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Soil fertility, nutrient content and uptake as affected by fertility levels and cutting management in fenugreek

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Abstract
A field experiment was carried at Agricultural Research Station, Sardarkrushinagar Dantiwada Agricultural University, Aseda, Gujarat during three consecutive *rabi* season from the year 2020-21 to 2022-23. Experiment was comprised of total twelve combinations of treatment in which three fertilizer levels *viz*; F_1: 100% RDF, F_2: 125% RDF, F_3: 150% RDF and three cutting management C_1: No cutting (Only seed production), C_2: Cutting at 50 DAS as leafy vegetable + seed production,C_3: Cutting at 40 and 70 DAS as leafy vegetable + seed production, C_4: Cutting at 30, 50 and 70 DAS as leafy vegetable + seed production laid out in randomized block design with factorial concept in three replications. Higher value of nitrogen in soil was recorded under the treatment F_3 fertility levels and remained at par with F_2 fertility levels and C_4 cutting which remained statistically at par with C_2 and C_3 cutting, while organic carbon, Available phosphorus and available potash was non significantly affected by different level of fertility and cutting managements. Higher nutrient content in seed, straw and total uptake of nutrient also found significantly higher under F_3 fertility levels followed by F_2 and in case of cutting managements C_1 recorded higher values which remained statistically at par with the treatment C_2 cutting.

Keywords: Fenugreek, Soil fertility, Nutrient content, Nutrient uptake

Introduction
Methi, is a local name of Fenugreek (*Trigonella foenumgraecum* L.) belongs to sub family papilionaceae of family leguminosae. Chemical analysis of fenugreek seed revealed that it contains 13.7 per cent water, 26.2 per cent protein, 5.8 per cent fat, 3 per cent mineral matter, 7.2 per cent fiber, 4.41 per cent carbohydrate, 0.16 per cent calcium, 0.37 per cent phosphorus, 14.1 mg iron, 333 calories and 160 IU carotene per 100 gm [1]. Fenugreek is mainly grown in India, Pakistan, China, Nepal and Bangladesh. In India, it is commercially grown in Rajasthan, Gujarat, Madhya Pradesh, Haryana, West Bengal, Punjab and Maharashtra. Rajasthan occupies 80% of area and production. The major area was occupied by Rajasthan (90.9 M.ha) followed by Madhya Pradesh (52.2 M.ha) and Gujarat (8.7 M.ha.) with production of 110.8, 101.8 and 16.6 M tonnes respectively [2]. In Gujarat it being cultivated in 8702 ha. Area with 16697 kg production during the year 2021-22. Farmers usually grow it for leaf cutting when crop grown for vegetable purpose. There is urgent need to standardize the nitrogen requirement when leaf cutting is practiced at various stages of growth since it may influence leaf and seed yields. We have taken various fertility levels and cutting at different stages to standardize the requirements of nutrient by crop its effect on nutrient content, uptake and on the soil fertility status after harvest of crop.

Materials and Methods
A field experiment was conducted at Agricultural Research Station, Sardarkrushinagar Dantiwada Agricultural University, Aseda, Gujarat during three consecutive *rabi* season of years 2020-21 to 2022-23. Fenugreek variety PEB (Pusha Early Bunch) was sown at second fort night of November of every season of the consecutive three years with line sowing at 45 cm spacing of different treatments of three fertilizer levels *viz*; F_1: 100% RDF, F_2: 125% RDF, F_3: 150% RDF and three cutting management C_1: No cutting (Only seed production), C_2: Cutting at 50 DAS as leafy vegetable + seed production,C_3: Cutting at 40 and 70 DAS as leafy vegetable +

seed production, C_4: Cutting at 30, 50 and 70 DAS as leafy vegetable + seed production laid out in radomized block design with factorial concept in three replications. The experiment field was prepared by applying farm yard manure @ 5 t/ha followed by ploughing at 15 days before sowing and second times ploughing followed by planking were done for smoothing the plot for sowing. The experiment cite were low in available nitrogen (160 kg N/ha), high in 6666available phosphorus (97 kg P_2O_5/ha) and high in available potash (229 kg K_2O/ha).

