FENUGREEK HAS POTENTIAL TO USE AS A FORAGE CROP

M. Anowarul Islam[1]

ABSTRACT

Fenugreek (*Trigonella foenum-graecum* L.) is a valuable specialty crop of the Fabaceae family which is used both as an herb and as a spice. Fenugreek has potential to be used as animal feed. The objective of this study was to evaluate 13 promising genotypes/accessions of fenugreek in two varying Wyoming environments for adaptability and stability for growth, seed yield, and forage quality. Thirteen genotypes/accessions were sown with four replicates during the spring of 2010 and 2011 at two locations of University of Wyoming: Lingle (irrigated and dryland) and Laramie (irrigated). The seeding rate was 27 kg pure live seed ha^{-1}. The plots were divided into two groups: forage production and seed production. Forage was mechanically harvested in mid-August to early September and seeds were harvested in mid-October of 2010 and 2011. At Lingle, fenugreek line F80 produced the highest dry matter (DM) yield (2,382 kg ha^{-1}) while line IT produced the lowest DM (1,058 kg ha^{-1}) under irrigation in 2010. Line IT produced the highest DM (823 kg ha^{-1}) in dryland in 2010. In 2011, DM increased 3-7 folds under irrigated (range 5,814-10,675 kg ha^{-1}) and 2-7 folds under dryland (range 1,383-2,335 kg ha^{-1}) conditions, compared to DM of 2010. In Laramie under irrigation, the highest yield was 1,547 kg ha^{-1} from line F96 in 2010 and 2,994 kg ha^{-1} from line LRC3708 in 2011. Variations in seed yield were also observed under irrigated (range 817-2,255 kg ha^{-1} in 2010; 544-1,988 kg ha^{-1} in 2011) and dryland (range 61-387 kg ha^{-1} in 2010; 64-529 kg ha^{-1} in 2011) conditions at Lingle and under irrigation at Laramie (range 25-580 kg ha^{-1} in 2010; 442-1,309 kg ha^{-1} in 2011). On average, seed yield produced under irrigated conditions were higher than those produced under dryland conditions. The highest seed yield (2,255 kg ha^{-1}) was obtained from line F96 under irrigation at Lingle in 2010. Forage quality was in the acceptable range at both locations, for example, the range of crude protein was 140 to 200 g kg^{-1}. It appears that fenugreek has potential to be used as a forage crop both in irrigated and semiarid environments.

Key Words: Accessions, dryland, fenugreek, forage quality, genotypes, irrigated

INTRODUCTION

Fenugreek, a self-pollinating, annual leguminous crop native to Asia and Southeast Europe, is cultivated worldwide (Acharya et al., 2008). This is a historically valuable medicinal as well as a culinary herb, and a spice specialty crop. Fenugreek's yellow-to-amber-colored seed is extensively used in preparing pickles, curry powders, paste, and often in Indian cuisine to impart flavor, color, and aroma. In some countries, seeds are also used as tea after being boiled and sweetened. The young leaves and sprouts of the plant are used as vegetables while the fresh or dried leaves are used to flavor other dishes. Fenugreek is also widely used in producing lower-cost, artificial maple syrup. Fenugreek is a rich source of polysaccharide galactomannan, which

[1] M. A. Islam (mislam@uwyo.edu), Department of Plant Sciences, University of Wyoming, WY 82071; **In**: Proceedings, 2013 Western Alfalfa & Forage Symposium, Reno, NV, 11-13, December, 2013. UC Cooperative Extension, Plant Sciences Department, University of California, Davis, CA 95616. (See http://alfalfa.ucdavis.edu for this and other alfalfa conference Proceedings.)

helps in lowering of plasma cholesterol and triglyceride levels, thus resulting in reduced cholesterol synthesis in liver and lowered blood sugar (Bordia et al., 1997; Acharya et al., 2008; Bandara et al., 2008).

