

Project Title: 2021 Warm-Season Forages and Nitrogen Study

Objective: To evaluate the nitrogen response of seven warm-season grasses under different levels of nitrogen fertility and contrasting moisture regimes

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Summary:

The trial was planted on May 27-28, 2021. The detailed management information is provided in Table 1. The seven forage species planted were pearl millet (Tifleaf 3), sudangrass (Piper), teff (Corvallis, 20BAR_ET), and three sorghum-sudan species (S5501, AS6402, S6504) with cutting intensities provided (table 2). The study was conducted in irrigated and rainfed environments. The rainfed environment received 4.3 inches of rainfall, and the irrigated environment received an additional 8 inches of irrigation.

Under rainfed, all grass cultivars did not respond to nitrogen rates except the sorghum-sudangrass (S5501), which responded to 233 lbs N/A available in the soil. However, this response is considered economically risky. The crude protein in teff (20BAR_ET) and two sorghum-sudan (AS6602 and S5501) responded to the high N rates. No crude protein response with the rest of the cultivars. Overall, crude protein in teff was higher than others due to its relatively lower yield. Yield and crude protein have inverse relations (figure 1). There is no interaction with the cultivar and N levels for water-soluble carbohydrates (WSC). The WSC, in general, increases with N levels. The relative feed value (RFV) was related to either N or cultivar. Generally, RFV increases with N. Also, teff and pearl millet tend to have higher RFV than others.

Under irrigation, teff yields (Corvallis and 20BAR_ET) did not respond to N. The yield response with N either plateaued or decreased as N further increased for the rest of the species. For pearl millet, sudangrass, and sorghum-sudangrass (only for S5501 and S6504), they pushed their yield potential under irrigation and 253 lbs/A total N. Although, the sorghum-sudangrass (AS6402) had its maximum response at 193 lbs/A under irrigation. Only the sudangrass (Piper) crude protein did not respond to N levels. Overall, teff species have superior crude protein but lower WSC than others. The WSC of all sorghum-sudangrass species, in general, have higher WSC but do not respond to N (except S6504, where the highest WSC was observed in the highest N level). Overall, the RFVs of the teff species are superior to others. Only the sudangrass (Piper) and sorghum-sudan (S5501) RFVs did not respond with N.

Table 1. Management Information

Seeding date:	5/27, 5/28	Field Location:	R4
Julian date:	147, 148	Harvest date:	Species dependent (7/29-9/29)
Seeding rate:	Variety-dependent	Julian date:	210-272
Previous crop:	Faba	Soil type:	Fine sandy loam
Herbicide:	CleansweepM (6/1/21)	Tillage:	Conventional
Insecticide:	None	Soil residual nutrient (NO₃-, P, K lb/A):	73-12-212 (Fall, 2020)
Fungicide:	None	Nutrient fertilizer applied (N, P₂O₅, K₂O lb/A):	See Table 3.

Table 2. Trial entries, seeding rates, and number of cuttings

Entry	Species	Seeding rate (Seeds/ft ²)	No. of cuts
Tifleaf 3	Pearl Millet	15	1
Piper	Sudangrass	25	2
Corvallis	Teff	10	3
20BAR_ET	Teff	10	3
S5501	Sorghum-Sudan	25	1
AS6402	Sorghum-Sudan	25	1
S6504	Sorghum-Sudan	25	1

Table 3. Nutrients applied in 2021. Total N supply includes the residual (73 lbs/A) + faba credit (20 lbs/A) + the applied nitrogen using urea and the N associated with the applied monoammonium phosphate.

Treatment ID	Total N	Applied N	P ₂ O ₅	K ₂ O
	-----lbs/Ac-----			
N0	95	2	45	80
N1	193	98	45	80
N2	213	118	45	80
N3	253	158	45	80
N4	293	198	45	80

Table 4: Total forage yield and average quality with nitrogen (N) under rainfed. The total N comprises of: 1) soil residual nitrates, 2) applied fertilizers, and 3) credit from previous Faba.

