

NORTHWEST CROPS & SOILS PROGRAM



2021 Perennial Grass Variety Trial



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2021 PERENNIAL GRASS VARIETY TRIAL
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In 2019, the University of Vermont Extension Northwest Crops and Soils Program initiated a trial evaluating forage yield and quality of an array of cool season perennial grass species and varieties planted in monocultures. The grass species selected were Kentucky bluegrass, meadow brome, meadow fescue, orchardgrass, perennial ryegrass, and timothy. The 2021 growing season was the second full season after establishment for these stands. These stands will continue to be monitored over multiple years to evaluate yield, quality, survivability, pest resistance, persistence, and other characteristics that will help identify the most suitable forage species and varieties in our region over a variety of weather conditions.

MATERIALS AND METHODS

Forage species and variety information for the trial is summarized in Table 1. The plot design was a randomized complete block with five replications. Treatments were grass varieties seeded in monoculture and evaluated for winter survival, forage yield, forage quality, and disease incidence and severity.

Table 1. Perennial grass species information.

Species	Variety
Kentucky bluegrass	Balin
	Ginger
Meadow brome	Fleet
	Macbeth
	Montana
Meadow fescue	Laura
	Liherold
	Preval
	SW Minto
	Tetrax
Orchardgrass	Echelon
	Harvestar
	Husar
	Inavale
	Luxor
	Niva
	Olathe
	Otello
Perennial ryegrass	Calibra
	Kentaur
	Remington
	Tivoli
	Tomaso

	Toronto
Timothy	Barfleo
	Barpenta
	Climax
	Lischka
	Promesse
	Tuuka

The soil type at the Alburgh location was a mix of clay and silt loam (Table 2). The seedbed was moldboard plowed, disked, and finished with a spike tooth harrow. The previous crop was soybean. Plots were 5' x 20' and replicated 5 times. In late April 2021, plots were visually inspected for winter survival. Plots were harvested with a Carter flail forage harvester in a 3' x 20' area on 20-May, 7-Jul, and 24-Aug 2021.

Table 2. Perennial forage trial management, Alburgh, VT.

Location	Borderview Research Farm – Alburgh, VT
Soil type	Benson rocky silt loam
Previous crop	Soybean
Tillage operations	Moldboard plow, disk and spike tooth harrow
Planting equipment	Great Plains small plot drill
Treatments	30
Replications	5
Plot size (ft.)	5 x 20
Planting date	18-Aug 2019
Harvest dates (2021)	20-May, 7-Jul, and 24-Aug

An approximate 1 lb subsample of the harvested material was collected and dried to calculate dry matter yield and forage quality. At the time this report was written, forage quality analysis was not complete for all samples and therefore, only yields are reported. Heading dates of each variety were noted at the first harvest by leaving a plot of each variety uncut until the variety had fully headed out. Yield and quality were not collected from this replicate. Severity of infection with leaf rust (*Puccinia sp.*) and leaf spot (*Stagonospora sp.* or *Septoria sp.*) were visually rated in each plot using a 0-10 scale on 23-Aug, where 0 is no infection and 5 is infection on 91-100% of the plot.

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) which includes cellulose, hemicellulose, and lignin. This measure indicates the bulky characteristic of the forage and therefore is negatively correlated with animal dry matter intake. The portion of the NDF fraction that is estimated to be digestible after 30 hours of fermentation in rumen fluid is

represented by the 30- hour NDF digestibility. The fraction of total NDF content which will remain undigested after 240 hours of incubation in rumen fluid is represented by the uNDF 240-hour.

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, 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 (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 varieties.

Varieties that were statistically similar in performance to one another share a letter. In this example, variety C is significantly different from variety A but not from variety 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 varieties 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 these varieties yielded significantly different from one another.

Hybrid	Yield
A	6.0b
B	7.5ab
C	9.0a
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). In general, the fall of 2020 was warmer and drier than normal. Winter precipitation was below normal for all months until April. These dry conditions were paired with above normal temperatures for all months except for February. April was warmer and wetter than normal but May through August were significantly drier than normal. July was unusually cool with temperatures averaging more than four degrees below normal. Drought conditions, categorized as “Abnormally Dry” and “Moderate Drought” (Drought.gov) were experienced for northern portions of VT and NY throughout the summer months. Overall, the grass trial accumulated 4,818 Growing Degree Days (GDDs) in 2021, 315 above the 30-year normal and 880 more than the 2020 season.

Table 3. 2020-2021 weather data for Alburgh, VT.

	2020			2021								
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average temperature (°F)	48.3	42.0	29.4	21.5	19.8	33.2	48.1	58.4	70.3	68.1	74.0	62.8
Departure from normal	-2.01	2.69	1.20	0.64	-3.07	0.93	2.52	-0.03	2.81	-4.31	3.25	0.14
Precipitation (inches)	3.56	1.41	1.40	0.39	0.47	0.97	3.52	0.66	3.06	2.92	2.29	4.09
Departure from normal	-0.27	-1.29	-1.10	-1.74	-1.30	-1.27	0.45	-3.10	-1.20	-1.14	-1.25	0.42
Growing Degree Days (base 41°F)	291	175	28	0	1	126	284	546	866	840	1006	655
Departure from normal	-13	93	28	0	1	104	69	6	72	-134	86	3

Based on weather data from a Davis Instruments Vantage Pro2 with WeatherLink data logger.

