

## AGRONOMIC STUDIES WITH FENUGREEK

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Fenugreek (*Trigonella foenum-graecum* L.) is an annual legume that produces a small seed used as a spice crop. The seed contains about 5% oil which is a mild flavoring agent. The Agriculture Canada Research Station at Morden, MB has evaluated numerous lines of fenugreek on the station and in Cooperative Yield Tests throughout western Canada and found that NC 109-1 was the highest yielding line. Accordingly, this line has been increased at both Morden and Saskatoon and a formal release will be made in 1992. An exclusive release will be used due to the extremely limited market. One Saskatchewan producer grew about 25 hectares of a low yielding, small seeded line from Australia in 1991.

NC 109-1 fenugreek is a late maturing line and often fails to mature in western Canada. However, extra early seeding permits normal maturation in the Dark Brown soil zone in most years. The scarcity of agronomic data resulted in initiation of an agronomic study on fenugreek at Saskatoon in 1990. This report presents results of agronomic studies on fenugreek in Saskatchewan for 1990 and 1991.

### MATERIALS AND METHODS

All experiments were conducted with two or more lines of fenugreek. NC 109-1 was used both years with Australian in 1990 and Line 9095 in 1991. Small plots were used; four rows 30 cm apart and 4 m long. The standard seeding rate was 36 seeds/m of row in rows 30 cm apart (about 12 seed/ft<sup>2</sup>). The soil was treated the previous fall with soil incorporated ethalfluralin (Edge) and the plots were hand weeded and direct combined with a small plot combine. However, the plots were also sprayed with metribuzin in 1990 and this severely inhibited growth for several weeks resulting in low yields. Data were collected on seed yield, days to flower, days to flower, plant height and 1000-seed weight. However, since the agronomic trials had no effect on any trait except seed yield, only yield data will be reported except for the Regional Yield Trial.

### RESULTS AND DISCUSSION

- A. Seeding Rate Study. Two fenugreek lines were seeded at 24, 36 or 48 seeds per meter of row in rows 30 cm apart in a randomized block design with six replications in both 1990 and 1991. NC 109-1 yielded significantly more than Australian in 1990, but no different than line 9095 in 1991 (Table 1). The effect of seeding rate was not significant, either year, indicating that general use of the middle seeding rate (36 seeds/m of row in rows 30 cm apart = 12 seeds/ft<sup>2</sup>) was more than adequate. Even 50% emergence of NC 109-1 in 1990, due to use of frost damaged seed, had no effect on seed yield due to different seeding rates.

Table 1. Seed yield of fenugreek in the Seeding Rate Study at Saskatoon, 1990 and 1991.

Year and line	Seeding rate			Line mean
	24s/m	36s/m	48s/m	
-----kg/ha-----				
<u>1990†</u>				
NC 109-1	1348	1422	1505	1425
Australian	<u>715</u>	<u>681</u>	<u>715</u>	<u>704</u>
Mean	1032	1052	1110	1064
<u>1991**</u>				
NC 109-1	2420	2314	2442	2392
9095	<u>2449</u>	<u>2564</u>	<u>2637</u>	<u>2550</u>
Mean	2434	2439	2540	2471

†CV = 17.3% and standard error = 92 in 1990. Only 50% emergence of NC 109-1 due to use of frost damaged seed.

\*\*CV = 6.9% and standard error = 70 in 1991.

**B. Seeding Depth Study.**

Two fenugreek lines were seeded 2.5, 5.0 or 7.5 cm (1, 2 or 3 inches) deep in a randomized complete block design with six replications in 1991 only. Seed yield decreased significantly at seeding depths below 2.5 cm (1 inch) (Table 2) as might be expected from a small-seeded legume such as fenugreek.

**C. Seeding Date Study.**

Two fenugreek lines were seeded on four seeding dates with and without metalaxyl fungicide seed treatment in a randomized complete block design with five replications at each date in 1991 only. Seeding dates were not randomized and thus a combined analysis was not done. Metalaxyl fungicide seed treatment had no effect so line means were averaged over fungicide and no fungicide. Seed yield from the April 23 seeding date was very high (Table 3) and dropped off to the May 30 seeding date except for a lower yield from the May 18 seeding date, which site was temporarily flooded, resulting in greatly reduced seed yield. These results indicate that fenugreek can tolerate cold soils in the spring even without a fungicidal seed treatment.

**D. Phosphate Rate Study.**

Two fenugreek lines were treated with three rates of seed-placed phosphate (0, 30 and 60 kg P<sub>2</sub>O<sub>5</sub>/ha as 11-55-0) in a randomized complete block design with four replications at Saskatoon in both 1990 and 1991. The plot area has been used for plots for over 40 years and tested high in available phosphate in previous years. Nevertheless the use of seed placed phosphate resulted in a small, but not significant, increase in seed yield of fenugreek in both years (Table 4).

Table 2. Seed yield of fenugreek in the Seeding Depth Study at Saskatoon in 1991.

