NORTHWEST CROPS & SOILS PROGRAM

2022 Perennial Grass Variety Trial

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2022 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 2022 growing season was the third full season after establishment. Monitoring the stand over multiple years will help evaluate yield, quality, survivability, pest resistance, persistence, and other characteristics of these species and varieties to 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 and quality.

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

Species	Variety
Orchardgrass	Echelon
	Harvestar
	Husar
	Inavale
	Luxor
	Niva
	Olathe
	Otello

Species	Variety
Perennial ryegrass	Calibra
	Kentaur
	Remington
	Tivoli
	Tomaso
	Toronto
Timothy	Barfleo
	Barpenta
	Climax
	Lischka
	Promesse
	Tuuka

The soil type at the Alburgh location was a Benson rocky silt loam (Table 2). The seedbed was moldboard plowed, disked, and finished with a spike tooth harrow prior to planting in 2019. The previous crop was soybean. Plots were 5’ x 20’ and replicated 5 times. In 2022, plots were harvested with a Carter flail forage harvester in a 3’ x 20’ area on 23-May, 1-Jul, and 16-Aug.

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 (2022)	23-May, 1-Jul, and 16-Aug

An approximate 1 lb subsample of the harvested material was collected and dried to calculate dry matter yield and forage quality. 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.

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.

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 an 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 2021 was warmer and wetter than normal. Winter temperatures were below normal, especially in January which saw nearly half of the days with average temperatures <10°F. Precipitation was below normal for January and February 2022. Despite a cool wet April, conditions in May were warmer with normal precipitation. However, monthly fluctuations led to June and August having cooler wetter weather and May and July having warmer drier weather. Overall, the grass trial accumulated 4008 Growing Degree Days (GDDs) in 2022, 14 above the 30-year normal.

Table 3. 2021-2022 weather data for Alburgh, VT.

	2021			2022							
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Average temperature (°F)	54.6	37.6	28.6	10.7	20.0	32.3	44.8	60.5	65.3	71.9	70.5
Departure from normal	4.31	-1.68	0.36	-10.20	-2.93	-0.03	-0.81	2.09	-2.18	-0.54	-0.20
Precipitation (inches)	6.23	2.26	1.42	0.28	1.14	2.52	5.57	3.36	8.19	3.00	4.94
Departure from normal	2.40	-0.44	-1.08	-1.85	-0.63	0.28	2.50	-0.40	3.93	-1.06	1.40
Growing Degree Days (base 41°F)	441	90	36	0	11	60	201	617	726	953	909
Departure from normal	137	9	36	0	11	38	-14	77	-67	-20	-11

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 in the trial continued to be challenged by difficult weather conditions and the age of the stand. However, there were still significant differences between species (Table 4). The meadow bromes again produced the highest first cut yields averaging 1.44 tons ac^{-1} which was significantly higher than all other species. The perennial ryegrass, which had performed very well in the spring of 2020, likely suffered from drought stress and potential winter survival issues in the past several years, resulting in very low yields in the spring of 2022 of only 0.236 tons ac^{-1}. Second cut was again dominated by the timothy, which produced 1.90 tons ac^{-1} with all others averaging around 1 ton ac^{-1}. The third cutting was similar or lower than 2nd cut for all species with no harvestable regrowth having accumulated for the perennial ryegrasses. The distribution of yield over the harvest can be a helpful tool in species and varietal selection (Figure 1). Meadow brome and Kentucky bluegrass produce more of their total biomass in the 1st harvest while timothy and perennial ryegrass produce more in the 2nd. Orchardgrass, interestingly, was more even across all three harvests this season. 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, 2022.

Species	1st cut	2nd cut	3rd cut	Season yield
		Dry matter tons ac^{-1}		
Kentucky bluegrass	0.824bc†	0.907bc	0.652bc	2.38c
Meadow fescue	0.689c	1.13bc	0.900ab	2.72bc
Meadow brome	**1.44a**	1.02bc	**1.09a**	**3.55a**
Orchardgrass	0.950b	1.35b	1.00a	3.30ab
Perennial ryegrass	0.236d	0.921c	0.00d	1.16d
Timothy	0.775bc	**1.90a**	0.618c	3.26ab
Level of significance	***	***	***	***
Trial mean	0.77	1.27	0.87	2.73

