

**Project Title:**

Nitrogen Requirement for Sustained Yield and Optimal Quality of Cool-Season Perennial Forages

**Objective:**

To test Nitrogen (N) requirements, yield, and quality of selected cool-season perennial grass forages.

**Personnel:**

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**Summary:**

Cool-season perennial grasses were planted on April 21<sup>st</sup>, 2022. N treatments were applied only in 2022. Treatment N4 (50 lbs N/Acre at tillering and 50 lbs N/Acre after first cut) was reapplied in 2025. (See Tables 1 and 2 for detailed management and fertilizer information.)

This study was irrigated and under a split-plot design where four N treatment levels were the main plots (Table 2), and four forage species were the subplots. In 2025, 8 inches of irrigation were applied. Four years of data are presented.

Forage yield responded significantly with N application across the four years of study (Figure 1). Forage yield increased with higher N rates applied per treatment where the 50 + 50 lb N/Acre produced the greatest yield except in 2024. Average annual forage yields were 1.7, 5.1, 3.9, and 3.5 tons/acre in 2022, 2023, 2024, and 2025, respectively. Yield in the second year (2023) was approximately three times that of the establishment year (2022) and declined in years three and four (2024–2025). Reapplication of 50 + 50 lb N in 2025 increased forage production relative to 2024. Among the perennial forage species tested, the dryland mix produced the highest yield across the years (Figure 2).

Nitrate levels significantly increased with increasing N applications, which is evident in the first year of establishment (2022) indicated in Figures 3 and 4. Nitrate levels decreased during subsequent years even with the reapplication of 180 lbs N to the N4 treatment in 2025. Among the grass entries, the dryland mix obtained the highest forage Nitrate level (Figure 4). Overall, Nitrate levels remained within safe levels (<300 ppm).

Forage quality data is presented in Table 3.

**Table 1.** Field Management Information

<b>Seeding date:</b>	April 21st, 2022 (111 Julian)	<b>Field Location:</b>	R3
<b>Seeding rate:</b>	Variety Dependent		
<b>Previous crop:</b>	Canola	<b>Soil type:</b>	Creston Silt Loam
<b>Herbicide:</b>	Detonate Cleaver (6/7/2022)	<b>Tillage:</b>	Conventional
<b>Insecticide:</b>	N/A	<b>Soil residual nutrient (N, P, K lb/A) in 2022:</b>	40-14-260
<b>Fungicide:</b>	N/A	<b>Nutrient fertilizer applied (N, P, K lb/A) Fall 2022:</b>	Varied - 20.2 - 14.9
<b>Harvest Dates:</b>	Cut 1: June 16, 2025 Cut 2: September 22, 2025		

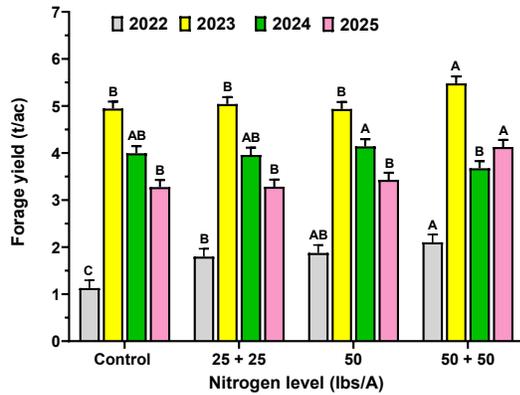
**Table 2.** Fertilizer treatments

<b>Treatment ID</b>	<b>N Treatments applied in 2022 (no application in 2023 &amp; 2024)</b>
N1	Control
N2	50 lbs N/Acre at planting
N3	25 lbs N/Acre at tillering + 25 lbs N/Acre after first cut
N4	50 lbs N/Acre at tillering + 50 lbs N/Acre after first (reapplied in 2025)

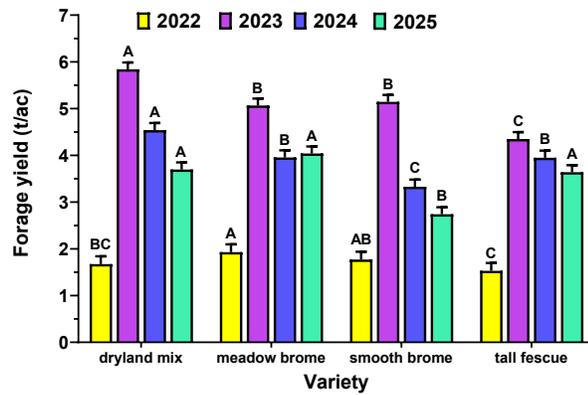
**Table 3.** Forage quality (dry basis) of perennial grass species for 2025. The same letter assignment within cuttings denotes insignificance at  $\alpha=0.05$ .