Historical averages are for 30 years of NOAA data (1990-2021) from Burlington, VT.

Impact of Species

Performance overall was lower than in 2020, but there were still significant differences between species (Table 4). With cool and wet weather in the spring, first cut yields were quite substantial for some species. The meadow bromes produced the most first cut biomass with 1.91 tons ac⁻¹ but were similar to all other species except perennial ryegrass. The perennial ryegrass, which had performed very well in the spring of 2020, likely suffered from drought stress and potentially winter survival issues, resulting in very low yields with first cut biomass of 0.338 tons ac⁻¹. Interestingly, in the second cut, the timothy and perennial ryegrass produced the highest yields of approximately 1 ton ac⁻¹ while all other species produced less than 0.5 tons ac⁻¹. The third cutting produced similar yields as second cut, however some species produced significantly higher yields in the third harvest than the second. For example, the meadow brome produced 0.980 tons ac⁻¹ in the third cutting, the highest yield for that cut, but only 0.485 tons ac⁻¹ in the second. Conversely, perennial ryegrass produced 0.964 tons ac⁻¹ in the second harvest and only 0.154 tons ac⁻¹ in the third. The distribution of yield over the harvest can be a helpful tool in species and varietal selection (Figure 1). While orchardgrass, meadow brome, and meadow fescue all have similar distributions with first and third cuts being larger than second, timothy had more even distribution of biomass between first and second harvests. Furthermore, Kentucky bluegrass produced the majority (over 70%) of its total biomass in the first harvest, whereas perennial ryegrass produced over 65% of its total biomass in the second harvest. These differences in distribution are important to consider when selecting a species to ensure that the productivity and timing of that productivity will meet your needs.

Table 4. Yield and quality over three harvests by species, 2021.

Species	DM yield				CP	ADF % of DM	NDF	30-hr NDF digestibility % of NDF
	1st cut	2nd cut	3rd cut	Total				
Kentucky bluegrass	1.88a†	0.335b	0.298cd	2.51ab	14.4a	34.0c	55.8c	61.7e
Meadow brome	1.91a	0.485b	0.980a	3.37a	15.2a	33.3c	56.5c	70.7a
Meadow fescue	1.46a	0.457b	0.550bc	2.47b	14.5a	30.6b	52.2b	70.2ab
Orchardgrass	1.84a	0.470b	0.758ab	3.07ab	13.8a	32.9c	56.6c	65.2d
Perennial ryegrass	0.338b	0.964a	0.154d	1.46c	11.4b	29.5a	47.9a	68.2bc
Timothy	1.62a	0.989a	0.506bc	3.12ab	13.9a	31.4b	52.1b	66.8cd
Level of significance‡	***	***	***	***	***	***	***	***
Trial mean	1.44	0.663	0.544	2.65	13.6	31.6	53.2	67.3

†Treatments that share a letter performed statistically similarly to one another.

‡*** $p < 0.0001$

Average quality parameters also varied by species across the season. Crude protein levels were highest in meadow brome at 15.2%, however, this was statistically similar to all other species except for perennial ryegrass. Perennial ryegrass, however, had the lowest ADF and NDF fiber fractions of all the species trialed. Of the NDF, over 70% was digestible in 30 hours for meadow brome and meadow fescue which was statistically higher than all other species. Kentucky bluegrass had the lowest digestibility of only 61.7%.

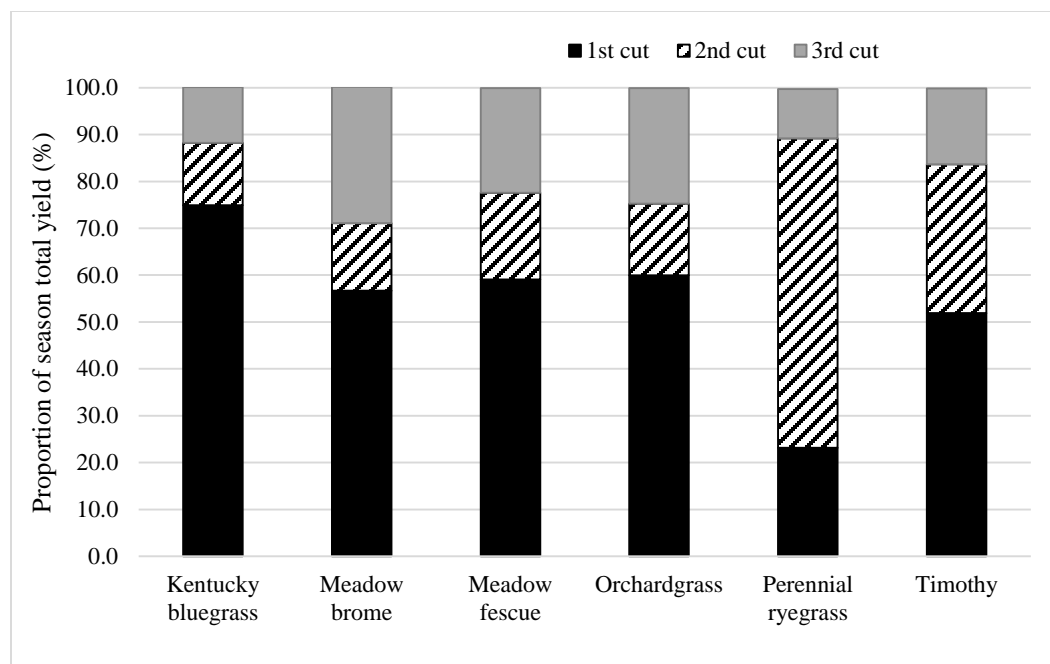


Figure 1. Seasonal distribution of yield by species, 2021.