The half dose of nitrogen and full dose of phosphorus were applied through urea and single super phosphate di ammonium phosphate as basal at the time of sowing and remaining nitrogen was top dressed at 30 days after sowing (DAS). Foliar sprays of nutrients were made at 30 and 45 days after sowing of crop. The observation of plant height at 30, 40, 50 and 70 DAS before each cuts. Green leaf yield was counted after each cuts and converted on hectare basis. The soil samples and plant samples were collected from each net plot area and after prepared for the laboratory studies for different macronutrient content. Data were statistically analyzed using analysis of variance (ANOVA) [3]. The mean differences were compared using LSD at 5%

The nutrient (NPK) uptake of seed and straw of fenugreek was worked out by using following formula:

$$\text{Nutrient uptake (kg/ha)} = \frac{\text{Nutrient content (\%)} \times \text{Yield (kg/ha)}}{100}$$

Results and Discussion

OC (%), Available Nitrogen, Phosphorus and Potash (kg/ha) in soil:

Effect of different fertility levels and cutting management did not affect significantly on OC (%) content in soil after harvest of crop. Available nitrogen found significantly higher in F_3: 150% RDF (169 kg N/ha) and remained statistically at par with F_2: 125% RDF (165 kg N/ha) and lower value was recorded under the application of 100% RDF levels (161 kg N/ha) on pooled results of three years, while C_4: Cutting at 30, 50 and 70 DAS as leafy vegetable + seed production recorded significantly higher available nitrogen (170 kg N/ha) and remained statistically at par with treatments C_3 (168 kg N/ha) and C_2 (163 kg N/ha) and lower value of available nitrogen was recorded under no cutting managements (161 kg N/ha). The effect of interactions was non-significant.

Available phosphorus and available potash in soil were found non-significantly affected by levels of fertility, cutting managements and interaction effect also found non-significant on pooled results of three years.

Nitrogen, Phosphorus and Potassium content in seed and straw of fenugreek and its total uptake by crops

Effect of different levels of fertility and cutting management on nitrogen content in seed remain non-significant on pooled results of three years. Nitrogen content in straw was remain unaffected by fertility levels on pooled results of three years but in case of cutting management, significantly highest N content in straw (1.68%) was recorded under C_3: Cutting at 40 and 70 DAS as leafy vegetable + seed production, while lower value was recorded under C_1. Total nitrogen uptake was recorded significantly higher under F_3: 150% RDF fertility levels (45.45 kg N/ha) and remained statistically at par with F_2 (45.37 kg N/ha) and lower value was recorded under F_1 (37.82 kg N/ha), while in case of cutting managements treatment C_1: No cutting (Only seed production) recorded significantly higher value of total nitrogen uptake (55.64 kg N/ha) which remained statistically at par with the treatment C_2 and C_3 and lower values of uptake was recorded under the C_4 (21.03 kg N/ha). Effect of interaction on total nitrogen content by fenugreek was significantly affected by fertility levels and cutting management. Significantly highest value of total nitrogen uptake was recorded under combination of F_3C_1 (63.46 kg N/ha) and treatment combination F_1C_4 shows lower value of total nitrogen uptake (16.34 kg N/ha) on pooled results of three years.

Effect of different levels of fertility on phosphorus content in seed was remain non-significant on pooled results but under cutting managements, phosphorus content in seed was recorded significantly higher under the treatment C_1: No cutting (0.54%) and remained statistically at par with the treatments C_2 and C_3, while lower values of phosphorus content in seed was recorded under C_4 (0.51%). Phosphorus content in seed and straw were non-significantly affected by fertility levels and cutting managements. Total uptake of phosphorus were recorded significantly higher in the treatment receiving 150% RDF (5.28 kg P_2O_5 kg/ha) of fertility levels and remained statistically at par with the treatment F_2 and lower values of total phosphorus uptake was recorded under the treatments F_1 (4.23 kg P_2O_5 kg/ha). In case of cutting managements, C_1: No cutting recorded significantly higher value of phosphorus uptake (6.63 kg P_2O_5 kg/ha) and remained statistically at par with treatment C_2 and C_3 while lower value was recorded under C_4 cutting (2.50 kg P_2O_5 kg/ha). Effect of interaction found non-significant.

Potash content in seed and straw of fenugreek were non-significantly affected by different fertility levels and cutting managements, but significantly higher value of total uptake of potassium was recorded in C_2: Cutting at 50 DAS as leafy vegetable + seed production (17.05 kg K_2O/ha) and remained statistically at par with treatment C_1 and C_3, while lower value of total potassium uptake was recorded under C_1 (7.90 kg K_2O/ha). Effect of interaction found non-significant.

The results of higher content and uptake of nutrient are due to higher absorption and translocation of nutrient through efficient root system and better crop growth resulted in higher production of dry matter in plant [4-10].

