2025 Forage Legume Variety Trial

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In 2024, the University of Vermont Extension Northwest Crops and Soils Program initiated a trial evaluating forage yield and quality of an array of perennial forage legume species and varieties planted in monoculture. The grass species selected were alfalfa, birdsfoot trefoil, red clover, and white clover. Monitoring these stands over multiple years can help evaluate yield, quality, survivability, pest resistance, persistence, and other characteristics of these species and varieties to identify those most suitable for 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 32 legume varieties seeded in monoculture and evaluated for forage yield.

Table 1. Perennial forage legume species and variety information, 2025.

Alfalfa	Birdsfoot trefoil	Red clover	White clover
AlfaMax HD 2 Plus	Bruce	Bearcat	Alice grazing clover
FSG415 BR	Bull	Blaze	Crusade
Galaxy200	Empire	Freedom!	Domino
KF PLH422	Leo	Milvus	Huia
KF 435 HD	Norcen	Persist	Kakariki
44 Mag	Wellington	Renegade	Ladino
Viking 374HD		Ruby	Legacy
Viking 394AP		VNS Medium	Marco Polo
			Renovation
			Rivendell

Table 2. Trial management, Alburgh, VT, 2025.

Location	**Borderview Research Farm - Alburgh, VT**
Soil type	Benson rocky silt loam
Previous crop	Perennial forbs (2024)
Plot size (ft)	5 x 20
Replicates	5
Tillage operations	Pottinger TerraDisc™ and spike tooth harrow
Planting equipment	Great Plains small plot drill
Planting date	17-Aug 2024
Harvest dates	29-May*
	1-Jul
	4-Aug

*No yields collected

The soil type at the trial location was a Benson rocky silt loam (Table 2). The seedbed was prepared using typical tillage operations for the area prior to planting. Plots were 5' x 20' and replicated 5 times. Due to spring weed pressure, plots were mowed and no yields collected at first harvest. At second and third harvests, the material within a 0.25m^2 quadrat was cut to approximately 4" from the soil surface in each plot. The material was weighed and dried to determine dry matter content and yield.

Data were analyzed using a general linear model 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 where the F-test was considered significant, at $p<0.10$. Variations in genetics, soil, weather, and other growing conditions can result in variations in yield and quality. Statistical analysis makes it possible to determine whether a difference between treatments is significant or whether it is due to natural variations in the plant or 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. This means that when the difference between two varieties within a column is equal to or greater to the LSD value for the column, there is a real difference between the varieties 90% of the time. Varieties that performed statistically similarly to one another share a letter. In the example to the right, variety C was significantly different from variety A, but not from variety B as evidenced by the sharing of letters between A and B but not A and C. The difference between C and B is 1.5, which is less than the LSD value of 2.0 and so these varieties were not significantly different in yield and thus they share the letter a.

Variety	Yield
A	6.0b
B	7.5ab
C	**9.0a**
LSD	2.0

RESULTS

Weather data were recorded with a Davis Instruments Vantage Pro2 weather station, equipped with a WeatherLink data logger at Borderview Research Farm in Alburgh, VT. Temperature, precipitation, and accumulation of Growing Degree Days (GDDs) are consolidated for the 2024-2025 growing season (Table 3). Despite a generally wet 2024, the fall was warmer and drier than normal providing above average GDDs heading into winter. Winter temperatures were largely below normal with continued low precipitation.

Table 3. Weather data and GDDs for forages in Alburgh, VT, 2024-2025.

