2014

Summer Annual Variety Trial

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UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

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Warm season grasses, such as sorghum x sudangrass crosses, sudangrass, millets, and teff are high-yielding summer annuals that can provide quality forage in the hot summer months, when cool season grasses are not as productive. The addition of summer annuals into a rotation can provide a harvest of high-quality forage for stored feed or grazing. Generally, summer annuals germinate quickly, grow rapidly, are drought resistant, and have high productivity and flexibility in utilization. However, it is important to know the challenges of growing summer annuals, including the high cost of annual establishment, increased risk of stand failure due to variable weather, and the risk of toxic levels of nitrates and prussic acid in sorghum and sudangrass crops. The UVM Extension Northwest Crops and Soils team conducted this variety trial to evaluate the yield and quality of warm season annual grasses.

MATERIALS AND METHODS

Twelve varieties of summer annuals were planted at Borderview Research Farm in Alburgh, VT on 2-Jun 2014 (Table 2). General plot management is listed in Table 1. Plots were managed with practices similar to those used by producers in the surrounding area. The previous crop was sod. The field was disked and spike tooth harrowed prior to planting. Plots were seeded with a Great Plains small plot drill at a seeding rate of 50 lbs acre^{-1} for the sorghums, sudangrasses and sorghum x sudangrass crosses, 25 lbs acre^{-1} for the millet, 20 lbs acre^{-1} for the annual ryegrass, and 6 lbs acre^{-1} for the teff. These seeding rates are slightly lower than the seeding rates for 2013.

Plots were harvested with a Carter forage harvester on 1-Aug and 4-Sep. The harvest area was 3' x 20'. The species and variety of summer annuals grown are listed in Table 2. Silage quality was analyzed by the University of Vermont Cereal Testing Lab (Burlington, VT) with an FOSS NIRS (near infrared reflectance spectroscopy) DS2500 Feed and Forage analyzer. 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 (NE_L), 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. Results were analyzed with an analysis of variance in SAS (Cary, NC). The Least Significant Difference (LSD) procedure was used to separate cultivar means when the F-test was 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 varieties 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 (LSD's) at the 10% level 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 varieties. Treatments that were not significantly lower in performance than the highest value in a particular column are indicated with an asterisk. In the example on right, A is significantly different from C but not from B. The difference between A and B is equal to 1.5, which is less than the LSD value of 2.0. This means that these varieties did not differ in yield. The difference between A and C is equal to 3.0, which is greater than the LSD value of 2.0. This means that the yields of these varieties were significantly different from one another. The asterisk indicates that B was not significantly lower than the top yielding variety.

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

Table 1. General plot management.

Trial Information	**Borderview Research Farm Alburgh, VT**
Soil Type	Benson rocky silt loam
Previous crop	sod
Planting date	2-Jun
First cut harvest date	1-Aug
Second cut harvest date	4-Sep
Seeding rate: Teff	6 lbs acre^{-1}
Annual ryegrass	20 lbs acre^{-1}
Millets	25 lbs acre^{-1}
Sorghums, Sudangrass, and crosses	50 lbs acre^{-1}
Tillage methods	Mold board plow, disk, and spike tooth harrow

Table 2. Summer annual varieties, characteristics, and seed source.

Variety	**Species**	**Characteristics**	**Seeding Rate (lbs. ac^{-1})**	**Seed Source**
Corvalis	Teff	non-BMR	6	King's Agriseed
Moxie CW 0406	Teff	non-BMR	6	King's Agriseed
Fria	Annual Ryegrass	endophyte-free	20	Seedway
Wonderleaf	Millet	non-BMR	25	King's Agriseed
AS 5201	Sorghum x Sudangrass	non-BMR	50	King's Agriseed
AS 6201	Sorghum x Sudangrass	BMR	50	King's Agriseed
AS 6401	Sorghum x Sudangrass	BMR	50	King's Agriseed
AS 6402	Sorghum x Sudangrass	BMR	50	King's Agriseed
AS 6501	Sorghum x Sudangrass	BMR	50	King's Agriseed
AS 9301	Sudangrass	BMR	50	King's Agriseed
Blackhawk	Sorghum x Sudangrass	BMR	50	Albert Lea Seeds
Hayking	Sudangrass	BMR	50	King's Agriseed

RESULTS AND DISCUSSION

Seasonal precipitation and temperature recorded at a weather station in Alburgh, VT are shown in Table 3. From June to September, there was an accumulation of 4180 Growing Degree Days (GDDs) in Alburgh which is 29 GDDs less than the 30-year average. Rainfall was above average during planting, with over 6 inches of rain in June. The remainder of the growing season had above average precipitation in July and just about average rainfall in August.

Table 3. Seasonal weather data[1] collected in Alburgh, VT, 2014.

Alburgh, VT	June	July	August	September
Average temperature (°F)	66.9	69.7	67.6	60.6
Departure from normal	1.1	-0.9	-1.2	0.0
Precipitation (inches)	6.09	5.15	3.98	1.33
Departure from normal	2.40	1.00	0.07	-2.31
Growing Degree Days (base 32°F)	1041	1171	1108	860
Departure from normal	27	-27	-31	2

[1]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.