Species	Cultivar	Total N (lbs/A)	YLD (tons/Ac)	CP, %	WSC, %	RFV
Teff	20BAR_ET	95	1.8	16.2	9.0	100.8
Teff	20BAR_ET	213	1.5	17.0	9.8	104.2
Teff	20BAR_ET	233	1.7	16.6	9.8	103.2
Teff	20BAR_ET	273	1.7	18.3	9.1	104.4
Teff	20BAR_ET	313	1.6	17.8	9.2	105.4
Sorghum-Sudan	AS6402	95	3.0	9.3	11.2	90.3
Sorghum-Sudan	AS6402	213	3.7	9.7	11.3	92.3
Sorghum-Sudan	AS6402	233	3.4	10.1	11.7	95.0
Sorghum-Sudan	AS6402	273	3.0	9.9	11.6	92.0
Sorghum-Sudan	AS6402	313	3.0	10.9	11.9	96.0
Teff	Corvallis	95	2.1	16.9	9.7	101.3
Teff	Corvallis	213	2.2	17.5	9.1	101.0
Teff	Corvallis	233	2.0	17.1	9.3	101.4
Teff	Corvallis	273	1.7	17.2	9.9	103.9
Teff	Corvallis	313	1.9	17.7	9.1	102.6
Sudangrass	Piper	93	4.6	14.8	11.1	97.7
Sudangrass	Piper	213	4.8	15.2	11.0	100.0
Sudangrass	Piper	233	5.2	15.4	10.4	100.3
Sudangrass	Piper	273	4.7	14.3	11.0	96.5
Sudangrass	Piper	313	4.6	13.4	11.4	98.3
Sorghum-Sudan	S5501	95	4.9	8.6	12.4	90.3
Sorghum-Sudan	S5501	213	5.6	8.0	13.8	92.0
Sorghum-Sudan	S5501	233	6.7	7.8	12.4	88.2
Sorghum-Sudan	S5501	273	4.7	9.7	12.1	92.0
Sorghum-Sudan	S5501	313	4.3	9.1	13.9	95.0
Sorghum-Sudan	S6504	95	4.6	7.7	14.8	96.7
Sorghum-Sudan	S6504	213	4.9	8.0	12.1	91.0
Sorghum-Sudan	S6504	233	5.1	7.9	14.0	96.0
Sorghum-Sudan	S6504	273	5.3	8.4	12.5	90.0
Sorghum-Sudan	S6504	313	4.8	8.4	14.1	95.0
Pearl Millet	Tifleaf 3	95	3.4	14.3	12.0	100.7
Pearl Millet	Tifleaf 3	213	3.8	14.6	12.7	101.3
Pearl Millet	Tifleaf 3	233	4.2	15.0	13.1	105.7
Pearl Millet	Tifleaf 3	273	3.8	15.6	12.1	103.7
Pearl Millet	Tifleaf 3	313	3.8	15.7	13.2	105.2
MEAN			3.7	12.9	11.5	97.9
CV (%)			16.2	4.2	5.9	1.9
LSD			1.0	1.6	-	-
P-Value (N x C)			<0.05	<0.05	ns	ns

YLD, yield; CP, crude protein; WSC, water-soluble carbohydrates; RFV, relative feed value; ns, not significant

Table 5: Total forage yield and average quality with nitrogen (N) under irrigation. The total N comprises of: 1) soil residual nitrates, 2) applied fertilizers, and 3) credit from previous Faba.

Species	Cultivar	Total N (lbs/A)	YLD (tons/Ac)	CP, %	WSC, %	RFV
Teff	20BAR_ET	95	1.8	14.5	8.5	94.3
Teff	20BAR_ET	213	2.3	17.6	8.1	99.1
Teff	20BAR_ET	233	2.1	18.0	7.7	97.7
Teff	20BAR_ET	273	2.1	18.2	7.5	97.8
Teff	20BAR_ET	313	1.7	19.3	8.2	102.3
Sorghum-Sudan	AS6402	95	3.5	6.4	11.4	82.0
Sorghum-Sudan	AS6402	213	5.4	9.9	10.7	86.0
Sorghum-Sudan	AS6402	233	5.1	9.5	10.8	84.0
Sorghum-Sudan	AS6402	273	5.1	9.5	11.5	86.7
Sorghum-Sudan	AS6402	313	5.0	11.4	11.4	89.3
Teff	Corvallis	95	1.3	14.6	8.7	95.6
Teff	Corvallis	213	2.2	15.7	9.7	100.8
Teff	Corvallis	233	2.3	17.2	9.5	102.6
Teff	Corvallis	273	2.6	18.4	7.9	98.8
Teff	Corvallis	313	2.1	18.4	8.3	100.9
Sudangrass	Piper	95	4.2	11.8	10.6	93.0
Sudangrass	Piper	213	5.5	13.0	10.5	93.7
Sudangrass	Piper	233	6.1	14.0	11.2	96.7
Sudangrass	Piper	273	7.5	13.7	10.3	92.8
Sudangrass	Piper	313	6.9	14.1	10.6	93.5
Sorghum-Sudan	S5501	95	4.1	5.7	12.6	84.7
Sorghum-Sudan	S5501	213	5.7	7.0	13.2	86.3
Sorghum-Sudan	S5501	233	7.5	6.4	12.1	81.7
Sorghum-Sudan	S5501	273	9.3	7.9	13.5	88.3
Sorghum-Sudan	S5501	313	7.6	9.0	12.4	87.4
Sorghum-Sudan	S6504	95	4.7	6.2	12.1	84.0
Sorghum-Sudan	S6504	213	6.5	7.8	12.1	86.3
Sorghum-Sudan	S6504	233	8.2	8.0	12.3	86.3
Sorghum-Sudan	S6504	273	9.2	8.8	14.0	93.0
Sorghum-Sudan	S6504	313	9.0	8.4	12.6	89.3
Pearl Millet	Tifleaf 3	95	4.2	8.1	12.6	90.7
Pearl Millet	Tifleaf 3	213	4.6	11.2	11.5	94.7
Pearl Millet	Tifleaf 3	233	5.2	9.8	11.2	92.3
Pearl Millet	Tifleaf 3	273	6.3	15.0	11.2	99.0
Pearl Millet	Tifleaf 3	313	5.6	13.5	12.0	96.7
MEAN			4.9	11.9	10.8	92.2
CV (%)			18.3	7.2	5.8	2.4
LSD			1.5	2.5	1.9	6.6
P-Value (N × C)			<0.001	<0.05	<0.05	<0.05