Impact of Variety- Kentucky bluegrass

Two varieties of Kentucky bluegrass were included in this evaluation (Table 5). In 2020, results were not reported for these varieties due to poor establishment and growth through the season. In 2021, the two varieties performed similarly to one another in yield and most quality parameters. Through the season, they averaged 2.51 tons ac⁻¹ at 14.4% protein and 61.7% NDF digestibility. Both varieties exhibited the same distribution of dry matter over the three harvests producing the majority in the 1st harvest. The variety Balin had a higher severity of leaf spots in the fall compared to Ginger, however, the overall severity was still quite low.

Table 5. Yield and quality of two varieties of Kentucky bluegrass, 2021.

Variety	DM Yield				CP	ADF	NDF	30-hr NDF digestibility	uNDF 240-hour	Rust 0-5 severity rating	Leaf spots
	1st cut	2nd cut	3rd cut	Total							
Balin	1.44	0.318	0.274	2.03	14.2	34.3b†	56.1	60.9	16.1	0.200	1.20b
Ginger	2.32	0.352	0.322	3.00	14.6	33.6a	55.5	62.5	14.9	0.600	0.600a
LSD ($p = 0.10$) ‡	NS¥	NS	NS	NS	NS	0.432	NS	NS	NS	NS	0.522
Species mean	1.88	0.335	0.298	2.51	14.4	34.0	55.8	61.7	15.5	0.400	0.900

†Treatments that share a letter performed statistically similarly to one another.

‡LSD; least significant difference at the $p=0.10$ level.

The top performing treatment is indicated in **bold**.

¥NS; not statistically significant.

Meadow Brome

Three varieties of meadow brome were included in this evaluation (Table 6). Similar to 2020, the three varieties performed similarly to one another in both yield and quality parameters. The meadow bromes

yielded an average of 3.37 tons ac⁻¹ over the three harvests. All varieties followed similar patterns of dry matter distribution through the season with 1st cut being the largest followed by 3rd cut and 2nd cut being the smallest. Crude protein averaged 15.2% and NDF digestibility averaged over 70%. Severity of rust and leaf spots in the fall were relatively low averaging approximately 1.4 on the 5-point scale for both. The varieties also exhibited similar maturation timing all heading around the 20-May.

Table 6. Yield and quality of three varieties of meadow brome, 2021.

Variety	DM Yield				CP	ADF	NDF	30-hr NDF digestibility	uNDF 240-hour	Rust	Leaf spots
	1st cut	2nd cut	3rd cut	Total							
Fleet	2.01	0.536	1.03	3.58	15.2	33.5	56.6	70.9	10.4	0.800	1.00
Macbeth	2.17	0.469	0.985	3.62	14.8	33.3	56.6	70.1	10.4	1.20	1.80
Montana	1.55	0.451	0.920	2.92	15.5	33.0	56.4	71.0	10.1	2.00	1.40
LSD ($p = 0.10$) ‡	NS†	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Species mean	1.91	0.485	0.980	3.37	15.2	33.3	56.5	70.7	10.3	1.33	1.40

†NS; not statistically significant

‡LSD; least significant difference at the $p=0.10$ level.

The top performer is indicated in **bold**.

Meadow Fescue

Five varieties of meadow fescue were included in this evaluation (Table 7). The varieties did not differ in dry matter yield, but did differ in some quality parameters. Total dry matter yields ranged from 2.04 to 2.78 tons ac⁻¹ but were statistically similar between varieties. Most of the varieties followed similar dry matter distribution patterns through the season, however, Laura and Preval both increased in yield substantially between the 2nd and 3rd cuttings while the other varieties were similar or lower in the 3rd cutting (Figure 2).

Table 7. Yield and quality of five varieties of meadow fescue, 2021.

Variety	DM Yield				CP	ADF	NDF	30-hr NDF digestibility	uNDF 240-hour	Rust	Leaf spots
	1st cut	2nd cut	3rd cut	Total							
Laura	1.64	0.335	0.730	2.71	15.1	30.1	53.6	68.7bc†	11.6b	3.20	3.00
Liherold	1.55	0.540	0.454	2.55	14.4	30.8	52.2	71.7ab	10.2ab	4.80	3.20
Preval	1.53	0.523	0.720	2.78	15.9	31.0	52.2	70.5abc	11.1b	1.80	2.00
SW Minto	1.08	0.466	0.492	2.04	13.0	31.4	52.3	67.9c	11.9b	2.80	2.40
Tetrax	1.49	0.419	0.356	2.26	14.3	29.9	50.5	72.4a	9.38a	2.20	2.20
LSD ($p = 0.10$) ‡	NS¥	NS	NS	NS	NS	NS	NS	3.02	1.66	NS	NS
Species mean	1.46	0.457	0.550	2.47	14.5	30.6	52.2	70.2	10.8	2.96	2.56

†Treatments that share a letter performed statistically similarly to one another.

‡LSD; least significant difference at the $p=0.10$ level.

The top performing treatment is indicated in **bold**.

¥NS; not statistically significant.