Table 1: Effect of different fertility levels and cutting management on soil fertility after harvest of crop (Pooled data of three years)

Treatment	OC (%)	Available nitrogen (kg/ha)	Available phosphorus (kg/ha)	Available potash (kg/ha)
Fertility levels (F)				
F_1: 100% RDF	0.306	161	82	235
F_2: 125% RDF	0.314	165	108	234
F_3: 150% RDF	0.294	169	129	238
S.Em+	0.008	1.979	21.53	2.278
C.D.(0.05)	NS	5.590	NS	NS
Cutting management (C)				
C_1: No cutting (Only seed production)	0.307	161	106	232
C_2: Cutting at 50 DAS as leafy vegetable + seed production	0.299	163	113	235

C_3: Cutting at 40 and 70 DAS as leafy vegetable + seed production	0.301	168	89	235
C_4: Cutting at 30, 50 and 70 DAS as leafy vegetable + seed production	0.310	170	118	241
S.Em±	0.009	2.285	12.07	2.630
C.D.(0.05)	NS	6.45	NS	NS
Interaction FxC				
S.Em±	0.016	6.079	15.86	4.556
C.D.(0.05)	NS	NS	NS	NS
(Y X F) (Y X C) (Y X F X C)	NS	NS	NS	NS
C.V%	15.56	7.19	17.48	5.79

Table 2: Effect of different treatment on nitrogen, phosphorus and potassium content and uptake by fenugreek (Pooled data of three years)

Treatment	N content (%)		Total uptake of N (kg/ha)	P content (%)		Total uptake of P (kg/ha)	K content (%)		Total uptake of K (kg/ha)
	Seed	Straw		Seed	Straw		Seed	Straw	
Fertility levels (F)									
F_1: 100% RDF	4.68	1.37	37.82	0.52	0.15	4.23	1.11	0.69	13.99
F_2: 125% RDF	4.74	1.17	45.37	0.52	0.13	4.84	1.11	0.61	15.12
F_3: 150% RDF	4.59	1.28	45.45	0.54	0.16	5.28	1.13	0.65	16.28
S.Em±	0.066	0.101	1.386	0.011	0.010	0.230	0.006	0.035	0.803
C.D. (0.05)	NS	NS	3.95	NS	NS	0.656	NS	NS	NS
Cutting management (C)									
C_1: No cutting (Only seed production)	4.61	1.11	55.64	0.54	0.13	6.63	1.12	0.60	20.28
C_2: Cutting at 50 DAS as leafy vegetable + seed production	4.71	1.10	45.80	0.52	0.13	5.34	1.12	0.62	17.05
C_3: Cutting at 40 and 70 DAS as leafy vegetable + seed production	4.66	1.68	45.05	0.51	0.17	4.79	1.10	0.71	15.28
C_4: Cutting at 30, 50 and 70 DAS as leafy vegetable + seed production	4.70	1.20	21.03	0.53	0.15	2.50	1.11	0.66	7.90
S.Em±	0.076	0.051	3.136	0.006	0.012	0.500	0.007	0.040	0.927
C.D. (0.05)	NS	0.145	14.11	0.016	NS	2.25	NS	NS	2.64
Interaction FxC									
S.Em±	0.132	0.08	2.77	0.018	0.020	0.46	0.021	0.069	1.604
C.D. (0.05)	NS	0.251	7.90	NS	NS	NS	NS	NS	NS
(Y X F) (Y X C) (Y X F X C)	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V%	6.92	16.93	16.21	4.61	33.83	23.47	2.75	26.03	25.99

Table 2.1: Interaction effect of different fertility levels and cutting management on total nitrogen uptake by fenugreek

F X C	C1	C2	C3	C4	Mean
F1	50.44	35.92	48.57	16.34	37.82
F2	53.02	47.30	46.90	22.27	42.37
F3	63.46	54.17	39.68	24.48	45.45
Mean	55.64	45.80	45.05	21.03	
S.Em±					2.77
C.D. (0.05)					7.90
C.V%					16.21

Conclusion

On the basis of three years pooled results, it can be concluded that fenugreek should be fertilized with in which whole dose of phosphorus (50 P_2O_5 kg/ha in the form of SSP) along with half dose of nitrogen (12.5 kg. N/ha) per hectare as basal and remaining half dose of nitrogen (12.5 kg. N/ha) after cutting at 50 days after sowing and left for seed production for getting higher nutrient uptake and to maintain the nutrient status of soil.

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