	14.8	9.8
Hayking	**73.7***	17.6*	**5312***	16.2	35.9	61.2	59.8	61.1	0.63	17.6*	11.2
AF7101	50.0	15.1	3113	17.0	33.0*	58.5	71.5*	62.9*	0.65*	17.7*	11.5
AS7301	47.1	13.2	2390	18.6*	**32.4***	**58.1**	72.1*	63.3*	0.65*	15.7	10.9
AS6501	55.1	13.3	3838	16.6	33.5*	58.8	70.8	62.9*	0.65*	18.3*	12.0*
AS6401	54.8	12.8	3759	16.5	34.1	59.3	**73.2***	62.7*	0.65*	17.1	11.4
AS9301	61.8	13.8	3956	16.3	33.3*	58.6	71.0	63.1*	0.65*	**18.8***	12.6*
Elite Pearl Millet	48.2	17.8*	3873	15.4	34.7	59.4	68.9	61.5	0.63	18.5*	**12.9***
Summer Feast	43.2	**18.1***	3849	15.2	34.7	59.9	69.9	61.9	0.64	18.3	12.8*
Wonderleaf Pearl Millet	53.7	17.5*	3873	14.7	35.6	60.8	68.5	60.7	0.62	17.6*	12.5*
LSD (0.10)	7.8	1.6	616	2.1	1.7	NS	2.1	1.2	0.01	1.7	0.9
Trial mean	54.0	15.5	3739	16.6	34.0	59.4	69.7	62.4	0.64	17.4	11.8

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.

The total yield and quality were calculated for this trial, and significant impacts of variety were identified (Table 6). For combined results of harvests, Hayking BMR sudangrass yielded the highest (9090 lbs. per acre), although not statistically different from AS9301 and Wonderleaf pearl millet (Figure 1). There was no difference among summer annuals for pounds of CP produced per acre. The lowest NDF yield (2962 lbs. per acre) occurred in AS7301, although it was not statistically different than AS6402. Hayking had the highest TDN yield (5586 lbs. per acre), and was statistically different from all other varieties except AS9301 and Wonderleaf pearl millet.

Table 6. Impact of varietal selection on across harvest dates for summer annuals, 2012.

Species	Total yield	CP	NDF	TDN	NSC
	lbs. ac^{-1}	lbs. ac^{-1}	lbs. ac^{-1}	lbs. ac^{-1}	lbs. ac^{-1}
AS6402 Sorghum Sudangrass	6173	1261	3497*	3905	584
Hayking Sudangrass	**9090***	**1564**	5359	**5586***	**936***
AF7101 Sorghum	7237	1302	4112	4526	753
AS7301 Sorghum	5299	1019	**2962***	3319	549
AS6501 Sorghum Sudangrass	7240	1306	4086	4525	815*
AS6401 Sorghum Sundagrass	7707	1423	4357	4796	810*
AS9301 Sudangrass	8128*	1451	4585	5112*	907*
Elite Pearl Millet	7737	1415	4374	4800	844*
Summer Feast Millet	7851	1376	4517	4853	860*
Wonderleaf Pearl Millet	7967*	1432	4563	4905*	863*
LSD (0.10)	1185	NS	697	730	127
Trial mean	7443	1355	4241	4633	792

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.