As was observed in 2020, the varieties Tetrax and Preval matured late, heading out on 3-Jun. Conversely, SW Minto headed much earlier and was headed by 20-May and the other varieties headed in between. Average quality across the three harvests showed statistical differences between varieties for only NDF digestibility measures. The variety Tetrax had a 30-hour NDF digestibility of 72.4%, which was statistically

similar to Liherold and Preval. SW Minto had the lowest NDF digestibility of 67.9%. Similarly, Tetrax had the lowest uNDF level of 9.38% which was statistically similar to Liherold.

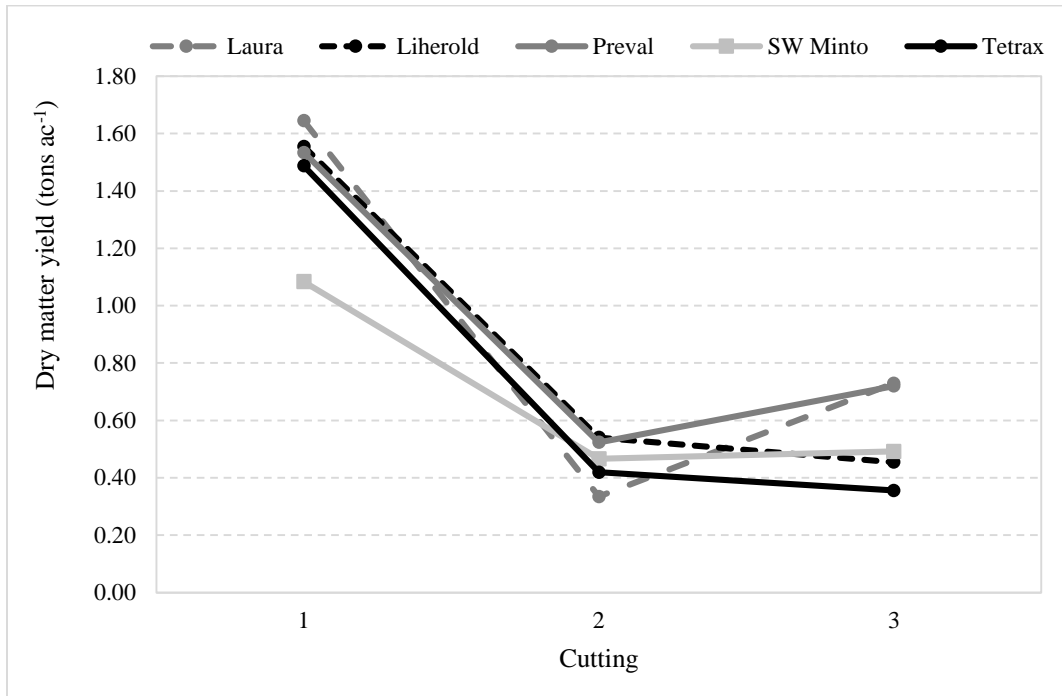


Figure 2. Dry matter yield of five meadow fescue varieties over three cuttings, 2021.

Orchardgrass

The seven varieties of orchardgrass differed statistically in terms of yield, but did not differ in quality (Table 8). Harvestar, Inavale, Luxor, Olathe, and Otello all matured early, heading out around 20-May. The varieties Echelon, Husar, and Niva were slightly later, heading around 24-May. In the 2nd harvest, yields ranged from 0.227 to 0.639 tons ac⁻¹. The highest yielding variety at 2nd cut was Niva, which was statistically similar to four other varieties. Overall season yields also differed across varieties. The highest yielding variety was Inavale with 3.79 tons ac⁻¹ which was statistically similar to five other varieties. The lowest yielding variety was Niva which produced only 1.94 tons ac⁻¹. Average quality and disease severity did not differ statistically across varieties. Average crude protein and digestibility measures were relatively low compared to other species in the trial averaging 13.8% for crude protein and 65.2% for 30-hour NDF digestibility respectively. Undigested NDF levels were also relatively high averaging 12.5%.

Table 8. Yield and quality of eight varieties of orchardgrass, 2021.

Variety	DM Yield				CP	ADF	NDF	30-hr NDF digestibility	uNDF 240-hour	Rust	Leaf spots
	1st cut	2nd cut	3rd cut	Total							
Echelon	1.71	0.546ab†	0.789	3.05ab	14.2	32.7	57.0	64.9	12.5	1.20	1.40
Harvestar	2.11	0.542ab	0.622	3.27ab	12.4	33.6	57.0	65.7	11.9	2.80	2.00
Husar	1.45	0.227c	0.266	1.94c	12.5	32.8	54.9	64.6	12.0	2.80	2.20
Inavale	2.27	0.608a	0.909	3.79a	13.4	34.1	56.8	64.3	12.8	1.60	1.60
Luxor	1.76	0.312bc	0.887	2.96ab	14.5	32.1	57.1	65.6	12.8	0.200	1.80
Niva	2.00	0.639a	1.00	3.64ab	15.3	32.3	56.4	65.1	13.0	0.800	0.800
Olathe	1.56	0.615a	1.03	3.21ab	14.3	33.2	56.7	65.9	12.1	1.20	1.80
Otello	1.84	0.272bc	0.565	2.68bc	14.0	32.2	57.0	65.6	12.7	1.20	1.60
LSD ($p = 0.10$) ‡	NS¥	0.294	NS	0.97	NS	NS	NS	NS	NS	NS	NS
Species mean	1.84	0.470	0.758	3.07	13.8	32.9	56.6	65.2	12.5	1.48	1.65

†Treatments that share a letter performed statistically similarly to one another.