	2024				2025						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Average temperature (°F)	64.7	52.1	42.2	26.4	19	18.7	35	45.1	57.5	67.8	73.2
Departure from normal	2.02	1.81	2.93	-1.81	-1.92	-4.18	2.69	-0.47	-0.93	0.35	0.82
Precipitation (inches)	2.61	2.00	1.75	1.83	0.32	0.37	1.63	3.71	5.78	2.38	3.76
Departure from normal	-1.06	-1.83	-0.95	-0.67	-1.81	-1.4	-0.61	0.64	2.02	-1.88	-0.30
Growing Degree Days (base 41°F)	711	380	152	24	0	2	110	229	514	810	985
Departure from normal	59.1	76	70	24	0	2	88	14	-25	17	12

Based on weather data from a Davis Instruments Vantage Pro2 with WeatherLink data logger.
Historical averages are for 30 years of NOAA data (1991-2020) from Burlington, VT.

However, precipitation returned in the spring with above average accumulation in April and May. This presented first cut harvest timing challenges for many farms across the region. Following a wet spring, precipitation remained below normal for the rest of the season with severe drought conditions experienced around the region. At the research site, the longest period of time with no precipitation event >0.25" was 16 days in late July into mid-August. After the third harvest at the end of July, the lack of rainfall severely impacted regrowth and no additional harvests were made. In total, precipitation was more than 3 inches below the 30-year normal in 2025 and more than 7.5 inches below normal for the 2024-2025 season. There was a total of 2,650 GDDs accumulated during 2025, 108 more than the 30-year normal.

Impact of Species

The four forage legume species included in the trial produced significantly different dry matter yields at each of the two harvests made in 2025 and over the season (Table 4). At the second harvest, the first where yields were collected, birdsfoot trefoil and red clover produced the highest yields over 1.25 tons ac^{-1}. Alfalfa produced the lowest yield just over 1 ton ac^{-1}. This trend continued into the third harvest and in looking at season total yields. The red clover and birdsfoot trefoil produced over 2.5 tons ac^{-1} across the two harvests while white clover produced about 2 tons ac^{-1} and alfalfa less than 2 tons ac^{-1}.

Table 4. Yield across two harvests for four forage legume species, 2025.

Species	DM Yield (tons ac^{-1})		
	2nd cut	3rd cut	Total
	tons ac^{-1}		
Alfalfa	1.02c‡	0.706c	1.73c
Birdsfoot trefoil	**1.28a**	1.27a	2.56a
Red clover	1.24ab	**1.41a**	**2.65a**
White clover	1.09bc	1.01b	2.11b
Level of significance†	**	***	***
Trial mean	1.15	1.09	2.23

†* p <0.1, ** p <0.05, *** p <0.0001
‡Treatments that share a letter performed statistically similarly to one another.
The top performing treatment is indicated in **bold**.

Impact of Variety- Alfalfa

Within alfalfa, the eight varieties included in the trial produced significantly different yields at the second harvest (Table 5). At this second harvest, varieties produced between 0.780 and 1.35 tons ac^{-1}. The top producing variety, 374, yielded statistically similarly to AlfaMax HD 2 Plus and FSG415BR. Yields at the third harvest ranged from 0.494 to 0.856 tons ac^{-1} but did not vary statistically likely due to variability influenced by conditions. When conditions were wet, plots exhibited evidence of foliar leaf spot diseases (Image 1). Later in the season, once conditions became dry and potato leaf hoppers entered the region, plots also exhibited evidence of "hopper burn" (Image 2) characteristic of potato leafhopper feeding damage. Differences in varietal susceptibility to these pests may contribute to performance differences, however, formal assessments of disease or insect incidence or severity were not made in 2025. Total yields for the season also did not vary statistically but ranged from 1.41 to 2.02 tons ac^{-1}.

Table 5. Yield across two harvests for eight alfalfa varieties, 2025.

Variety	DM Yield (tons ac^{-1})		
	2nd cut	3rd cut	Total
	tons ac^{-1}		
374	**1.35a†**	0.677	**2.02**
394	0.995bc	**0.856**	1.85
44 Mag	0.911bc	0.709	1.62
AlfaMax HD 2 Plus	1.14ab	0.854	1.99
FSG415BR	1.09ab	0.721	1.81
Galaxy200	0.979bc	0.713	1.69
KF 435 HD	0.912bc	0.494	1.41
KF PLH422	0.780c	0.629	1.41
LSD (p = 0.10)‡	0.277	NS§	NS
Species mean	1.02	0.706	1.73

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

Image 1. Leaf spot disease symptoms on alfalfa.