†Treatments that share a letter performed statistically similarly to one another.
The top performing treatment is indicated in **bold.**
*** p <0.0001

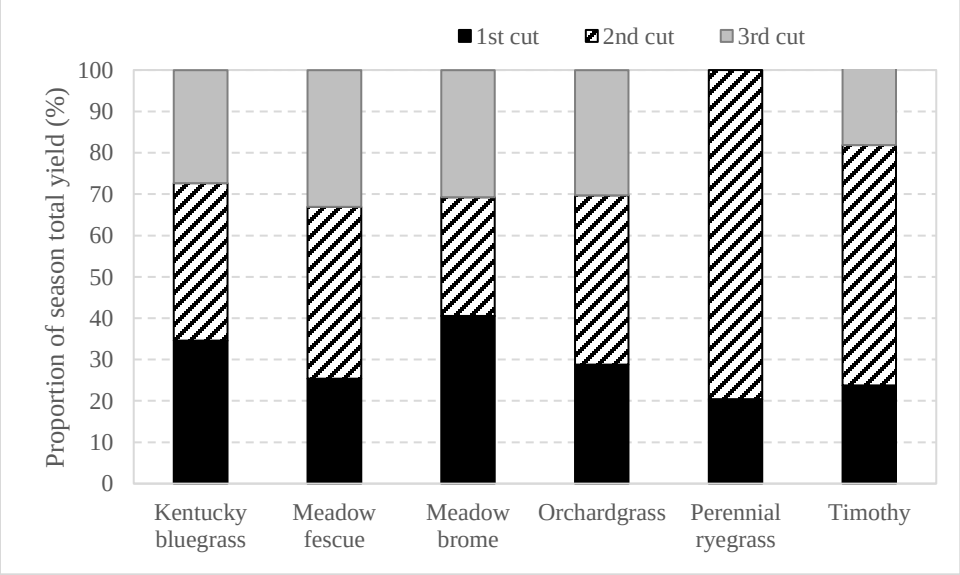

Figure 1. Seasonal distribution of yield by species, 2022.

Average quality parameters also varied by species across the season (Table 5). Crude protein levels were highest in meadow fescue at 13.9%, however, this was statistically similar to meadow brome and Kentucky bluegrass. The NDF concentrations were lowest in perennial ryegrass and meadow fescue and highest in the orchardgrass and meadow brome. Of the NDF, over 70% was digestible within 30 hours for meadow fescue and meadow brome which was statistically higher than all other species. Kentucky bluegrass had the lowest digestibility of 63.5%. Predicted milk yield per ton of forage fed was highest for meadow fescue at 4068 lbs ton^{-1}.

Table 5. Average forage quality characteristics by species, 2022.

Species	CP	NDF	WSC	30-hr NDFD	Milk yield
		% DM		% NDF	lbs ton^{-1}
Kentucky bluegrass	13.5ab	53.5c	11.8b	63.5d	3781bc
Meadow fescue	**13.9a**	51.1ab	12.9b	**72.7a**	**4068a**
Meadow brome	13.7ab	56.9d	9.95c	71.0ab	3702c
Orchardgrass	12.7b	56.9d	10.5c	67.0c	3796c
Perennial ryegrass	12.5b	**50.3a**	**15.1a**	68.5bc	3807c
Timothy	12.5b	52.0bc	12.8b	67.3c	3916b
Level of significance	**	***	***	***	***
Trial mean	13.0	53.4	12.3	68.5	3857

†Treatments that share a letter performed statistically similarly to one another.
The top performing treatment is indicated in **bold.**
*** p <0.0001
***p<.05*

Considering both dry matter yield and quality of that dry matter can help us better understand the value of the forage produced by these species (Table 6). Protein (CP) yield per acre was statistically similar for all species except for perennial ryegrass, which was significantly lower due to its low dry matter yield. Meadow brome produced the highest digestible NDF yields of 1.43 tons ac^{-1} which was similar to orchardgrass but significantly higher than all other species. Despite perennial ryegrass' significantly higher water soluble carbohydrates (WSC) content, its yield per acre limited its WSC yield to just .157 tons ac^{1}, significantly lower than all other species. Overall, milk yield per acre was highest for meadow brome, which was statistically similar to all species except for Kentucky bluegrass and perennial ryegrass.

Table 6. Yield of forage quality components by species, 2022.