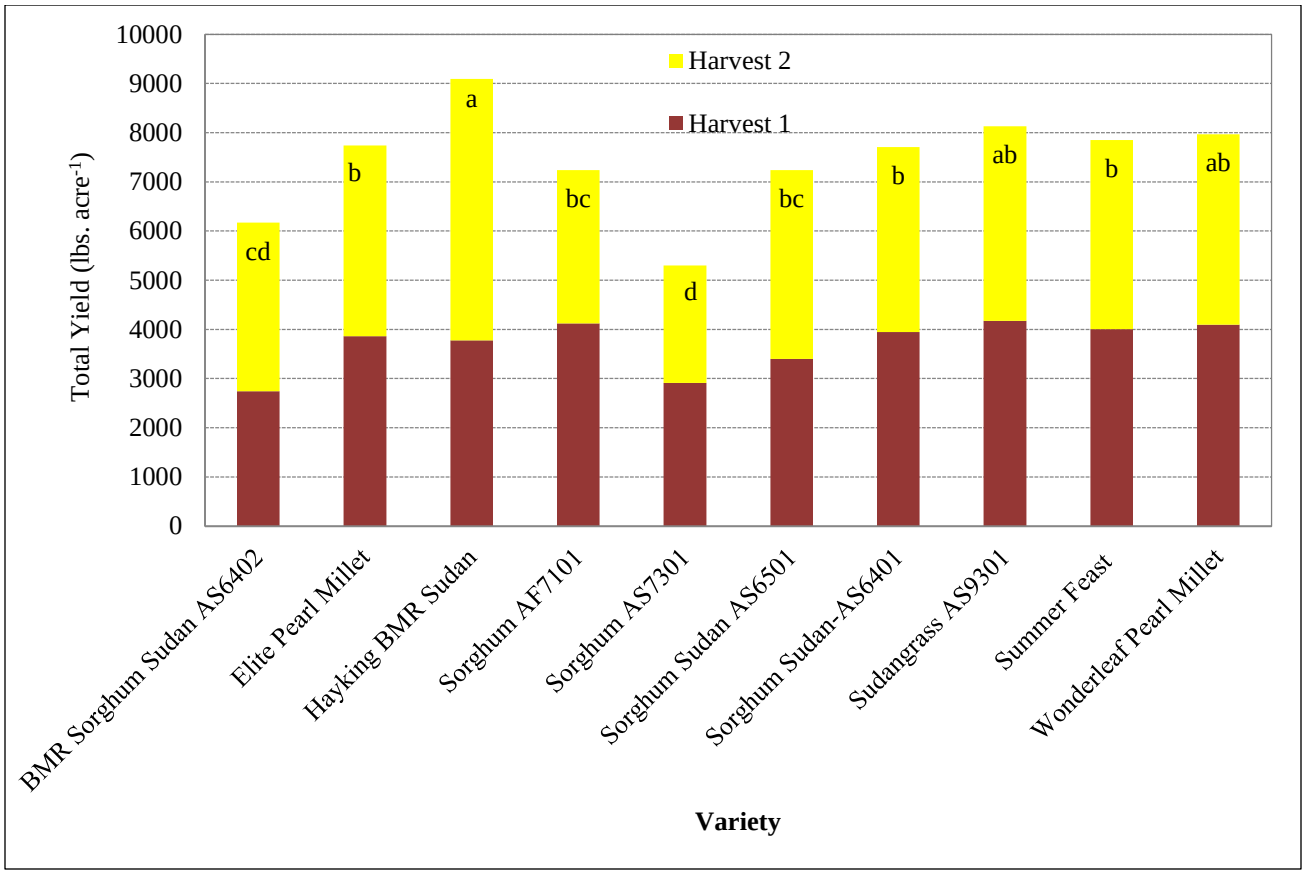

Figure 1. Impact of summer annual varietal and species selection on total yields, 2012.

DISCUSSION

These results indicate that warm season annual grasses can produce high yielding and quality forage crops. There are several varieties and species that can perform well in our climate. Overall, the sudangrass varieties Hayking and AS9301 resulted in the highest yields per acre. They also generally performed well in quality parameters. The millet species tended to be slightly lower in yield as compared to the sorghum, sundangrass, and sorghum sudangrass crosses. Of all the millet varieties, Wonderleaf exhibited the best combination of yield and quality characteristics. Crude protein concentrations averaged 20% for the first cut and 16.6% for the second cut. A drop in CP between harvests indicates a potential N deficiency in the summer annuals. These crops are known to be heavy feeders and maximum yield and quality will be met if fertility requirements of the plants are met. This is often difficult under organic production where N sources are primarily limited to manure application. There was a significant difference across species and varieties in dNDF. Hayking had a low fiber digestibility when compared to other BMR enhanced summer annuals. Interestingly, the millets had exceptional dNDF and they are not BMR varieties. Overall, there are a number of summer annuals that perform well in our region. This crop has the potential to enhance feed quality during the hot dry summer months.

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