Nitrogen Management of Teff

Teff (*Eragrostis tef* (Zucc.) Trotter) is an annual C_4 grass native to Ethiopia. It is adapted to drought-stress as well as waterlogged soil conditions. In Ethiopia, Teff is a major cereal crop. However, teff has also been grown successfully in South Dakota, Nevada, Oregon, Washington, Kentucky, and the Mid Atlantic region. Yields ranged from 4 to 7 tons/acre.

Challenging spring weather in the humid Northeast, where growing seasons are already short, has resulted in a search for fast-growing high-quality forage alternatives to corn that can still be planted in June and July. Earlier work in New York explored the potential of brown midrib sorghum x sudangrass hybrids (BMR SxS) as "emergency forage" (Agronomy Factsheets 14 and 26). These studies showed 3.5 to 6.2 ton/acre of high quality BMR SxS forage could be produced in 2-cut harvest systems but that 110 to 130 lb N/acre per cut was needed for fields without a manure history. Although these studies showed BMR SxS to be a promising alternative to corn, the high N fertilizer need is not conducive to growing BMR SxS in non-manured fields. Furthermore, the high moisture content of the forage can cause harvest challenges.

Over the past several years, we conducted research on teff management. In Agronomy Factsheet #24 we summarized our findings; teff can be seeded from June through late July and does not pose the same harvest challenges as SxS.

In this factsheet we report on nitrogen management for teff. With eight on-farm trials, we addressed the question "How much N does teff grown for forage in New York need?"

Nitrogen Field Trials

Eight N-rate studies (0, 50, 75, 100 lb N/acre) were conducted over 2 years in three different regions of New York State (Northern, Eastern, and Central NY). Of these eight trials, four were harvested in a single-cut management system, while two each were 2-cut or 3-cut systems. All trials were replicated four times.

Yield

First cut yields ranged from 0.8 to 2.4 ton/acre DM with maximum yields ranging from 1.6 to 2.5 ton/acre DM. Total DM yield of multiple cut systems ranged from 3.3 to 3.6 ton/acre for 2-cut systems and from 4.8 to 4.9 ton/acre for the 3-cut systems (Table 1). And, across all sites, 50 lb N/acre was sufficient. These yields were comparable to 3.5 to 4.3 ton/acre DM for BMR SxS at sites without prior organic N inputs and 4.6 to 6.2 ton/acre at sites with a manure or sod history in earlier New York trials. So, based on DM yield, teff could be a competitive alternative to BMR SxS as emergency forage.

Table 1. Effect of N application rate on dry matter (DM) yield of teff grown in 1-, 2- or 3-cut harvest systems in New York State.

Site	Cuttings	N application rate (lb N/acre per cut)			
		0	50	75	100
		----------% of DM----------			
1	1-cut	1.62 b	2.51 a	2.42 a	2.52 a
2	1-cut	1.14 b	1.75 a	2.03 a	2.05 a
3	1-cut	2.40 a	2.14 a	2.09 a	1.99 a
4	1-cut	1.67 a	1.65 a	1.72 a	1.70 a
5	2-cut	2.41 b	3.41 a	3.72 a	3.58 a
6	2-cut	1.49 c	2.62 b	2.73 b	3.30 a
7	3-cut	3.58 b	4.68 a	4.67 a	4.78 a
8	3-cut	3.35 b	5.01 a	5.22 a	4.91 a

Yield values within a row followed by the same letter are not significantly different at P=0.05.

Figure 1: Teff is an annual C_4 grass native to Ethiopia.

Quality

Crude protein levels of 1st cut teff increased with N application from an average of 12.2% without N to 15.5% when 50 lb N/acre were applied, and 18.6% with a 100 lb N/acre application (Table 2).

Across all sites, N addition decreased NDF of first cutting from 65.4% (no N applied) to 62.2% (100 lb N/acre), and ADF from 36.3% (no N applied) to 33.4% (100 lb N/acre) (Table 2). However, when 50 lb N/acre were added, only NDF decreased significantly (from 65.4% to 63.6%). Nitrogen addition did not impact NDF digestibility (average of 70.6%).

Table 2: Effect of N application rate on neutral detergent fiber (NDF), fiber digestibility (dNDF at 48 hours), and acid digestible fiber (ADF) of first cutting of teff (average of eight different location/years in New York State).

	N application rate (lb N/acre)			
	0	50	75	100
	----------% of DM----------			
CP	12.15 d	15.53 c	17.32 b	18.59 a
NDF	65.41 a	63.62 b	62.32 bc	62.16 c
dNDF	70.66 a	71.00 a	70.00 a	70.78 a
ADF	36.33 a	34.92 ab	34.21 b	33.41 b

Yield values within a row followed by the same letter are not significantly different at *P*=0.05.

Table 3. Effect of N application rate (lb N/acre per cut) on crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), of teff grown in two 2- and two 3-cut harvest systems in New York.

		N application rate (lb N/acre per cut)			
	Cut	0	50	75	100
		----------% of DM----------			
CP	1	11.73 c	15.58 b	17.28 a	18.48 a
	2	9.79 c	14.81 b	16.14 b	19.15 a
	3	9.90 b	16.06 a	16.79 a	18.50 a
NDF	1	65.09 a	63.41 b	61.58 b	62.20 b
	2	68.60 a	65.04 b	64.24 b	63.70 b
	3	72.93 a	68.64 ab	67.64 b	66.78 b
ADF	1	36.64 a	34.89 b	33.59 b	33.53 b
	2	36.39 a	35.07 a	34.62 a	34.66 a
	3	38.33 a	36.94 a	38.64 a	35.48 a

Yield values within a row followed by the same letter are not significantly different at *P*=0.05.

For multiple-cut systems, CP levels increased with similar trends for 2nd and 3rd cuttings as noted for 1st cutting (Table 3). Nitrogen application reduced forage NDF, although for 3rd cutting more than 50 lb N/acre was needed for a significant reduction. Forage ADF was decreased upon addition of 50 lb N/acre only for first cutting. Thus, also for multiple-cut systems, 50 lb N/acre per cut was optimal for both yield and quality.

Conclusions

High-quality teff forage can be grown in New York in 2- or 3-cut systems with DM yields ranging from 3.3 to 4.9 ton/acre, depending mostly on rainfall late summer. Yield and forage quality results of the eight trials support a recommendation of no more than 50 lb N per acre per cut, whereas on soils with recent organic N additions (following sod in the rotation or manure application), no additional N is recommended for 1st cutting.

Our New York data add to the existing literature that suggests that N addition to obtain maximum yield (50 lb N/acre in this study) results in both optimal yield and quality.

Additional Resources

- Agronomy Fact Sheet #24 (Teff as Emergency Forage). http://nmsp.css.cornell.edu/publications/factsheets.asp.
- Nitrogen needs of teff grown as forage crop in New York State. Forage and Grazinglands doi: 10.1094/FG-2009-0612-01-RS.
- Hoffman, P.C., R.D. Shaver, D.J. Undersander, L.M. Bauman, and T.K. Seeger. 2001. Understanding NDF Digestibility. Focus on forage. University of Wisconsin Extension Bulletin 3:10.

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For more information

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http://nmsp.css.cornell.edu

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