Species	CP	30-hr digestible NDF	WSC	Milk yield
		tons ac^{-1}		
Kentucky bluegrass	0.330a	0.812c	0.263b	4.48b
Meadow fescue	0.380a	1.00bc	0.318ab	5.45ab
Meadow brome	**0.501a**	**1.43a**	0.327ab	**6.55a**
Orchardgrass	0.425a	1.25ab	0.313ab	6.19a
Perennial ryegrass	0.122b	0.380d	0.157c	2.05c
Timothy	0.403a	1.12bc	**0.345a**	6.15ab
Level of significance	***	***	***	***
Trial mean	0.354	0.997	0.287	5.15

†Treatments that share a letter performed statistically similarly to one another.
The top performing treatment is indicated in **bold.**
*** p <0.0001

Impact of Variety- Kentucky bluegrass

Two varieties of Kentucky bluegrass were included in this evaluation (Table 7). In 2022, the two varieties performed similarly to one another in yield and most quality parameters, as was also observed in 2021. Through the season they averaged 2.38 tons ac^{-1} at 13.5% protein and 63.5% NDF digestibility. The two varieties did differ slightly in WSC content with Balin averaging 1.5% higher than Ginger across the season. However, dry matter, quality components, and predicted milk yields were similar between the two varieties on a per acre basis. The two varieties also exhibited similar maturation timing heading around 21-May.

Table 7. Yield and quality of two varieties of Kentucky bluegrass, 2022.

Variety	1st cut	2nd cut	3rd cut	Season yield	CP	30-hr digestible NDF	WSC	Milk yield
	Dry matter tons ac^{-1}				tons ac^{-1}			
Balin	0.699	0.839	**0.763**	2.30	0.304	0.763	**0.277**	4.36
Ginger	**0.948**	**0.975**	0.540	**2.46**	**0.355**	**0.860**	0.248	**4.59**
LSD (p=0.10) ‡	NS†	NS	NS	NS	NS	NS	NS	NS
Species mean	0.824	0.907	0.652	2.38	0.330	0.812	0.263	4.48

The top performing treatment is indicated in **bold.**
†NS; not statistically significant
‡LSD; least significant difference at the p=0.10 level.

Meadow Brome

Three varieties of meadow brome were included in this evaluation (Table 8). Similar to previous years, the three varieties performed similarly to one another in both yield and quality parameters. The meadow bromes yielded an average of 3.55 tons ac^{-1} over the three harvests. Crude protein averaged 13.7% and NDF digestibility averaged just over 70%. The varieties also exhibited similar maturation timing all heading around the 25-May.

Table 8. Yield and quality of three varieties of meadow brome, 2022.

Variety	1st cut	2nd cut	3rd cut	Season yield	CP	30-hr digestible NDF	WSC	Milk yield
	Dry matter tons ac^{-1}				tons ac^{-1}			
Fleet	1.27	**1.30**	1.01	3.58	0.470	1.456	0.329	6.59
Macbeth	**1.69**	1.29	**1.38**	**4.36**	**0.670**	**1.77**	**0.381**	**8.21**
Montana	1.36	0.470	0.886	2.71	0.363	1.06	0.271	4.85
LSD (p=0.10) ‡	NS†	NS	NS	NS	NS	NS	NS	NS
Species mean	1.44	1.02	1.09	3.55	0.501	1.430	0.327	6.55

The top performing treatment is indicated in **bold.**
†NS; not statistically significant
‡LSD; least significant difference at the p=0.10 level.

Meadow Fescue

Five varieties of meadow fescue were included in this evaluation (Table 9). The varieties did not differ in dry matter yield or quality. Total dry matter yields averaged 2.72 tons ac^{-1} with only one variety, Preval, producing over 3 tons ac^{-1}. Protein levels averaged 13.9% with fiber digestibility averaging nearly 73%.

The varieties did differ slightly in maturation timing with all varieties, except Preval, heading around 30-May. Preval headed slightly later around 3-Jun.

Table 9. Yield and quality of five varieties of meadow fescue, 2022.