Image 2. Potato leafhopper damage on alfalfa.

Impact of Variety- Birdsfoot trefoil

The six varieties of birdsfoot trefoil included in the trial produced significantly different yields at second harvest (Table 6). Yields ranged from just under 1.00 ton ac^{-1} to 1.81 tons ac^{-1}. The variety Bruce produced the highest yield and was statistically higher than all other varieties. Yields at third harvest were statistically similar across varieties. Overall, yields across the two harvests in the season, Bruce was the only variety to produce over 3.00 tons ac^{-1}. However, statistically this was similar to Bull and Norcen. The lowest yielding varieties produced just 2.00 tons ac^{-1}.

Table 6. Yield across two harvests for six birdsfoot trefoil varieties, 2025.

Variety	DM Yield (tons ac^{-1})		
	2nd cut	3rd cut	Total
	tons ac^{-1}		
Bruce	**1.81a**†	1.27	**3.08a**
Bull	1.32b	**1.57**	2.89a
Empire	1.09cd	1.06	2.15b
Leo	1.19bcd	1.07	2.26b
Norcen	1.30bc	1.38	2.68ab
Wellington	0.995d	1.28	2.28b
LSD (p = 0.10)‡	0.229	NS§	0.612
Species mean	1.28	1.275	2.56

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

Impact of Variety- Red clover

The eight varieties of red clover included in the trial produced significantly different dry matter yields at the second harvest (Table 7). Yields ranged widely from 0.814 to 1.44 tons ac^{-1}. The variety Milvus produced the highest yield, which was statistically similar to all other varieties except the lowest producers Ruby and Blaze. Conditions early in the season were very wet and conducive to promoting foliar diseases. In the red clovers, powdery mildew was prevalent, however, not in all varieties (Images 3 and 4). Differences in varietal susceptibility to these pests may contribute to performance differences, however, formal assessments of disease or insect incidence or severity were not made in 2025.

Table 7. Yield across two harvests for eight red clover varieties, 2025.

Variety	DM Yield (tons ac^{-1})		
	2nd cut	3rd cut	Total
	tons ac^{-1}		
Bearcat	1.16ab†	1.21	2.37
Blaze	1.12b	**1.91**	**3.03**
Freedom!	1.37ab	1.47	2.84
Milvus	**1.44a**	1.40	2.84
Persist	1.35ab	1.11	2.46
Renegade	1.42a	1.48	2.90
Ruby	0.814c	1.35	2.16
VNS	1.24ab	1.39	2.63
LSD (p = 0.10)‡	0.283	NS§	NS
Species mean	1.24	1.41	2.65

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

Image 3. Powdery mildew on red clover.

Image 4. Plot on left low mildew pressure, plot on right high pressure.

Impact of Variety- White clover

The ten white clover varieties included in the trial produced statistically similar yields to one another at each harvest and across the season (Table 8). Yields averaged approximately 1 ton ac^{-1} at each harvest. While there was a wider range in yields at the third harvest when conditions were very dry, variation within varieties likely contributed to the lack of statistical significance. Like the alfalfas and red clovers in the trial, the white clovers also suffered from foliar diseases early in the season and signs of heat and drought stress later in the season (Images 5 and 6). The reddening of clover leaves is a stress response and can be associated with nutrient deficiencies, namely boron, extreme heat, or pest pressure.

Table 8. Yield across two harvests for ten white clover varieties, 2025.