Hayking sudangrass was the tallest variety at 34.2 inches, significantly taller compared to some of the shorter species (Teff and ryegrass) that only reached 15 inches tall (Table 4). The summer annuals did not grow as tall as those grown in 2013, when the average height was 45 inches (data not shown). There was a significant yield difference amongst the first cut of summer annual varieties. The sorghum x sudangrass 'AS 6501' was the highest yielding variety with 2942 lbs DM acre^{-1}. Average dry matter (DM) yield for the first harvest was 1463 lbs acre^{-1} and ranged from 562 to 2942 lbs acre^{-1}. Corvalis teff had the highest crude protein, NFC and digestible NDF and low ADF and NDF values (Table 4). In general, teff and the annual ryegrass had significantly higher crude protein than the sudangrasses, crosses, and millet. Acid detergent fiber (ADF) and neutral detergent fiber (NDF) were most desirable for the teff and the annual ryegrass.

Table 4. Yield and quality of summer annual forages, 1st cut, Alburgh, VT, 2014

Variety	Height	DM	Yield	CP	ADF	NDF	NFC	NDFD
	inches	%	lbs/acre	% of DM	% of DM	% of DM	% of DM	% of NDF
AS 5201	28.2*	23.3	1419	10.9	35.8	62.9	23.5	60.2
AS 6201	30.1*	23.2	2425*	11.9	35.7	62.2	21.7	60.7*
AS 6401	23.2	24.4	752	11.9	34.3	60.6	22.7	59.9
AS 6402	20.3	25.1	713	12.0	33.8	61.6	23.1	56.4
AS 6501	31.8*	21.3	**2942***	12.1	35.5	61.4	21.8	60.4*
AS 9301	24.3	24.9	1981*	12.0	33.7	60.6	22.8	60.6*
Blackhawk	32.2*	22.3	2357*	11.5	37.0	64.0	21.8	62.0*
Corvalis	15.8	25.8	710	**15.3***	**31.9***	56.4*	24.3*	60.6*
Fria	15.7	24.7	1300	14.7*	32.3*	**55.4***	**25.7***	62.2*
Hayking	**34.2***	23.7	1674	12.9	35.7	61.1	23.1	61.5*
Moxie CW 0406	17.2	23.8	562	15.2*	32.4*	57.4*	24.2*	61.5*
Wonderleaf	20.9	23.7	724	12.9	34.1	58.4	24.4*	62.8*
Trial Mean	24.5	23.9	1463	12.8	34.3	60.2	23.3	60.7
LSD (p<0.10)	6.21	NS	1040	1.53	1.65	2.81	1.80	2.36

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.

Average dry matter yields for second cut were 1849, about 400 lbs. more than first harvest means. Moxie Teff had the highest yield at 2592 lbs. acre^{-1} (Table 5). The two teff varieties, millet, and annual ryegrass had the highest second cut yields. The sorghum x sudangrass variety 'AS 6501' had the highest crude protein, lowest NDF, and highest digestible NDF of the second cut.

Table 5. Yield and quality of summer annual forages, second cut, Alburgh, VT, 2014.

	DM	Yield	CP	ADF	NDF	NFC	NDFD	Total Yield
	%	lbs/acre	% of DM	% of DM	% of DM	% of DM	% of NDF	lbs/acre
AS 5201	21.7	1635	13.7	38.0	65.8	20.0*	57.7*	3055
AS 6201	20.3	1472	15.3*	37.9	62.4*	18.4	59.6*	3897
AS 6401	21.0	1877	14.7*	36.7	62.8*	19.6	57.5*	2629
AS 6402	22.1	1847	14.2	38.0	64.6	18.6	56.8	2559
AS 6501	18.6	996	**16.1***	38.4	**61.9***	17.7	**59.6***	3938
AS 9301	23.3	1364	13.8	37.3	64.3	20.0*	58.0*	3345
Blackhawk	20.9	1534	15.0*	38.2	63.7*	18.6	58.0*	3891
Corvalis	**26.3***	2451*	12.9	39.1	67.1	19.8	56.0	3161
Fria	23.7*	2198*	14.0	38.5	64.1	20.7*	56.7	3498
Hayking	20.4	1989	14.1	37.9	64.3	20.1*	59.0*	3663
Moxie CW 0406	24.1*	**2592***	13.7	39.1	64.3	20.7*	54.9	3154
Wonderleaf	21.6	2237*	12.3	38.7	64.6	**21.4***	56.1	2960
Trial Mean	22.0	1849	14.1	38.1	64.2	19.6	57.5	3312
LSD (p<0.10)	3.00	595	1.45	NS	2.26	1.54	2.33	NS

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.

Overall yields are presented in Figure 1. There was no statistical difference in total yield amongst the summer annual species/varieties in 2014. The average total yield for two cuts was 3312 lbs. acre^{-1}, which was less than yields in 2013 (2.5 tons acre^{-1}) and 2012 yields (3.7 tons acre^{-1}). Cooler weather during the 2014 growing season likely led to lower yields of the summer annuals.