‡LSD; least significant difference at the $p=0.10$ level.

The top performing treatment is indicated in **bold**.

¥NS; not statistically significant.

Perennial Ryegrass

Six varieties of perennial ryegrass were included in this evaluation (Table 9). Perennial ryegrass is the least cold hardy species included in this trial and therefore, may not be recommended for your specific location. Sites with prolonged periods of cold temperatures, with little to no insulation from snow cover during the winter, can lead to reduced survival and productivity.

Table 9. Yield and quality of six varieties of perennial ryegrass, 2021.

Variety	DM Yield				CP	ADF	NDF	30-hr NDF digestibility	uNDF 240-hour	Rust	Leaf spots
	1st cut	2nd cut	3rd cut	Total							
Calibra	0.512	0.775	0.000b†	1.29	10.6	29.4	45.7a	67.4	12.1a	2.20	1.80
Kentaur	0.364	0.928	0.150b	1.44	11.1	28.7	47.0ab	68.2	11.8a	2.00	2.00
Remington	0.139	1.097	0.101b	1.34	11.4	29.7	49.0c	67.4	13.1b	2.40	2.00
Tivoli	0.287	1.081	0.000b	1.37	11.6	30.0	47.9bc	68.8	11.8a	3.60	2.60
Tomaso	0.420	0.899	0.619a	1.94	13.0	29.7	48.9bc	68.9	12.0a	1.80	2.00
Toronto	0.304	1.004	0.055b	1.36	11.0	29.5	49.0c	68.3	13.1b	2.40	2.20
LSD ($p = 0.10$) ‡	NS¥	NS	0.325	NS	NS	NS	2.03	NS	0.935	NS	NS
Species mean	0.34	0.964	0.154	1.46	11.4	29.5	47.9	68.2	12.3	2.40	2.10

†Treatments that share a letter performed statistically similarly to one another.

‡LSD; least significant difference at the $p=0.10$ level.

The top performing treatment is indicated in **bold**.

¥NS; not statistically significant.

The winter of 2020-2021 was warmer than normal during most months with below average precipitation. The plots survived the winter but were much less vigorous than in 2020 and continued to struggle through yet another dry year. Dry matter yields overall did not differ by variety and averaged only 1.46 tons ac^{-1} .

However, yields during the 3rd harvest did differ significantly. By the third harvest, most varieties could not recover from the drought stress and were not harvestable or produced very little biomass, however, Tomaso produced 0.619 tons ac⁻¹. Varieties also differed in fiber (NDF) content and uNDF content. Calibra had the lowest average NDF content of 45.7% which was statistically similar to Kentaur. The lowest uNDF content was 11.8% from Tivoli which was statistically similar to four other varieties. Average crude protein was quite low at 11.4%. Average NDF digestibility was <70% for all varieties averaging 68.2%.

When we look at the dry matter yield by cutting, we see differences in productivity throughout the season across the varieties, however it is important to note that these were not statistically significant (Figure 3). While most varieties follow a similar pattern of the highest yielding at the 2nd harvest followed by the 1st and 3rd, Calibra produced more similarly between the 1st and 2nd harvest compared to other varieties. Similarly, Tomaso produced a much more substantial 3rd harvest than all other varieties. In general, this distribution is much different than all the other species and demonstrates the benefit of increasing the diversity of species in a stand in order to be resilient to a wider range of growing conditions.

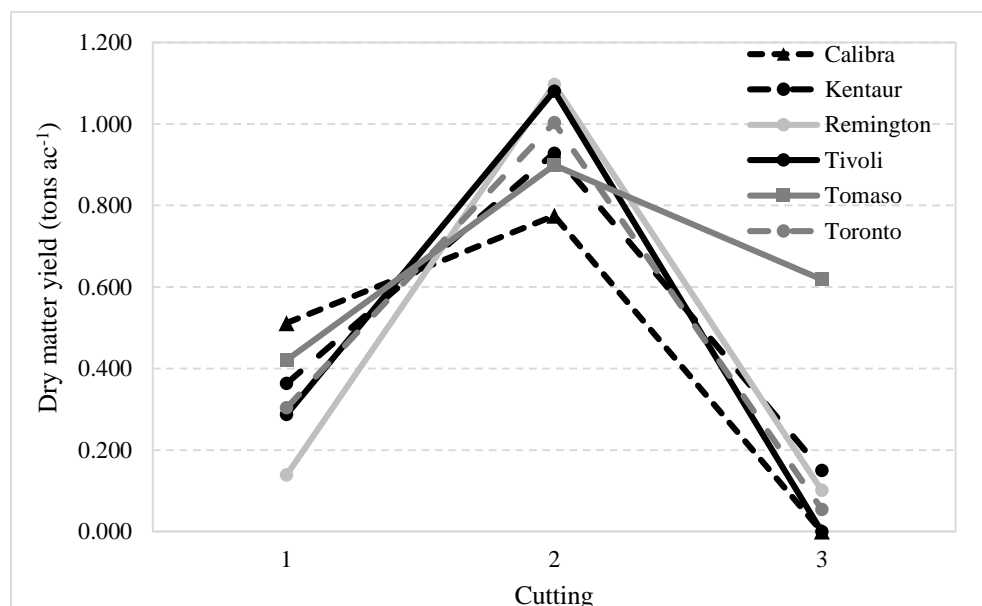


Figure 3. Dry matter yield of six perennial ryegrass varieties over three cuttings, 2021.

