

Influence of Different Seeding Dates on Fenugreek (*Trigonella foenum-graecum* L.) Forage Yield and Nutritive Value

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Summary

Fenugreek (*Trigonella foenum-graecum* L.) is used as medicinal plant in many Asian countries and has been reported to have forage quality similar to alfalfa. Fenugreek is an annual crop and may have the potential to diversify forage production systems in the central High Plains. This study evaluated forage dry matter (DM) production and the nutritive value of three fenugreek cultivars as influenced by planting date at Hays and Garden City, KS, in 2014. Results at Hays showed forage DM yield of fenugreek cultivars was not affected by planting date, but fenugreek cultivars differed significantly ($P < 0.05$) in forage DM yield. Averaged across planting date, forage DM production was 760 lb/a for 'Amber,' 910 lb/a for 'F96,' and 672 lb/a for 'Tristar.' Forage crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), total digestible nutrient (TDN) concentrations, and relative feed value (RFV) did not differ ($P > 0.05$) among fenugreek cultivars. Planting early, however, did increase CP levels and lower ADF and NDF concentrations. Despite the lower yields observed in 2014, our preliminary results showed that fenugreek can produce forage with nutritive value comparable to alfalfa and that further testing is needed to determine if fenugreek can provide an option for producers who want to diversify their forage production operations, particularly under limited irrigation conditions.

Introduction

Fenugreek is an annual legume crop native to Asia and southeast Europe (Acharya et al., 2008) that historically has been used for medicinal as well as culinary herb purposes. Fenugreek's yellow- to amber-colored seed is used in preparing pickles, in curry powders and paste, and in Indian cuisine to impart flavor, color, and aroma. In some countries, the seeds are also used as tea after being boiled and sweetened.

Studies in Canada documented the potential of fenugreek as a forage crop for livestock in the northern Great Plains (Acharya et al., 2008). Forage nutritive value of fenugreek was greater or comparable to alfalfa (*Medicago sativa* L.) harvested at the early bloom stage (Mir et al., 1993). Growth and performance of steers fed mature fenugreek forage or early-bloom alfalfa silage, both supplemented with barley grain, did not differ significantly (Mir et al., 1998). Fenugreek forage is non-bloating, making it an attractive forage crop for the cattle industry (Acharya et al., 2008). Apart from

its high-quality forage production, like alfalfa and other legumes, fenugreek can fix nitrogen (N) and help maintain soil health and quality. Fenugreek provides an option for producers who want to take advantage of N fixation from forage legumes to reduce N fertilizer inputs. An alternative forage crop such as fenugreek has the potential to diversify forage and crop production systems in Kansas. The goal of this research is to develop agronomic production recommendations for potential adaptation of fenugreek to western Kansas growing conditions. A specific objective was to determine the influence of planting date on forage production and quality of fenugreek cultivars under dryland conditions.

Procedures

Two field experiments were initiated at the Kansas State University Agricultural Research Center in Hays and Garden City, KS, in spring 2014 to evaluate planting date effects on fenugreek forage production. Due to drought conditions in the spring of 2014, the study in Garden City was overtaken by weeds and therefore abandoned.

The experiment in Hays was conducted on a Harney silt loam soil (fine, montmorillonite, mesic Typic Agriustoll). Initial soil analysis measured on samples collected at the 0- to 15-cm soil depth were 2.4% organic matter, pH 6.2, phosphorus (P) 14.3 mg/kg, potassium (K) 522 mg/kg, calcium (Ca) 3,618 mg/kg, magnesium (Mg) 508 mg/kg, and nitrate-N 8.3 mg/kg.

Treatments were three plantings dates (April 1, April 22, and May 22), and three fenugreek cultivars ('Amber,' 'Tristar,' and 'F96') in a split-plot arrangement with four replicates. All seeds were inoculated with appropriate inoculant. Individual plot sizes were 10 ft × 30 ft.

Fenugreek forage was harvested at the milk stage to determine DM yield and nutritive value. At each harvest, forage samples were collected by clipping two random quadrats (1 m² each) from each plot to 7.5-cm stubble height. Fresh weights of samples were recorded, and subsamples were dried at 60°C for at least 48 hours in a forced-air oven for DM determination. Oven-dried samples were ground to pass through a 1-mm mesh screen in a Wiley mill and analyzed for forage nutritive value [crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), total digestible nutrients (TDN), and relative feed value (RFV)]. Forage analysis was conducted at Ward Laboratories, Inc., in Kearney, Nebraska.

Statistical Analysis

Data were analyzed as a split-plot design in an analysis of variance using the PROC MIXED procedure of SAS (SAS Institute Inc., Cary, NC, 2002). Planting date and fenugreek cultivars were considered fixed effects, and replications and their interactions were considered as random effects. The LSMEANS procedure of PROC MIXED along with adjusted Tukey's test was used for mean comparisons (SAS Institute, 2002). Interactions and treatment effects were considered significant when F test *P*-values were ≤0.05.

Results

Forage Dry Matter Yield

The interaction of planting date \times cultivar on forage DM yield and nutritive value was not significant ($P > 0.05$). Similarly, planting date had no influence ($P > 0.05$) on fenugreek forage DM production. Averaged across cultivar, forage yield was 842, 698 and 801 lb/a when planted on April 1, April 22, and May 12, respectively (Table 1). However, fenugreek cultivar differed significantly ($P = 0.05$) in forage DM yield. In general, average forage production of the advanced line 'F96' was greater or comparable to the commercial fenugreek cultivars 'Amber' and 'Tristar' (Table 2).