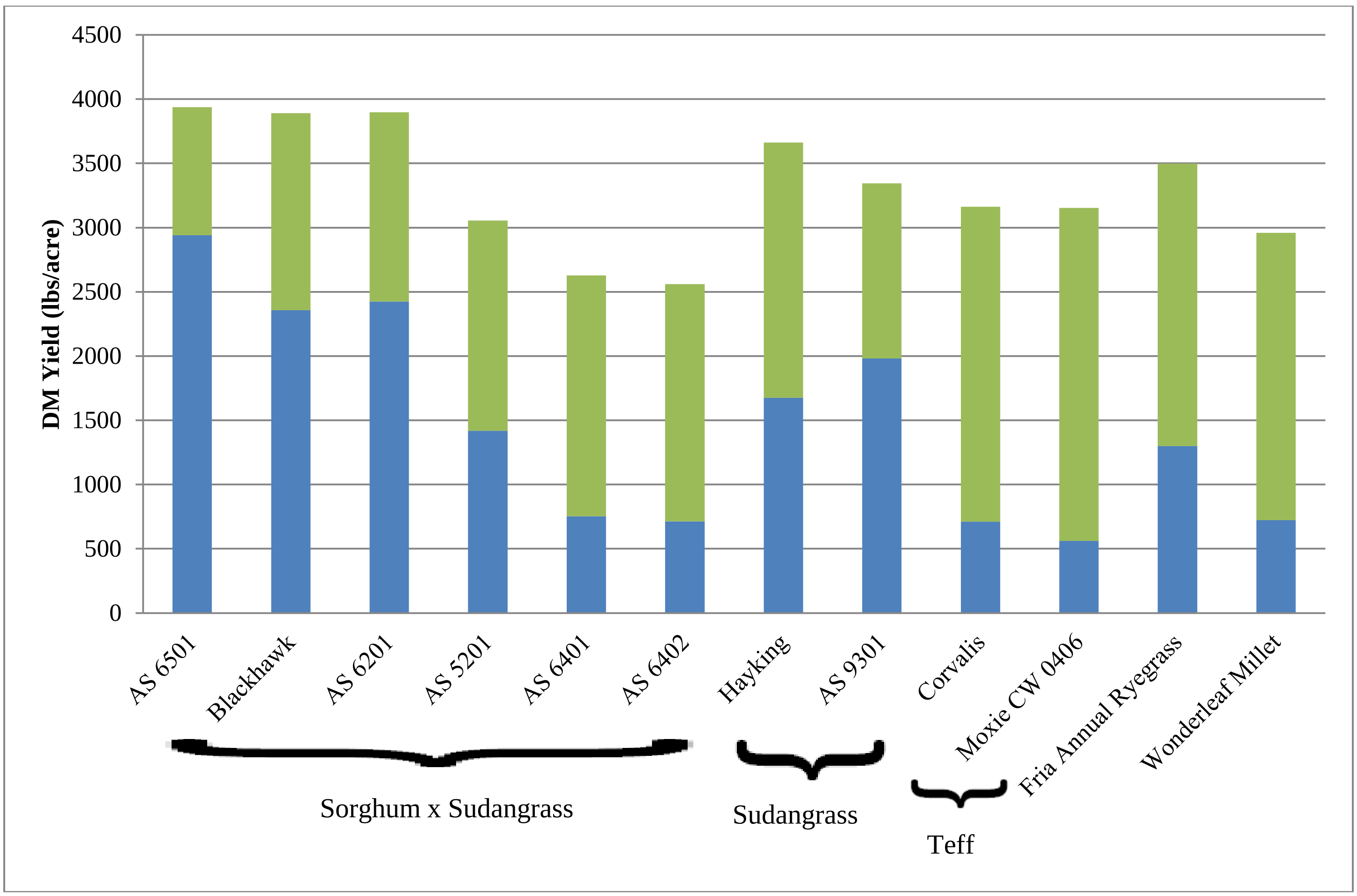

Figure 1. Dry matter yield of summer annuals. 1st cut yields= bottom bar, 2nd cut yields=top bar.

It is important to be aware of the risk of nitrate accumulation and the presence of prussic acid when growing summer annuals. Nitrates are considered relatively safe for feed up to 5000 ppm, however there is a risk of excessive nitrate accumulation under excessive fertility and immediately after a drought stressed crop receives rainfall. Additionally, sorghums and sudangrasses may contain prussic acid which is toxic when present. To avoid prussic acid poisoning:

- Graze sorghum or crosses when they are at least 18 inches tall.
- Do not graze plants during and shortly after drought periods when growth is severely reduced.
- Do not graze wilted plants or plants with young tillers.
- Do not graze after a non-killing frost; regrowth can be toxic.
- Do not graze after a killing frost until plant material is dry (the toxin usually dissipates within 48 hours).
- Do not graze at night when frost is likely. High levels of toxins are produced within hours after frost occurs.
- Delay feeding silage six to eight weeks following ensiling.

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