Variety	1st cut	2nd cut	3rd cut	Season yield	CP	30-hr digestible NDF	WSC	Milk yield
	Dry matter tons ac^{-1}				tons ac^{-1}			
Laura	0.715	1.38	0.687	2.78	0.412	1.03	0.297	5.69
Liherold	**0.852**	1.10	0.975	2.92	0.423	1.11	0.317	5.88
Preval	0.645	**1.39**	**1.19**	**3.23**	**0.458**	**1.21**	**0.355**	**6.34**
SW Minto	0.540	1.06	0.616	2.21	0.271	0.780	0.279	4.35
Tetrax	0.692	0.720	1.03	2.45	0.335	0.880	0.340	5.00
LSD (*p*=0.10) ‡	NS†	NS	NS	NS	NS	NS	NS	NS
Species mean	0.689	1.13	0.900	2.72	0.380	1.00	0.318	5.45

The top performing treatment is indicated in **bold.**
†NS; not statistically significant
‡LSD; least significant difference at the p=0.10 level.

Orchardgrass

The eight varieties of orchardgrass only differed statistically in terms of 1st cut yields (Table 10). Harvestar was the highest yielding at 1st cut producing 1.22 tons ac^{-1} which was statistically similar to Otello, Luxor, Niva, and Olathe. The varieties yielded similarly in the 2nd and 3rd harvests. Protein levels averaged 12.7% with Olathe and Otello producing slightly higher levels although not statistically different from the other varieties. Fiber digestibility averaged 67%. The varieties did differ dramatically in maturation timing. Otello and Olathe were the earliest maturing heading on the 23-May and 25-May respectively. Harvestar, Luxor, and Niva headed on 28-May, while Inavale, Echelon, and Husar headed on 30-May.

Table 10. Yield and quality of eight varieties of orchardgrass, 2022.

Variety	1st cut	2nd cut	3rd cut	Season yield	CP	30-hr digestible NDF	WSC	Milk yield
	Dry matter tons ac^{-1}				tons ac^{-1}			
Echelon	0.635c†	1.23	0.990	2.85	0.303	1.01	0.284	4.97
Harvestar	**1.22a**	1.30	1.04	3.56	0.449	1.35	0.361	6.81
Husar	0.768bc	1.09	0.795	2.65	0.333	0.995	0.266	5.02
Inavale	0.663c	1.44	0.721	2.82	0.368	1.07	0.263	5.30
Luxor	1.09a	1.22	1.08	3.40	0.428	1.28	0.331	6.36
Niva	1.02ab	1.57	1.05	3.64	0.478	1.39	0.335	6.97
Olathe	0.994ab	**1.66**	**1.28**	**3.94**	**0.537**	**1.49**	**0.340**	**7.29**
Otello	1.20a	1.31	1.04	3.56	0.509	1.39	0.326	6.83
LSD (*p*=0.10) ‡	0.304	NS¥	NS	NS	NS	NS	NS	NS
Species mean	0.950	1.35	1.00	3.30	0.425	1.25	0.313	6.19

†Treatments that share a letter performed statistically similarly to one another. The top performing treatment is indicated in **bold.**
‡LSD; least significant difference at the p=0.10 level.
¥NS; not statistically significant

Perennial Ryegrass

Six varieties of perennial ryegrass were included in this evaluation (Table 11). 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 11. Yield and quality of six varieties of perennial ryegrass, 2022.

Variety	1st cut	2nd cut	3rd cut	Season yield	CP	30-hr digestible NDF	WSC	Milk yield
	Dry matter tons ac^{-1}					tons ac^{-1}		
Calibra	0.271	0.707	0.000	0.978	0.088c†	0.293	0.149	1.71
Kentaur	0.252	0.832	0.000	1.08	0.104bc	0.361	0.161	1.87
Remington	0.251	**1.17**	0.000	**1.42**	**0.142a**	**0.449**	0.161	**2.37**
Tivoli	0.183	0.825	0.000	1.01	0.123abc	0.353	0.143	1.91
Tomaso	0.104	1.11	0.000	1.22	0.141a	0.410	0.149	2.20
Toronto	**0.358**	0.881	0.000	1.24	0.135ab	0.389	**0.182**	2.22
LSD (p=0.10) ‡	NS¥	NS	NS	NS	0.036	NS	NS	NS
Species mean	0.236	0.921	0.00	1.16	0.122	0.376	0.157	2.05

†Treatments that share a letter performed statistically similarly to one another. The top performing treatment is indicated in **bold.**
‡LSD; least significant difference at the p=0.10 level.
¥NS; not statistically significant.