Studies have reported that fenugreek is a potent stimulator of breastmilk production and its use was associated with an increase in milk production up to 900 percent (Fleiss, 1988). Fenugreek has also been extensively reported in Canada to be grown to feed animals (Mir et al., 1993, 1996, 1997, 1998; Shah and Mir, 2004; Acharya et al., 2008). Studies showed the nutritive value of fenugreek forage is comparable to early-bloom alfalfa (*Medicago sativa* L.) regardless of growth stage (Mir et al., 1993, 1997, 1998). It has been shown in a trial in western Canada that steer growth on mature fenugreek and early-bloom alfalfa silage supplemented by barley did not differ (Mir et al., 1996, cf. Acharya et al., 2008). The fact is that fenugreek produces high quality forages in all growth stages, does not create bloat problem in cattle, contains animal growth promoting substances (e.g., diosgenin) – all which makes it attractive forage crop for North American cattle industries (Acharya et al., 2008). Furthermore, as a member of Fabaceae and nitrogen fixing crop, it has the potential to maintain and buildup soil health and quality (Acharya et al., 2008). In Canada, it has also been reported that fenugreek has great potential as a component crop in the rain-fed crop rotation in the Canadian prairies, particularly in Alberta (Acharya et al., 2008). Unfortunately, there is no information available on whether this important specialty crop will grow to maturity in the central High Plains of Wyoming and the neighboring states in the USA. The objective of the study was to evaluate some promising genotypes/accessions of fenugreek in two varying Wyoming environments for the phenotypic adaptability and stability for growth, seed yield, and forage quality.

PROCEDURES

Experimental Sites, Materials, and Management. Seeds of 13 genotypes/accessions were sown in replicated experiments during the late spring of 2010 (early June) and 2011 (late May) at University of Wyoming Research and Extension facilities. One irrigated site was used at the University of Wyoming Research and Extension and Greenhouse facilities in Laramie. At the University of Wyoming Sustainable Agriculture Research and Extension Center near Lingle, Wyoming, two sites were sown. One site was on irrigated and the other was on dryland. Seeding was conducted onto a clean, firm, and smooth seed bed with four replicates in a randomized complete block design. The sowing rate was 27 kg pure live seed ha^{-1}. The experimental plots were divided into two duplicate groups, one group for forage production and the other for seed production. Weed control, irrigation (irrigated plots), fertilizer application, and other management were performed as and when necessary during the establishment period.

Fenugreek plots at Lingle, Wyoming

For forage yield, plots were mechanically harvested in mid-August to early September in 2010 and 2011 using a harvester. Plots for seed production in both locations were sprayed with roundup in mid-September to desiccate the plants aiming to obtain uniform seed maturity. The seeds were harvested using a combine in mid-October of 2010 and 2011. At each harvest, forage subsamples were collected from each plot and used for quality analysis using near infrared reflectance spectroscopy (NIRS).

Fenugreek seed harvesting using a combine at Lingle, Wyoming

Results and Discussion. Forage dry matter (DM) data showed promising and interesting results for some of the genotypes/accessions (Table 1). For example, at Lingle, line F80 produced the highest DM yield (2,382 kg ha^{-1}) while line IT produced the lowest DM (1,058 kg ha^{-1}) under irrigation in 2010. Line IT produced the highest DM (823 kg ha^{-1}) in dryland in 2010. In 2011, DM increased 3-7 folds under irrigated (range 5,814-10,675 kg ha^{-1}) and 2-7 folds under dryland (range 1,383-2,335 kg ha^{-1}) conditions, compared to DM of 2010. The highest yield was 10,675 kg ha^{-1} (line F70) under irrigated and 2,335 kg ha^{-1} (line L3068) under dryland conditions. In Laramie under irrigation, the highest yield was 1,547 kg ha^{-1} from line F96 in 2010 and 2,994 kg ha^{-1} from line LRC3708 in 2011.

Table 1. Dry matter (DM) yield of fenugreek genotypes/accessions under irrigated and dryland conditions at Lingle and Laramie in 2010 and 2011.