Timothy

Six varieties of timothy were included in this evaluation (Table 10, Figure 4). Results were not reported for timothy varieties in 2020 due to poor establishment. In 2021, the timothy varieties differed in yield at 2nd cut and in fiber contents. Yields at the second harvest ranged from 0.577 to 1.640 tons ac⁻¹. Overall season yields did not differ by variety and averaged 3.12 tons ac⁻¹. The distribution of dry matter across the season was quite different between the varieties. While most of the varieties gradually declined in yield as the season progressed, Tuukka produced similar yields in the 1st and 2nd harvests while Climax experienced a dramatic decline from the 1st to 2nd harvest. This suggests that some varieties may tolerate heat and drought conditions better than others.

Table 10. Yield and quality of six varieties of Timothy, 2021.

Variety	DM Yield				CP	ADF	NDF	30-hr NDF digestibility	uNDF 240-hour	Rust 0-5 severity rating	Leaf spots
	1st cut	2nd cut	3rd cut	Total							
Barfleo	1.37	0.608b†	0.438	2.42	13.9	30.4a	53.2b	66.8	13.2	2.00	2.20
Barpenta	2.00	1.351a	0.595	3.94	15.6	31.1a	51.2a	69.3	10.9	0.200	1.00
Climax	1.91	0.705b	0.497	3.11	13.9	31.7ab	54.0b	63.9	13.7	0.400	1.40
Lischka	1.24	0.577b	0.329	2.15	12.0	32.9b	52.3ab	64.8	12.8	0.600	1.80
Promesse	1.59	1.054ab	0.639	3.29	13.4	31.3a	50.9a	67.9	11.1	0.400	1.40
Tuukka	1.60	1.640a	0.538	3.78	14.4	30.9a	51.0a	68.1	11.4	0.600	1.00
LSD ($p = 0.10$) ‡	NS¥	0.598	NS	NS	NS	1.36	1.78	NS	NS	NS	NS
Species mean	1.62	0.989	0.506	3.12	13.9	31.4	52.1	66.8	12.2	0.700	1.47

†Treatments that share a letter performed statistically similarly to one another.

‡LSD; least significant difference at the $p=0.10$ level.

The top performing treatment is indicated in **bold**.

¥NS; not statistically significant.

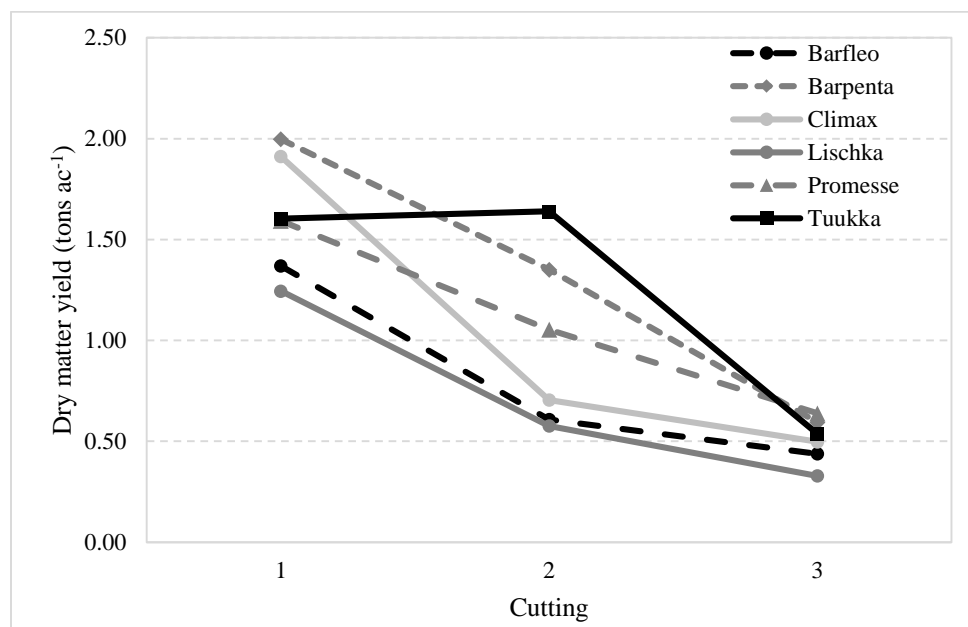


Figure 4. Dry matter yield of six timothy varieties over three cuttings, 2021.

DISCUSSION

Overall, performance of these perennial grasses was substantially lower in 2021 than 2020. Overall, yields averaged just 2.65 tons ac^{-1} , half of the 2020 yields. However, similar to 2020 orchardgrass and meadow brome produced the highest yields. While perennial ryegrass is often regarded as the gold standard for producing excellent dairy quality forage, meadow brome and meadow fescue rivaled its quality while producing higher yields. However, it is also critical to recognize that forage quality is significantly impacted by harvest timing. Within species, varieties differed in maturation timing, which can impact the suitability to your operation. Fields that tend to be wetter and more difficult to harvest early in the spring should be planted to later maturing varieties, allowing a longer harvest window prior to declines in quality. Finally,

the distribution of dry matter production throughout the season can be important to consider, especially for use in grazing systems. Yield and quality data by variety across each cutting can be found in Tables 11 and 12 and Figure 5. It is important to recognize that these data only represent one year and should not alone be used to make management decisions.