The plots continue to overwinter but are progressively less vigorous and productive, likely due to several years of compounding drought stress. Dry matter yields overall did not differ by variety and averaged only 1.16 tons ac^{-1}. Due to minimal regrowth from hot and dry conditions, none of the varieties were harvestable for a 3rd harvest. Varieties did not differ in forage quality, however, there were slight differences in overall protein yield per acre with Remington, Tomaso, Toronto, and Tivoli producing significantly more than Calibra and Kentaur. While there were some differences in fiber digestibility and WSC content, ultimately the yields of these components were very low and did not differ by variety.

Timothy

Six varieties of timothy were included in this evaluation (Table 12). The varieties performed similarly in yield and quality. Similar to 2021, 1st cut yields were relatively low averaging .775 tons ac^{-1} while 2nd cut averaged 1.90 tons ac^{-1}. Total season yields averaged 3.26 tons ac^{-1} and, while there were some difference, they were not statistically significant. Protein and fiber digestibility were relatively low averaging 12.5% and67% respectively. These differences in yield and quality are reflected in the yield of quality components and predicted milk, however, the varieties were not statistically different from one another likely due to variability.

Table 12. Yield and quality of six varieties of Timothy, 2022.

Variety	1st cut	2nd cut	3rd cut	Season yield	CP	30-hr digestible NDF	WSC	Milk yield
	Dry matter tons ac^{-1}					tons ac^{-1}		
Barfleo	0.644	1.57	0.599	2.82	0.331	0.906	0.315	5.25

Barpenta	0.596	**2.23**	0.641	3.46	0.432	1.19	0.315	6.44
Climax	0.848	1.80	0.450	3.10	0.365	1.05	0.360	5.80
Lischka	0.673	1.41	0.592	2.68	0.286	0.90	0.309	4.99
Promesse	0.880	2.17	**0.688**	3.74	0.453	1.26	**0.401**	6.95
Tuukka	**1.01**	2.20	0.587	**3.79**	**0.550**	**1.42**	0.367	**7.48**
LSD (p=0.10) ‡	NS†	NS	NS	NS	NS	NS	NS	NS
Species mean	0.775	1.90	0.593	3.26	0.403	1.12	0.345	6.15

‡LSD; least significant difference at the p=0.10 level.
The top performing treatment is indicated in **bold.**
†NS; not statistically significant.

DISCUSSION

Overall, performance of these perennial grasses was similar to 2021 with season yields averaging just 2.73 tons ac^{-1}. However, similar to 2020 and 2021, 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 13 and 14 and Figures 2 and 3. 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 13. Dry matter yield for 30 varieties of six perennial grass species, 2022.

Species	Variety	Heading date	DM Yield			Total
			1st cut	2nd cut	3rd cut	
			20-May	7-Jul	24-Aug	
Kentucky Bluegrass	Balin	21-May	0.699	0.839	**0.763**	2.30
	Ginger	21-May	**0.948**	**0.975**	0.540	**2.46**
Species mean			0.824	0.907	0.652	2.38
Meadow Brome	Fleet	25-May	1.27	1.30	1.01	3.58
	Macbeth	25-May	1.69	1.29	1.38	4.36
	Montana	25-May	1.36	0.470	0.886	2.71
Species mean						
Meadow Fescue	Laura	30-May	0.715	1.38	0.687	2.78
	Liherold	30-May	**0.852**	1.10	0.975	2.92
	Preval	3-Jun	0.645	**1.39**	**1.19**	**3.23**
	SW Minto	30-May	0.540	1.06	0.616	2.21
	Tetrax	30-May	0.692	0.720	1.03	2.45
Species mean			0.689	1.13	0.900	2.72
Orchardgrass	Echelon	30-May	0.635	1.23	0.990	2.85
	Harvestar	28-May	**1.22**	1.30	1.04	3.56
	Husar	30-May	0.768	1.09	0.795	2.65
	Inavale	30-May	0.663	1.44	0.721	2.82
	Luxor	28-May	1.09	1.22	1.08	3.40
	Niva	28-May	1.02	1.57	1.05	3.64
	Olathe	25-May	0.994	**1.66**	**1.28**	**3.94**
	Otello	23-May	1.20	1.31	1.04	3.56
Species mean			0.950	1.35	1.00	3.30
Perennial Ryegrass	Calibra	N/A	0.271	0.707	0.000	0.978
	Kentaur	N/A	0.252	0.832	0.000	1.08
	Remington	N/A	0.251	**1.17**	0.000	**1.42**
	Tivoli	N/A	0.183	0.825	0.000	1.01
	Tomaso	N/A	0.104	1.11	0.000	1.22
	Toronto	N/A	**0.358**	0.881	0.000	1.24
Species mean			0.236	0.921	0	1.16
Timothy	Barfleo	N/A	0.644	1.57	0.599	2.82
	Barpenta	N/A	0.596	**2.23**	0.641	3.46
	Climax	N/A	0.848	1.80	0.450	3.10
	Lischka	N/A	0.673	1.41	0.592	2.68
	Promesse	N/A	0.880	2.17	**0.688**	3.74
	Tuukka	N/A	**1.01**	2.20	0.587	**3.79**
Species mean			0.775	1.90	0.592	3.26