Variety	DM Yield (tons ac^{-1})		
	2nd cut	3rd cut	Total
	tons ac^{-1}		
Alice grazing clover	1.14	**1.25**	2.39
Crusade	0.987	0.986	1.97
Domino	1.16	0.929	2.09
Huia	1.11	0.827	1.94
Kakariki	**1.27**	1.16	**2.43**
Ladino	1.02	0.755	1.78
Legacy	0.960	0.975	1.93
Marco Polo NZ clover	1.16	1.15	2.31
Renovation	1.13	1.00	2.13
Rivendell	1.02	1.10	2.12
LSD (p = 0.10)†	NS‡	NS	NS
Species mean	1.10	1.01	2.11

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

Image 5. Foliar leaf spots on white clover.

Image 6. Reddening of white clover leaves as a stress response.

DISCUSSION

In the trial's first year of production, yields were only collected at two harvests (Table 9, Figures 1 and 2). Wet conditions at the beginning of the season contributed to foliar diseases across much of the trial. Varieties will be assessed in the future for differences in pest and disease susceptibility as that is an important aspect of varietal performance. Overall, alfalfas and white clovers produced the lowest yields. With drought conditions persisting through much of the season, the white clovers, which are shallower rooted and therefore less drought tolerant, suffered in productivity. While alfalfa is generally considered a drought tolerant forage crop due to deep root systems, the varieties included in this trial were mainly branched root varieties which tend to produce more and smaller roots nearer the soil surface. While this type of root system may allow plants to explore wider soil areas around the crown, it is possible these are less drought tolerant as well. Monitoring these stands into subsequent years can help provide valuable information on varietal performance, resilience, and persistence.

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Table 9. Yield across two harvests for 32 forage legume varieties, 2025.

Species	Variety	DM Yield (tons ac^{-1}) 2nd cut	3rd cut	Total
		tons ac^{-1}		
Alfalfa	374	1.35	0.677	2.02
	394	0.995	0.856	1.85
	44 Mag	0.911	0.709	1.62
	AlfaMax HD 2 Plus	1.14	0.854	1.99
	FSG415BR	1.09	0.721	1.81
	Galaxy200	0.979	0.713	1.69
	KF 435 HD	0.912	0.494	1.41
	KF PLH422	0.780	0.629	1.41
LSD (p = 0.10)		0.277	NS	NS
Species mean		1.02	0.706	1.73
Birdsfoot trefoil	Bruce	1.81	1.27	3.08
	Bull	1.32	1.57	2.89
	Empire	1.09	1.06	2.15
	Leo	1.19	1.07	2.26
	Norcen	1.30	1.38	2.68
	Wellington	0.995	1.28	2.28
LSD (p = 0.10)		0.229	NS	0.612
Species mean		1.28	1.27	2.56
Red clover	Bearcat medium red	1.16	1.21	2.37
	Blaze	1.12	1.91	3.03
	Freedom!	1.37	1.47	2.84
	Milvus	1.44	1.40	2.84
	Persist	1.35	1.11	2.46
	Renegade	1.42	1.48	2.90
	Ruby	0.814	1.35	2.16
	VNS medium red	1.24	1.39	2.63
LSD (p = 0.10)		0.283	NS	NS
Species mean		1.24	1.41	2.65
White clover	Alice grazing clover	1.14	1.25	2.39
	Crusade	0.987	0.986	1.97
	Domino	1.16	0.929	2.09
	Huia	1.11	0.827	1.94
	Kakariki	1.27	1.16	2.43
	Ladino	1.02	0.755	1.78
	Legacy	0.960	0.975	1.93
	Marco Polo NZ clover	1.16	1.15	2.31
	Renovation	1.13	1.00	2.13
	Rivendell	1.02	1.10	2.12
LSD (p = 0.10)		NS	NS	NS
Species mean		1.10	1.01	2.11