Forage Quality	Cut 1				Cut 2			
	Dryland Mix	Meadow Brome	Smooth Brome	Tall Fescue	Dryland Mix	Meadow Brome	Smooth Brome	Tall Fescue
Crude Protein	7.3ab	6.3c	6.9b	7.7a	7.8b	5.8d	8.9a	6.8c
ADF	35.7c	37.5a	36.6b	34.5d	37.1b	43.7a	37.3b	34.4c
NDF	62.8a	64.0a	63.8a	60.0b	59.7b	61.4a	53.1d	56.1c
RFV	90.9b	86.9c	88.3bc	96.6a	93.5b	83.3c	105.0a	103.2a
NFC	20.5a	21.4a	20.9a	22.0a	17.2c	15.2d	19.2b	20.6a
WSC	14.9b	14.8b	14.5b	16.0a	12.4b	9.8c	12.3b	14.3a
Starch	1.7b	2.0a	2.0a	1.9a	1.1a	0.1c	0.7b	0.8b

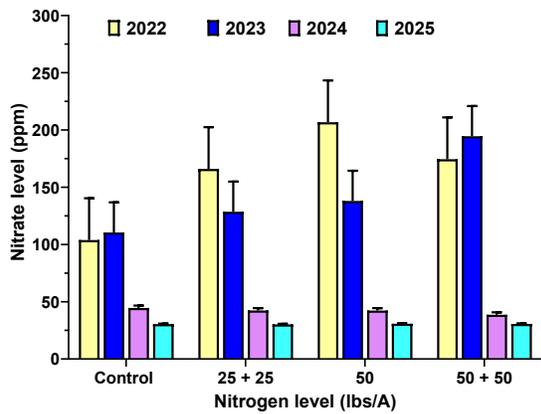
ADF – Acid Detergent Fiber; NDF – Neutral Detergent Fiber; RFV – Relative Feed Value; NFC – Non-Fiber Carbohydrates ; WSC – Water Soluble Carbohydrates



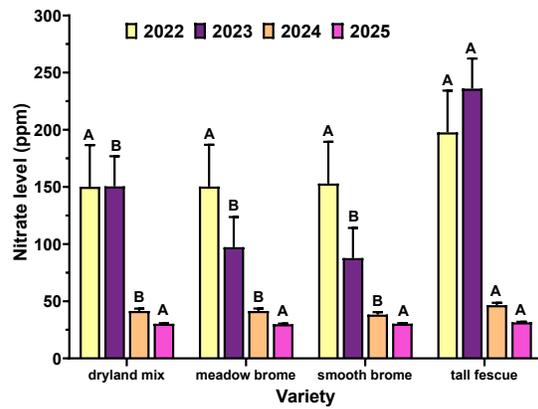
**Figure 1.** Forage yield (30% dry matter) from 2022-2025 with N levels. Fertilizer was applied in 2022 and reapplied 50+50 lbs N/Acre in 2025. The same letter assignment denotes non-significance at  $\alpha=0.05$  within each year.



**Figure 2.** Forage yield (30% dry matter) from 2022-2025 with each grass species. The same letter assignment denotes non-significance at  $\alpha=0.05$  within each year.



**Figure 3.** Forage Nitrate levels from 2022-2025. Fertilizer was applied in 2022. 50lbs +50 lbs N/Acre reapplied in 2025. The same letter assignment denotes non-significance at  $\alpha=0.05$  within each year.



**Figure 4.** Forage Nitrate levels from 2022-2025 across each grass species. The same letter assignment denotes non-significance at  $\alpha=0.05$  within each year.

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