Table 14. Average quality of 30 varieties of six perennial grass species, 2022.

Species	Variety	CP	WSC	NDF	30-hr NDF digestibility	CP	WSC	30-hr digestible NDF	Predicted milk yield
		% of DM			% of NDF	tons ac^{-1}			
Kentucky Bluegrass	Balin	13.3	**12.6**	**53.2**	63.0	0.304	**0.277**	0.763	4.36
	Ginger	**13.6**	11.1	53.7	**64.0**	**0.355**	0.248	**0.862**	**4.59**
Species mean		13.5	11.8	53.5	63.5	0.330	0.263	0.812	4.48
Meadow Brome	Fleet	12.8	9.78	57.7	70.2	0.470	0.329	1.46	6.59
	Macbeth	**14.7**	9.79	**56.1**	**72.5**	**0.670**	**0.381**	**1.77**	**8.21**
	Montana	13.7	**10.29**	57.0	70.5	0.363	0.271	1.06	4.85
Species mean		13.7	9.95	56.9	71.0	0.501	0.327	1.43	6.55
Meadow Fescue	Laura	**14.6**	12.2	51.8	72.0	0.412	0.297	1.03	5.69
	Liherold	14.2	11.6	52.8	72.0	0.423	0.317	1.11	5.88
	Preval	14.2	12.7	52.1	73.2	**0.458**	**0.355**	**1.21**	**6.34**
	SW Minto	12.7	13.5	51.6	70.3	0.271	0.279	0.781	4.35
	Tetrax	14.0	**14.3**	**47.4**	**75.9**	0.335	0.340	0.877	5
Species mean		13.9	12.9	51.1	72.7	0.380	0.318	1.00	5.45
Orchardgrass	Echelon	11.8	11.0	57.1	66.9	0.303	0.284	1.01	4.97
	Harvestar	12.6	10.9	56.5	66.9	0.449	**0.361**	1.35	6.81
	Husar	12.3	**11.3**	**56.4**	66.5	0.333	0.266	0.995	5.02
	Inavale	12.5	10.8	57.2	66.7	0.368	0.263	1.07	5.30
	Luxor	12.5	10.0	57.4	66.1	0.428	0.331	1.28	6.36
	Niva	13.0	10.4	57.0	67.2	0.478	0.335	1.39	6.97
	Olathe	13.5	9.8	56.6	67.9	**0.537**	0.340	**1.49**	**7.29**
	Otello	**13.8**	9.5	57.5	**68.0**	0.509	0.326	1.39	6.83
Species mean		12.7	10.5	56.9	67.0	0.425	0.313	1.25	6.19

Species	Variety	CP	WSC	NDF	30-hr NDF digestibility	CP	WSC	30-hr digestible NDF	Predicted milk yield
		% of DM			% of NDF	tons ac^{-1}			
Perennial Ryegrass	Calibra	11.0	**16.8**	49.2	66.7	0.088	0.149	0.293	1.71
	Kentaur	11.1	15.6	51.6	70.3	0.104	0.161	0.361	1.87
	Remington	13.2	13.1	52.0	64.5	**0.142**	**0.161**	**0.449**	**2.37**
	Tivoli	13.6	15.7	49.0	**73.1**	0.123	0.143	0.353	1.91
	Tomaso	**13.8**	13.8	51.6	68.2	0.141	0.149	0.410	2.20
	Toronto	12.6	15.7	**48.8**	68.4	0.135	0.182	0.389	2.22
Species mean		12.5	15.1	50.3	68.5	0.122	0.157	0.376	2.05
Timothy	Barfleo	12.0	13.0	52.0	64.2	0.331	0.315	0.906	5.25
	Barpenta	13.1	12.1	51.1	67.5	0.432	0.315	1.19	6.44
	Climax	12.0	**13.7**	52.2	68.4	0.365	0.360	1.05	5.80
	Lischka	11.0	13.2	53.6	64.5	0.286	0.309	0.904	4.99
	Promesse	12.4	12.4	53.0	66.6	0.453	**0.401**	1.26	6.95
	Tuukka	**14.6**	12.4	**50.0**	**72.7**	**0.550**	0.367	**1.42**	**7.48**
Species mean		12.5	12.8	52.0	67.3	0.403	0.345	1.12	6.15