Line	Seeding depth			Mean
	2.5 cm	5.0 cm	7.5 cm	
	-----kg/ha-----			
NC 109-1	2928	2741	1801	2490
9095	<u>2976</u>	<u>2651</u>	<u>1648</u>	<u>2425</u>
Mean	2952	2696	1724	2458
C.V. (%)				11.0
Standard error				111

Table 3. Seed yield of fenugreek in the Seeding Date Study at Saskatoon in 1991.

Line	Seeding date <sup>†</sup>				Mean
	April 23	May 2	May 18**	May 30	
	-----kg/ha-----				
NC 109-1	3850	2960	1164	2231	2551
Australian	<u>2135</u>	<u>1594</u>	<u>864</u>	<u>1210</u>	<u>1451</u>
Mean	2993	2277	1014	1721	2001
C.V. (%)	9.3	14.0	10.1	11.7	-
Standard error	64	143	46	90	-

<sup>†</sup>Metalaxyl fungicidal seed treatment had no effect, so the effects were averaged.

\*\*Temporary flooding at this site greatly reduced yield.

Table 4. Seed yield of fenugreek in the Phosphate Rate Study at Saskatoon in 1990 and 1991.

Year and line	Seed-placed phosphate rate (kg/ha)			Mean
	0	30	60	
<u>1990†</u>	-----kg/ha-----			
NC109-1	1079	1325	1254	1219
Australian	<u>465</u>	<u>432</u>	<u>466</u>	<u>454</u>
Mean	772	878	860	836
<u>1991**</u>				
NC109-1	2708	2832	3064	2868
9095	<u>2825</u>	<u>2883</u>	<u>2940</u>	<u>2883</u>
Mean	2766	2858	3002	2876

†C.V. = 16.4% and standard error = 60 in 1990.

\*\*C.V. = 16.0% and standard error = 230 in 1991.

E. Inoculation Study. Two fenugreek lines were either inoculated with Rhizobium or non-inoculated and seeded in a randomized complete block design with six replications at Saskatoon in 1991 only. Inoculation had no effect on seed yield (data not shown), possibly because of the high level of available soil nitrogen in the plot area. Unfortunately, the roots were not checked for nodules.

F. Row Spacing Study. Two fenugreek lines were seeded in 15 or 30 cm rows at Saskatoon in 1991 and in 10, 20 or 40 cm rows at Saskatoon in 1990. Row spacing had no effect on seed yield in either experiment (data not shown).

G. Herbicide Screening Study. Two fenugreek lines are sprayed post-emergence with bentazon (Basagran at 0.84 kg a.i./ha), imazethapur (Pursuit at 0.060 kg a.i./ha) or metribuzin (Sencor at 0.212 kg a.i./ha) in a randomized complete block design with four replications at Saskatoon. Metribuzin severely reduced seed yield as a result of severe stand thinning (85%, Table 5). However, bentazon and imazethapyr had no deleterious effect on seed yield with minimal stand thinning.

H. Intercropping Study. Fenugreek and coriander seed were mixed together and seeded in the same row. The normal seeding rate of each was 36 seeds per meter of row in rows 30 cm apart (12 seeds/ft<sup>2</sup>). The seeding mixtures were 100% fenugreek, 75% fenugreek - 25% coriander, 50% fenugreek - 50% coriander, 25% fenugreek - 75% coriander, and 100% coriander. A randomized complete block design with four replications was used at Saskatoon only in 1991. Fenugreek is a much stronger competitor than coriander in that 50% coriander reduced seed yield of fenugreek by 23%, whereas 50% fenugreek reduced seed yield of coriander by 83% (Table 6). These results suggest that fenugreek may have some potential in intercropping studies.

Table 5. Effect of bentazon (Basagran), imazethapyr (Pursuit) and metribuzin (Sencor) on seed yield, stand reduction and weed control in fenugreek in the Preston plots in 1991.

Treatment and rate*	Conc. (%)	Seed yield** (kg/ha)	Stand reduction** (%)	Crop control** (%)
Imazethapyr-0.062 kg a.i./ha	24 EC	2985	4.6	3.5
Bentazon-0.84 kg a.i./ha	48 EC	2895	3.9	9.0
Metribuzin-0.212 kg a.i./ha	50 SU	2210	85.0	54.0
Hand weeded check		3105	0	0
Unweeded check		2985	0	0
Standard error		130	17	2.6

\*Herbicide was applied in 110 L/ha water at 275 kPa on June 17, or 21 days after seeding (2-3 leaf stage)

\*\*Data are the average of two lines and four replications.

Table 6. Seed yield of fenugreek and coriander in an intercropping study in the Preston plots in 1991.