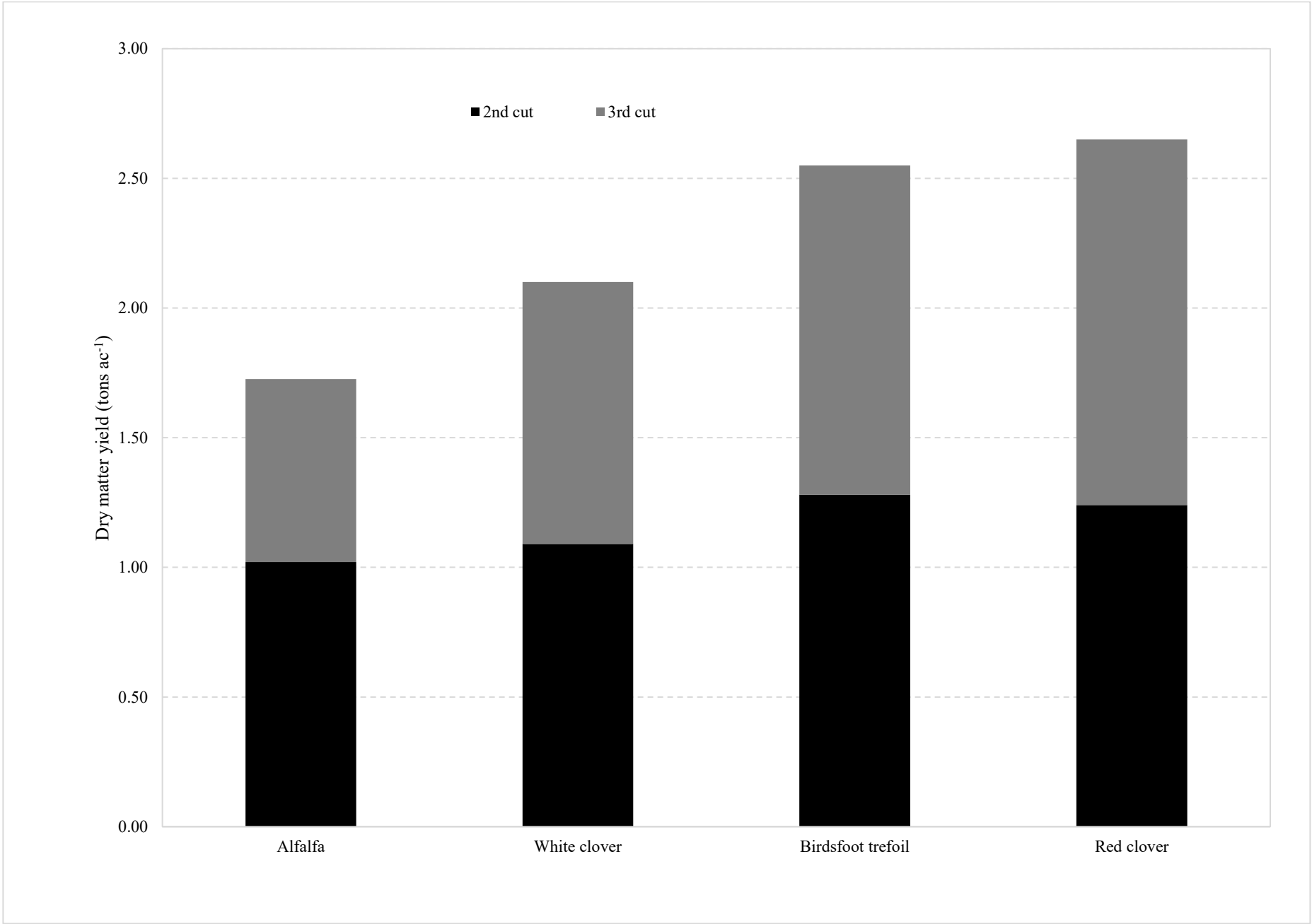

Figure 1. Dry matter yield across two harvests of four forage legume species, 2025.