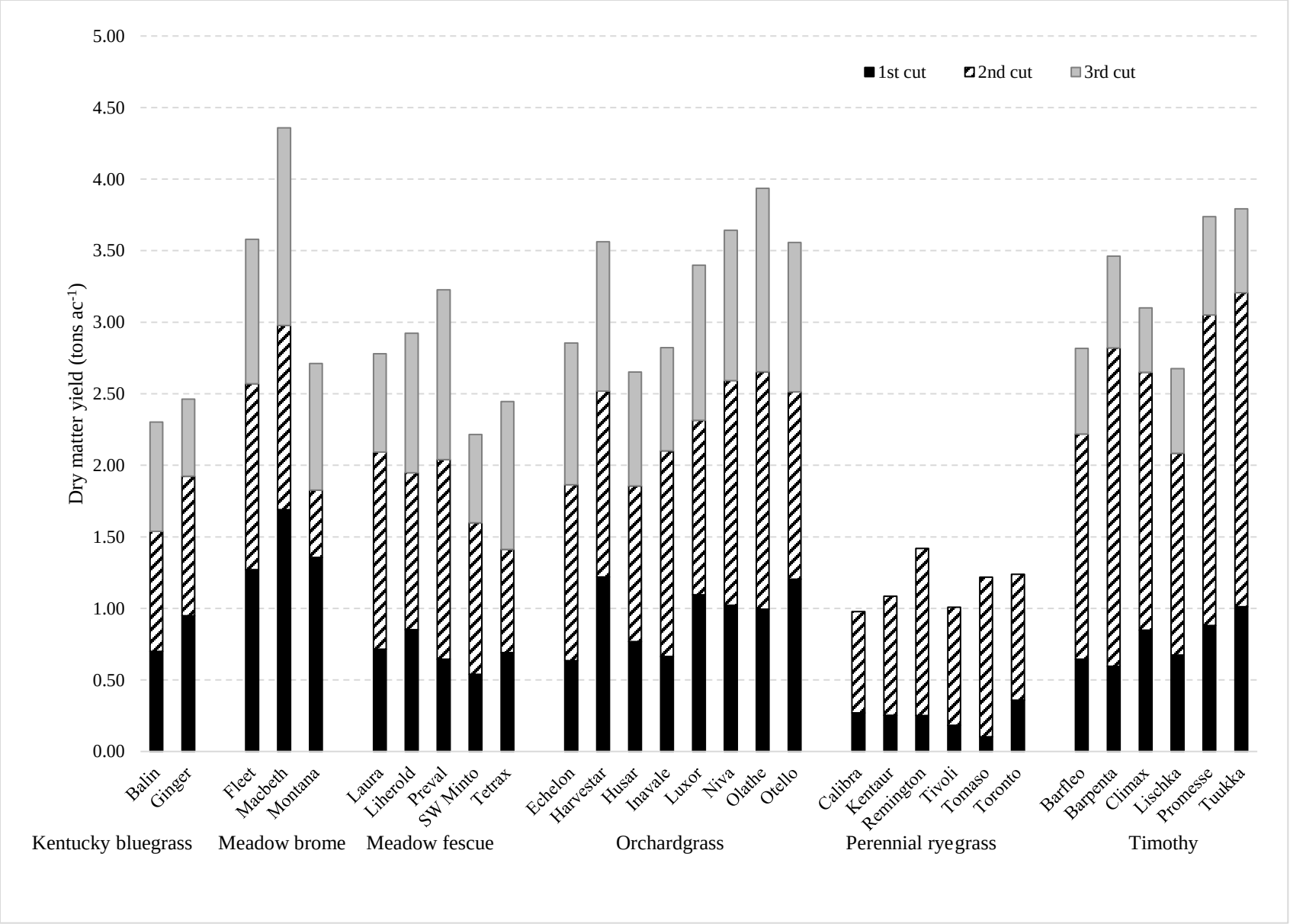

Figure 2. Dry matter yields over three harvests, 2022.