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Table 11. Dry matter yield for 30 varieties of six perennial grass species, 2021.

Species	Variety	Heading date	DM Yield			Total
			1st cut 20-May	2nd cut 7-Jul	3rd cut 24-Aug	
Kentucky Bluegrass	Balin	20-May	1.44	0.318	0.274	2.03
	Ginger	20-May	2.32	0.352	0.322	3.00
Species mean			1.88	0.335	0.298	2.51
Meadow Brome	Fleet	20-May	2.01	0.536	1.03	3.58
	Macbeth	20-May	2.17	0.469	0.985	3.62
	Montana	20-May	1.55	0.451	0.920	2.92
Species mean			1.91	0.485	0.980	3.37
Meadow Fescue	Laura	1-Jun	1.64	0.335	0.730	2.71
	Liherold	1-Jun	1.55	0.540	0.454	2.55
	Preval	3-Jun	1.53	0.523	0.720	2.78
	SW Minto	20-May	1.08	0.466	0.492	2.04
	Tetrax	3-Jun	1.49	0.419	0.356	2.26
Species mean			1.46	0.457	0.550	2.47
Orchardgrass	Echelon	24-May	1.71	0.546	0.789	3.05
	Harvestar	20-May	2.11	0.542	0.622	3.27
	Husar	24-May	1.45	0.227	0.266	1.94
	Inavale	20-May	2.27	0.608	0.909	3.79
	Luxor	20-May	1.76	0.312	0.887	2.96
	Niva	24-May	2.00	0.639	1.00	3.64
	Olathe	20-May	1.56	0.615	1.03	3.21
	Otello	20-May	1.84	0.272	0.565	2.68
Species mean			1.84	0.470	0.758	3.07
Perennial Ryegrass	Calibra	7-Jun	0.512	0.775	0.000	1.29
	Kentaur	7-Jun	0.364	0.928	0.150	1.44
	Remington	7-Jun	0.139	1.097	0.101	1.34
	Tivoli	7-Jun	0.287	1.081	0.000	1.37
	Tomaso	7-Jun	0.420	0.899	0.619	1.94
	Toronto	7-Jun	0.304	1.004	0.055	1.36
Species mean			0.34	0.964	0.154	1.46
Timothy	Barfleo	N/A	1.37	0.608	0.438	2.42
	Barpenta	N/A	2.00	1.351	0.595	3.94
	Climax	N/A	1.91	0.705	0.497	3.11
	Lischka	N/A	1.24	0.577	0.329	2.15
	Promesse	N/A	1.59	1.054	0.639	3.29
	Tuukka	N/A	1.60	1.640	0.538	3.78
Species mean			1.62	0.989	0.506	3.12

The top performing treatment is in **bold**.

Table 12. Average quality of 30 varieties of six perennial grass species, 2021.

Species	Variety	CP	% of DM			% of NDF		Rust 0-5 severity rating	Leaf spots
			ADF	NDF	NFC	30-hr NDF digestibility	uNDF 240-hour		
Kentucky Bluegrass	Balin	14.2	34.3	56.1	20.5	60.9	16.1	0.200	1.20
	Ginger	14.6	33.6	55.5	19.1	62.5	14.9	0.600	0.600
Species mean		14.4	34.0	55.8	19.8	61.7	15.5	0.400	0.900
Meadow Brome	Fleet	15.2	33.5	56.6	18.1	70.9	10.4	0.800	1.00
	Macbeth	14.8	33.3	56.6	17.6	70.1	10.4	1.20	1.80
	Montana	15.5	33.0	56.4	16.9	71.0	10.1	2.00	1.40
Species mean		15.2	33.3	56.5	17.6	70.7	10.3	1.33	1.40
Meadow Fescue	Laura	15.1	30.1	53.6	21.1	68.7	11.6	3.20	3.00
	Liherold	14.4	30.8	52.2	23.4	71.7	10.2	4.80	3.20
	Preval	15.9	31.0	52.2	21.8	70.5	11.1	1.80	2.00
	SW Minto	13.0	31.4	52.3	23.4	67.9	11.9	2.80	2.40
	Tetrax	14.3	29.9	50.5	23.3	72.4	9.38	2.20	2.20
Species mean		14.5	30.6	52.2	22.6	70.2	10.8	2.96	2.56
Orchardgrass	Echelon	14.2	32.7	57.0	17.6	64.9	12.5	1.20	1.40
	Harvestar	12.4	33.6	57.0	19.4	65.7	11.9	2.80	2.00
	Husar	12.5	32.8	54.9	21.6	64.6	12.0	2.80	2.20
	Inavale	13.4	34.1	56.8	18.7	64.3	12.8	1.60	1.60
	Luxor	14.5	32.1	57.1	17.6	65.6	12.8	0.200	1.80
	Niva	15.3	32.3	56.4	18.0	65.1	13.0	0.800	0.800
	Olathe	14.3	33.2	56.7	18.4	65.9	12.1	1.20	1.80
	Otello	14.0	32.2	57.0	17.9	65.6	12.7	1.20	1.60
Species mean		13.8	32.9	56.6	18.6	65.2	12.5	1.48	1.65