YLD, yield; CP, crude protein; WSC, water-soluble carbohydrates; RFV, relative feed value; ns, not significant

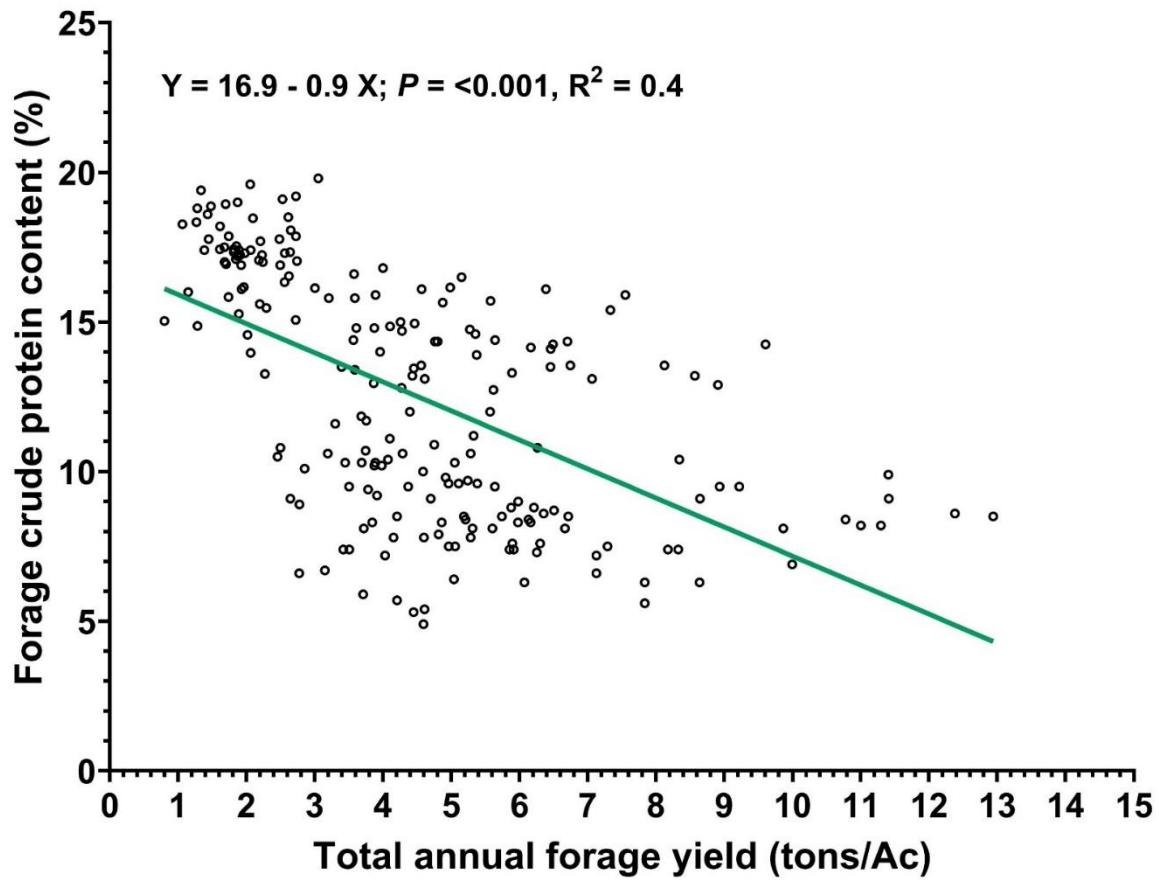


Figure 1: Total forage yield (sum of all cuttings) and average crude protein content (mean of all cuttings) relationship between forage yield and crude protein contents across species, nitrogen, and environments.