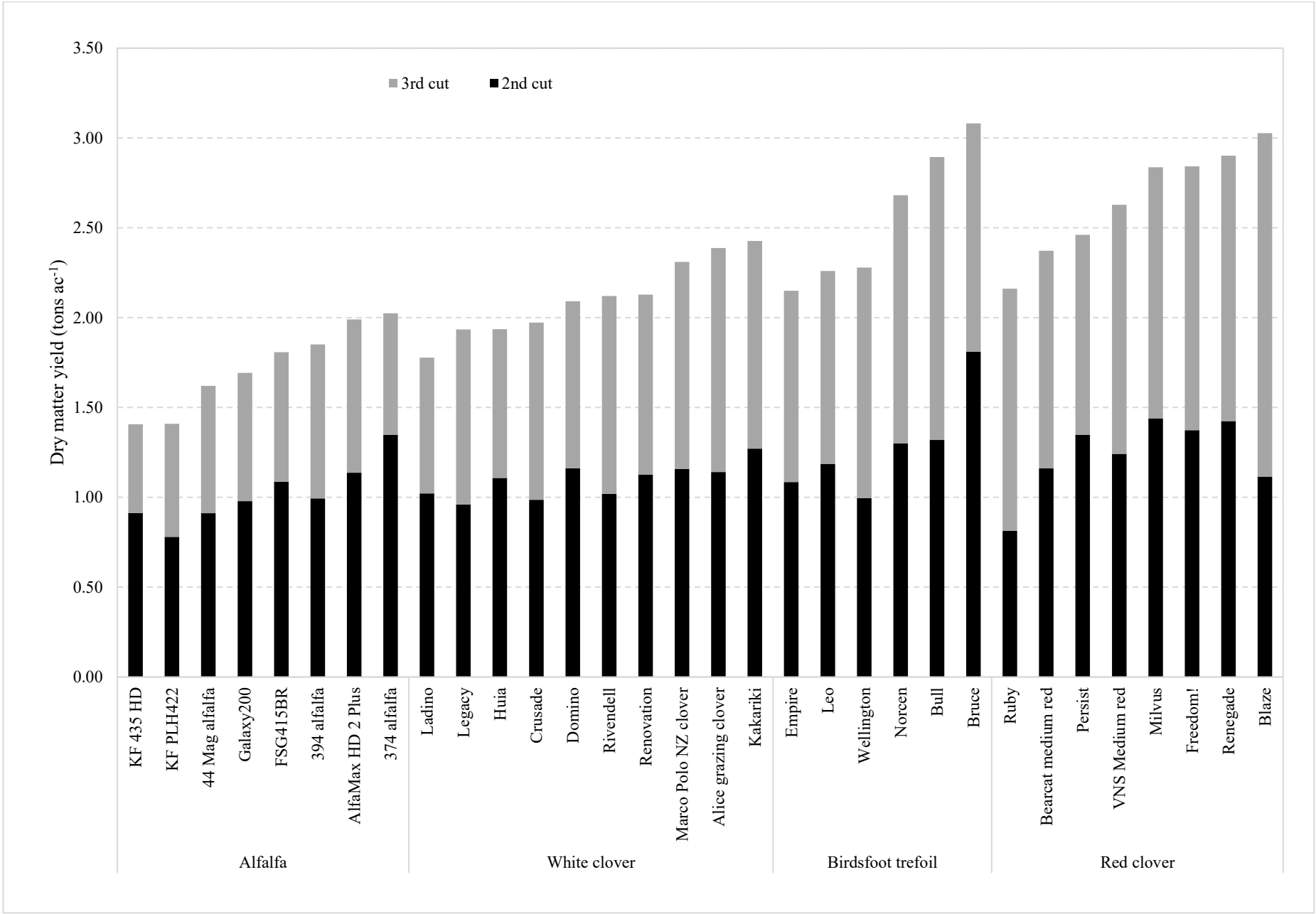

Figure 2. Dry matter yield across two harvests for 32 forage legume varieties, 2025.