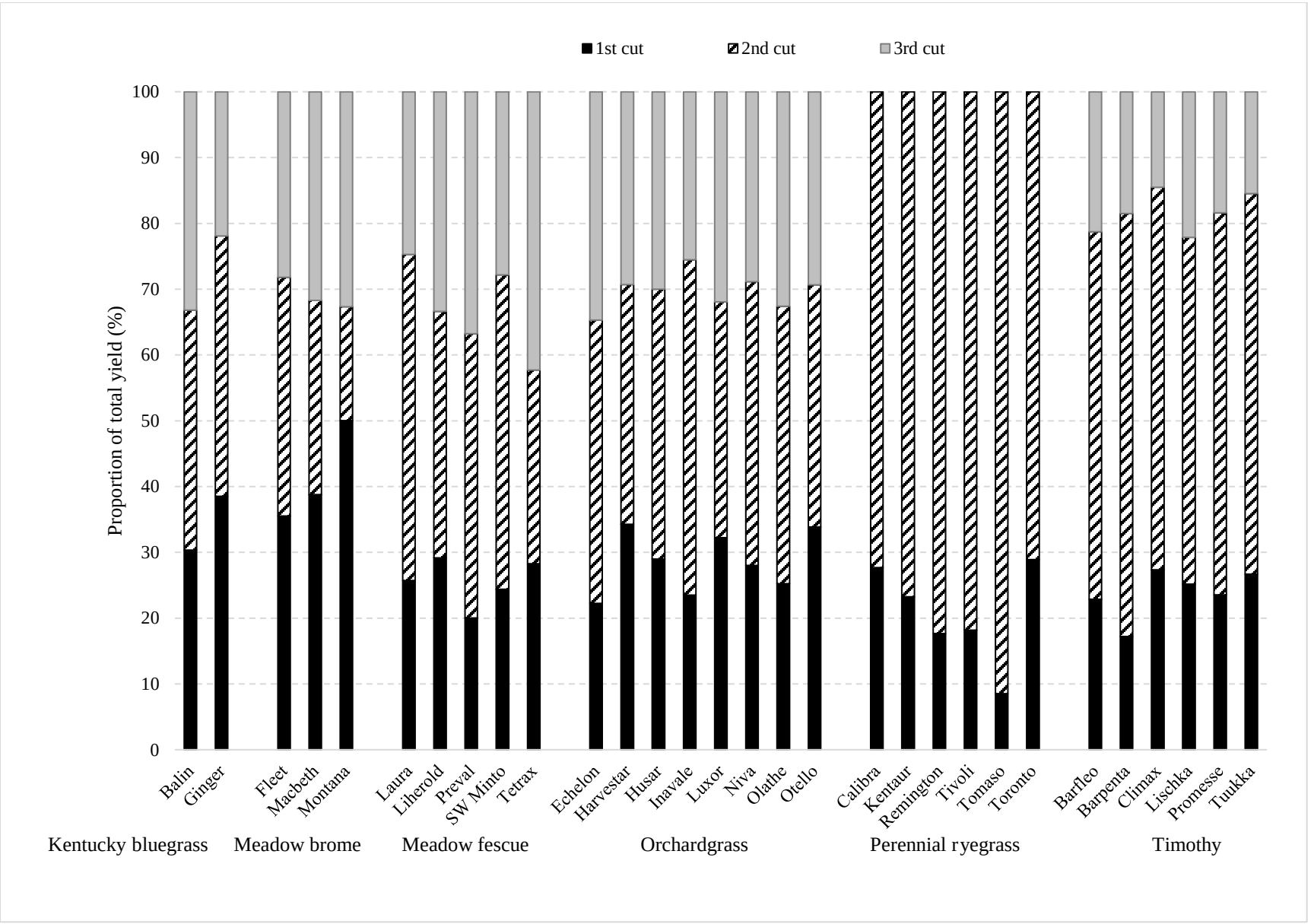

Figure 3. Dry matter yield distribution over three harvests, 2022.