Genotypes/	Lingle				Laramie	
accessions	Irrigated		Dryland		Irrigated	
	2010	2011	2010	2011	2010	2011
	DM (kg ha^{-1})					
Amber	1427	8092	345	1474	1082	2454
F17	1507	8241	581	1474	1400	2000
F70	1506	10675	341	1723	328	2086
F75	1546	5814	629	1655	669	1878
F80	2382	6975	371	1428	693	2480
F86	1735	6991	348	1768	445	2422
F96	1807	6785	745	1383	1547	2917
IT	1058	7498	823	1700	695	2450
L3068	1167	6666	376	2335	180	2500
LRC3375	1679	8148	512	1678	1277	2989
LRC3708	1828	7960	460	1496	1012	2994
Tristar	1531	8585	295	1972	940	2490
X92	1451	8545	501	1542	926	2399
LSD(0.05)	1124	4756	364	779	710	1054

Large variations were also observed for seed yield under irrigated (range 817-2,255 kg ha^{-1} in 2010; 544-1,988 kg ha^{-1} in 2011) and dryland (range 61-387 kg ha^{-1} in 2010; 64-529 kg ha^{-1} in 2011) conditions at Lingle and under irrigation at Laramie (range 25-580 kg ha^{-1} in 2010; 442-1,309 kg ha^{-1} in 2011) (Table 2). Greater seed yields were associated with irrigated plots than dryland plots. The highest seed yield (2,255 kg ha^{-1}) was obtained from line F96 under irrigation at Lingle in 2010.

Lesser variations were observed for forage quality among the lines compared to forage and seed yield under both irrigated and dryland conditions. Forage quality was in the acceptable range at both locations, for example, the ranges of crude protein, neutral detergent fiber, acid detergent fiber, in vitro true dry matter digestibility, and relative feed value were 140-200 g kg^{-1}, 360-580 g kg^{-1}, 270-390 g kg^{-1}, 560-720 g kg^{-1}, and 100-171, respectively.

Forage DM yield, seed yield, and forage quality values obtained in this study seem to be lower than those reported elsewhere (Mir et al., 1993, 1996, 1997, 1998; Shah and Mir, 2004; Acharya et al., 2008) in 2010, however, in 2011, these values were similar to those reports. Late planting (early June) of fenugreek in 2010 may have contributed largely to these low yields and forage quality (Acharya et al., 2008) and yield and quality have improved in 2011 because of two weeks early planting (late May) in 2011.

Table 2. Seed yield of fenugreek genotypes/accessions under irrigated and dryland conditions at Lingle and Laramie in 2010 and 2011.

Genotypes/	Lingle				Laramie	
accessions	Irrigated		Dryland		Irrigated	
	2010	2011	2010	2011	2010	2011
	Seed yield (kg ha^{-1})					
Amber	845	719	88	460	25	863
F17	1660	1554	142	204	67	1177
F70	1014	1131	61	395	99	648
F75	1522	1034	201	284	214	904
F80	1165	970	109	410	117	667
F86	1193	1809	164	408	187	1180
F96	2255	1568	387	175	347	1309
IT	817	1068	143	132	284	1008
L3068	912	1988	184	64	51	1101
LRC3375	1504	1554	223	312	580	1032
LRC3708	1456	1491	152	276	416	442
Tristar	1312	544	191	529	223	1286
X92	1227	1590	197	199	151	945
LSD(0.05)	451	852	275	91	358	347

CONCLUSION

The study was repeated in 2012 and similar trend was observed for forage yield, seed yield, and forage quality (data not shown). Several lines of fenugreek performed well both in irrigated and dryland conditions however, it appears that line F96 is one of the best lines that performs very well for DM and seed yields under irrigated and dryland conditions at both locations. Fenugreek has potential to be used as a forage crop both in irrigated and rain-fed environments. It is expected that selection of well-adapted high performing fenugreek genotypes/accessions may result in development of cultivars that will be specifically suitable for Wyoming, neighboring states, and in the West.

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