Species	Variety	CP	ADF	NDF	NFC	30-hr NDF digestibility	uNDF 240-hour	Rust	Leaf spots
			% of DM			% of NDF		0-5 severity rating	
Perennial Ryegrass	Calibra	10.6	29.4	45.7	29.6	67.4	12.1	2.20	1.80
	Kentaur	11.1	28.7	47.0	28.3	68.2	11.8	2.00	2.00
	Remington	11.4	29.7	49.0	25.2	67.4	13.1	2.40	2.00
	Tivoli	11.6	30.0	47.9	27.5	68.8	11.8	3.60	2.60
	Tomaso	13.0	29.7	48.9	25.2	68.9	12.0	1.80	2.00
	Toronto	11.0	29.5	49.0	26.6	68.3	13.1	2.40	2.20
Species mean		11.4	29.5	47.9	27.1	68.2	12.3	2.40	2.10
Timothy	Barfleo	13.9	30.4	53.2	23.8	66.8	13.2	2.00	2.20
	Barpenta	15.6	31.1	51.2	22.3	69.3	10.9	0.200	1.00
	Climax	13.9	31.7	54.0	22.2	63.9	13.7	0.400	1.40
	Lischka	12.0	32.9	52.3	26.1	64.8	12.8	0.600	1.80
	Promesse	13.4	31.3	50.9	25.3	67.9	11.1	0.400	1.40
	Tuukka	14.4	30.9	51.0	24.2	68.1	11.4	0.600	1.00
Species mean		13.9	31.4	52.1	24.0	66.8	12.2	0.700	1.47

The top performing treatment is in **bold**.

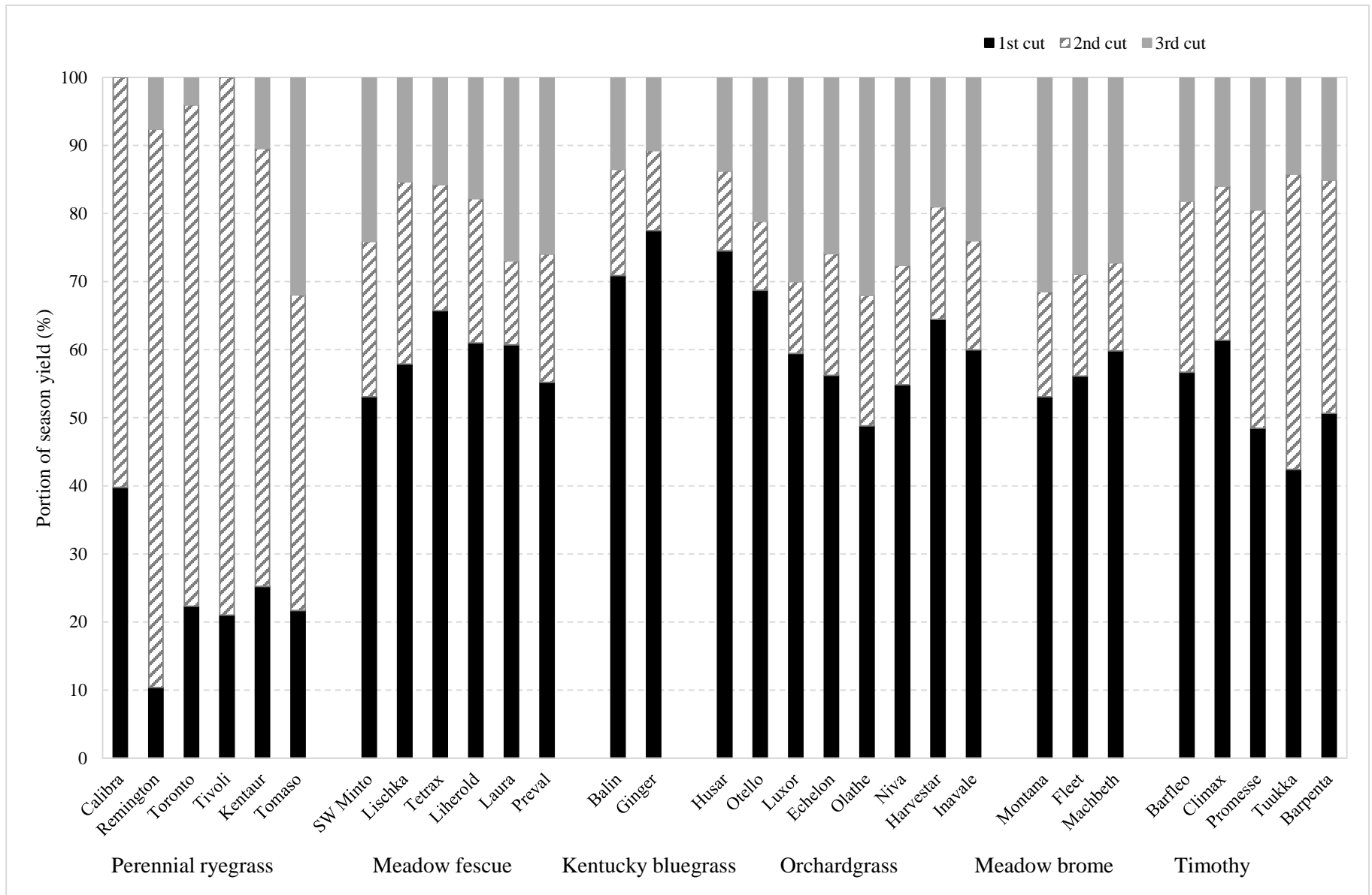


Figure 5. Dry matter yield distribution over three harvests, 2021.