Forage DM yields observed in this study are lower than yields reported elsewhere. For instance, fenugreek produced an average yield of 5,179 lb/a and 9,286 lb/a when grown under rainfed and irrigated conditions, respectively, in southern Alberta, Canada (Mir et al., 1998). Acharya et al. (2007) reported an average DM yield of 5,357 lb/a for 'Amber' and 'Tristar' grown in rainfed conditions across Alberta and southern British Columbia in Canada. Drought conditions in the spring of 2014 might have been responsible for the lower yields observed in our study. The crop also may be more suited to the cooler northern Great Plains climate than the central or southern Great Plains. Despite the lower yields observed in 2014, further testing is needed to determine if fenugreek can provide an option for producers who want to diversify their forage production operations, especially under limited irrigation conditions.

Forage Nutritive Value

Planting date had a significant ($P < 0.05$) effect on fenugreek CP, ADF, NDF, and TDN concentrations as well as RFV (Table 1). Delaying planting until May 12 decreased CP concentration and increased ADF and NDF concentrations. Planting fenugreek early increased CP levels and decreased fiber content, as indicated by the relatively lower ADF and NDF concentrations (Table 1). Similarly, early planting resulted in greater P and K concentration in the forage. Ca and Mg concentrations did not differ among the three planting dates.

Forage CP concentrations did not differ ($P > 0.05$) among fenugreek cultivars. Averaged across planting date, CP concentrations were 19.2% for 'Amber' and 'F96' and 19.9% for 'Tristar.' Similarly, ADF, NDF, TDN, and RFV values did not differ significantly among the fenugreek cultivars evaluated. However, Ca and K concentrations differed among the cultivars. Average Ca concentration ranged from 16.1% ('Amber' and 'Tristar') to 15.1% (for 'F96'). Similarly, K concentrations were 3.2% ('F96'), 3.0% for 'Tristar,' and 3.0% for 'Amber' (Table 2). P and Mg levels did not differ ($P > 0.05$) among the cultivars.

Observed CP concentrations were consistent with those reported by others in Canada (Archarya et al., 2008; Mir et al., 1998). For instance, CP concentrations for 'Amber' and 'Tristar' were 17.4% and 16.1%, respectively, when grown under non-irrigated conditions in Alberta (Archarya et al., 2007). The ADF and NDF data reported in this study are comparable to the ADF (37.1%kg) and NDF (51.0%) concentrations reported by Mustafa et al. (1996) for fenugreek hay harvested at the late bloom to early pod formation stage. Forage CP below 6.2% has been reported to be deficient for most

ruminant livestock (National Research Council, 1996). Similarly, forages with TDN concentrations <50% are considered less digestible and of lower quality for ruminants (NRC, 1996). Therefore, the observed CP and TDN values among all the fenugreek cultivars evaluated in this study were in excess of the maintenance requirement levels for beef cattle production.

Conclusion

Forage nutritive value of fenugreek cultivars under rainfed conditions in western Kansas is comparable or greater than alfalfa, but DM yield was lower than average yields of dryland alfalfa reported for the region. Our preliminary results demonstrate the potential of fenugreek to diversify forage production in the central Great Plains. Further studies are needed to determine the crop's suitability for limited irrigation and dryland cropping systems in the central Great Plains region.

References

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Table 1. Fenugreek forage dry matter productivity and nutritive value as affected by time of planting

Date	Dry matter yield	Crude protein	Acid detergent fiber	Neutral detergent fiber	Total digestible nutrients	Calcium	Phosphorus	Potassium	Magnesium	Relative feed value
	lb/a									
April 1	842 a ¹	20.9a	28.3b	32.7b	71.3a	1.6a	0.27a	3.1a	0.27a	19.2a
April 22	698 a	21.5a	26.0b	29.8b	73.8a	1.6a	0.27a	3.2a	0.30a	21.6a
May 12	801 a	15.8b	33.0a	39.9a	66.1b	1.5a	0.21b	2.8b	0.26a	14.8b
SE ²	136	1.3	1.4	1.5	1.5	0.07	0.01	0.14	0.02	0.5

¹Means followed by same letter(s) in a column are not significantly different at $P \geq 0.05$.

²Standard error for mean comparison.

Table 2. Fenugreek cultivar effects on forage dry matter productivity and nutritive value.

Cultivar	Dry matter yield lb/a	Crude protein	Acid detergent fiber	Neutral detergent fiber	Total digestible nutrients	Calcium	Phosphorus	Potassium	Magnesium	Relative feed value
Amber	759ab ¹	19.2a	29.3a	34.5a	70.2a	16.1a	0.25a	3.0b	0.28a	18.1a
F96	910a	19.2a	29.1a	34.3a	70.3a	15.1b	0.25a	3.2a	0.27a	18.5a
Tristar	672b	19.9a	28.8a	33.7a	70.7a	16.1a	0.24a	3.0b	0.27a	18.9a
SE ²	94	0.7	0.8	0.7	0.8	0.04	0.01	0.09	0.01	1.2

¹Means followed by same letter(s) in a column are not significantly different at $P \geq 0.05$.

²Standard error for mean comparison.