Seeding rate (% normal)		Seed yield (g/plot)	
Fenugreek	Coriander	Fenugreek	Coriander
100	0	1456	0
75	25	1297	39
50	50	1122	79
25	75	704	175
0	100	0	463

I. **Harvest Method Studies.** Two fenugreek lines were seeded at Saskatoon in 1990 only and harvested by desiccating, direct combining or by hand harvesting. Seed yields were similar from all three harvest methods, indicating that shattering is not a problem in fenugreek production.

J. **Regional Yield Trial.** Five fenugreek lines were grown in a randomized complete design with six replications at Saskatoon and Bounty in 1991. Data were collected on yield and other agronomic traits. NC109-1 was among the highest yielding entries and will be released in 1992 (Table 7). All five lines are late maturing. 9095 is the tallest line and both 9095 and NC 109-1 have large seeds.

Two Observational Yield Trials were also grown at Saskatoon in 1991 (62 additional lines). Several of these lines outyielded NC109-1 and will be tested further (data on file).

Table 7. Yield and agronomic data for five fenugreek lines grown in the Preston plots and at Bounty in 1991.

Line	Seed yield (kg/ha)			Days to flower (Preston)	Days to mature (Preston)	Height (cm)	1000-seed wt. (g)
	Preston	Bounty	Mean				
9095	3499	1332	2416	38	116	61	21.0
Paul	3391	1194	2292	42	117	44	15.5
NC 109-1	3093	1341	2217	39	116	38	19.0
Australian	2566	1133	1849	42	114	42	14.3
Margaret	2539	547	1543	43	119	47	15.3

Standard error 116 49  
C.V. (%) 9.4 10.9

K. Irrigation Study. Two fenugreek lines were grown in 20 ranges the length of the linear irrigation system at Outlook in 1990. The sprinkler was managed so that two replications of five irrigation zones were established with each zone receiving increasing amounts of water. Vegetative yield increased with increasing amounts of water, but no differences were evident for seed yield (data not shown), possibly due to increased disease.

L. Chemical Composition Study. A study of the chemical composition of NC 109-1 fenugreek grown in 1991 indicates the following composition of the seed:

1. Dietary fiber - 44.4% (31.1% insoluble, 13.3% soluble)
2. Crude protein (N x 6.25) - 36.0%
3. Crude oil - 6.5%
4. Ash- 3.2%
5. Starch - 1.6%
6. Sugars - 0.4%

Fenugreek is unique in that the seed is nearly devoid of sugar and starch and high in dietary fiber.

Another sample of seed of five fenugreek lines grown in 1990 was used to determine the fatty acid profile (Table 8).

Table 8. Percent oil and fatty acid composition of oil for five fenugreek lines grown at Saskatoon in 1990.

Line	Oil % as is	Fatty acid composition (%)				
		Palmitic acid	Stearic acid	Oleic acid	Linoleic acid	Linolenic acid
NC 109-1	4.65	13.3	5.3	16.3	39.7	21.7
9095	4.91	13.7	4.9	16.3	37.3	23.6
Australian	3.90	13.9	4.2	15.6	35.2	27.2
Paul	4.43	15.1	4.6	14.2	37.9	24.2
Margaret	4.58	13.5	4.5	14.1	38.6	25.5
Mean	4.49	13.9	4.7	15.3	37.7	24.4

## SUMMARY

1. NC 109-1 is one of the higher yielding fenugreek lines and will be released in 1992.
2. A seeding rate of 12 seeds/ft<sup>2</sup> (130 seeds/m<sup>2</sup>) provides an excellent stand. This is about 23 lb/a (26 kg/ha) for NC 109-1 fenugreek.
3. Seeding depth should not exceed about 2 inches (5 cm) and 1 inch (2.5 cm) is preferred if seeded in moist soil.
4. Row spacings of 10, 20, 30 or 40 cm (4, 8, 12 or 16 inches) had no effect on seed yield.
5. Early seeding (April 23) resulted in the highest yield. It tolerates cool soils and light frosts in the early spring. Fenugreek often is damaged by early fall frosts, but this can be overcome by seeding extra early.
6. Seed placed phosphate consistently increased seed yield, but the increase was not significant in soils testing high in available phosphate.
7. Inoculation had a small, but insignificant, positive effect on yield in soils high in available soil nitrogen.
8. Post emergent application of imazethapyr (Pursuit) at 0.062 kg a.i./ha or bentazon (Basagran) at 0.84 kg a.i./ha provided good weed control with minimal damage to the fenugreek. Metribuzin (Sencor) at 0.212 kg a.i./ha severely damaged fenugreek and reduced yields accordingly.
9. Fenugreek does not shatter readily and can be direct combined after complete maturity.
10. Fenugreek greatly outcompeted coriander in an intercropping study and may have potential in intercropping studies.
11. Several additional fenugreek lines are reasonably well adapted to the Dark Brown soil zone.
12. Fenugreek seed has a unique chemical composition in that it contains very little starch and sugar. The carbohydrate fraction consists largely of dietary fiber (44%). The oil concentration is 4 to 5% and linoleic acid is the major fatty acid (38%), followed by linolenic acid (24%).