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Research Communication

Effect of phosphorus levels and cutting management on growth and yield of fenugreek (*Trigonella foenum-graecum*)

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ABSTRACT

A field experiment was conducted during the winter (*rabi*) season of 2020–21 at C.P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Banaskantha, Gujarat to study the effect of phosphorus levels and cutting management on growth and yield of fenugreek (*Trigonella foenum-graecum* L.). The experiment was conducted in a factorial randomised block design (FRBD) with nine treatment combinations comprising of 3 levels of phosphorus fertilizer (50, 100 and 150% RDP) and 3 levels of cutting management (no cutting, 60 days after cutting, 85 days after cutting) with 4 replications. The results revealed that application of 100% RDP with cutting at 60 DAS as leafy vegetable & its seed production had significant effect on number of branches per plant (1.0), number of pods per plant (2.45), seed yield (65 kg/ha), halum yield (149 kg/ha) and fenugreek equivalent yield (154 kg/ha) compared with other treatment. Treatment at 60 DAS as leafy vegetable & its seed production fetched highest net return (63,298₹/ha) and BCR (3.13) during experiment.

Key words: Phosphorus, Cutting management and Fodder equivalent yield

Fenugreek is the third largest spice in India after coriander and cumin. Fenugreek (*Trigonella foenum - graecum* L.) is one of the major spices of India, it is one of the major green fodder crops, especially grown in *rabi.* It is cultivated worldwide as a semi-arid crop. Fenugreek belongs to Fabaceae family. It was named, Trigonella, from Latin language that means ‘‘little triangle” due to its yellowish-white triangular flowers. It is named as Methi (Hindi, Urdu, Punjabi and Marathi) and heyseed in English. Seeds are bitter in taste due to presence of two alkaloids “Trigonellin” and “Choline”. Fenugreek seeds are also used as seasoning agent for pickles and vegetables. As a spice, it flavours food. Dried leaves powder is also used for garnishing and flavouring variety of food. In maple syrup, extract of fenugreek used as flavouring agent. The seeds are used in colic flatulence, dysentery, diarrhea, dyspepsia, chronic cough, enlargement of liver and spleen, rickets, gout and diabetes. Fenugreek being a legume crop is heavy feeder of phosphorus. Phosphorus is one of the major primary nutrient meaning that it is frequently deficient for crop production and required by crops. Phosphorus role on plant metabolism is enhance to symbiotic nitrogen fixation. In fenugreek, cutting is beneficial for higher production of seed as well as green leaf production to farmers. One or two leaf cutting may be done leading to higher seed production. It is a general practice with the farmers to leave the crop for seed taking a few leaf cuttings. The leaf plucking of fenugreek seed crop at early stage can provide an extra income to the farmers (Spices Board of India, 2019-20).

A field experiment was conducted at the Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Banaskantha, Gujarat (24°-19’ N latitude and 72°-19’ E longitude with an altitude of 154.52 meter above the mean sea level) during *rabi* season 2020–21. The soil of the experimental plot was loamy sand in texture and slightly saline in reaction (pH-7.45). The soil was low in organic carbon (0.29%), available nitrogen (171.2 kg/ha) and medium in available phosphorus (39 kg/ha) and available potassium (262.3 kg/ha) with soil. The treatment comprised of 3 levels of phosphorus fertilizer, viz. P_1, 50% RDP; P_2, 100% RDP; P_3, 150% RDP and 3 levels of cutting management, viz, C_1, no cutting; C_2, Cutting at 60 DAS as

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leafy vegetable + seed production and C_3, Cutting at 85 DAS as leafy vegetable + seed production with 4 replications. The fenugreek variety "Pusa Early Bunching (PEB)" was sown on 7th November, 2020 with recommended seed rate of 18 kg/ha by maintaining 30 cm distance between rows. The seeds were sown manually at the depth of 4–5 cm in previously opened furrows and covered properly with soil. The experimental plots were fertilized as per treatments. The total quantity of urea and SSP as per treatments were applied in previously opened furrow at the time of sowing (From urea containing 46% N and SSP containing 16% P_2O_5). The seeds were treated uniformly with *Rhizobium* @ 5 ml/kg seed allowed to dry in the shade before sowing. Representative samples of seed and haulm were taken from each net plot for the biochemical analysis. The seed and plant samples were oven dried at 65 ± 5 °C till the constant weight and powdered by mechanical grinder. These prepared samples were utilized for estimation of nitrogen and phosphorus. The techniques employed for the biochemical analysis of N content was Micro Kjeldahl's method (Sunniah and Asija (1956). and P by Vanadomolybdo phosphoric acid yellow colour method Olsen *et al.* (1954).

Phosphorus treatment exhibited significant effect on plant height (48.69 cm), number of branches per plant (8.89), number of pods per plant (20.26), length of pod (8.40 cm), number of seeds per pod (11.13) and test weight (6.82 g) were recorded highest with 150 % RDP being at par with 100% RDP. Green leaf yield was produced maximum green biomass (5722 kg/ha) with application of 150% RDP (P_3). Whereas seed yield (448 kg/ha) and haulm yield (1089 kg/ha) were recorded significantly higher in 150% RDP (P_3) but remained at par with phosphorus @ 100% RDP (P_2). FEY (1683 kg/ha) was significantly highest @ 150% RDP.

Phosphorus being part of the essential nutrients required for the promotion of the meristematic and physiological activities such as plant height, number of leaves, root development, number of pods/plants, num-

Table 1. Effect of phosphorus levels and cutting management on growth, yield and yield attributes of fenugreek

Treatment	Plant height (cm) at harvest	Number of branches/ plant	Number of pods/ plant	Length of pod (cm)	Number of seeds/ pod	Test weight (g)	Green leaf yield (kg/ha)	Seed yield (kg/ha)	Haulm yield (kg/ha)	FEY (kg/ ha)
Phosphorus (P)										
P_1, 50% RDP	44.42	7.58	17.94	7.63	9.77	6.28	4746	315	880	1334
P_2, 100% RDP	46.67	8.59	19.16	8.06	10.66	6.78	5485	411	1005	1591
P_3, 150% RDP	48.69	8.89	20.26	8.40	11.13	6.82	5722	448	1089	1683
SEm±	1.16	0.20	0.49	0.21	0.17	0.13		13	29	30
CD (P=0.05)	3.38	0.57	1.42	0.60	0.51	0.38		37	86	89
Cutting management (C)										
C_1, No cutting (only seed production)	55.68	9.58	22.33	9.24	11.16	7.30	-	529	1336	562
C_2, Cutting at 60 DAS as leafy vegetable + seed production	48.46	9.14	18.98	8.84	10.59	6.95	7574	402	1089	2322
C_3, Cutting at 85 DAS as leafy vegetable + seed production	35.65	6.33	16.06	6.02	9.81	5.63	8379	244	549	1724
SEm±	1.16	0.20	0.49	0.21	0.17	0.13		13	29	30
CD (P=0.05)	3.38	0.57	1.42	0.60	0.51	0.38		37	86	89
Interaction effect (P × C)										
SEm±	2.00	0.34	0.84	0.36	0.30	0.23		22	51	53
CD (P=0.05)	NS	1.00	2.45	NS	NS	NS		65	149	154
CV%	8.60	8.19	8.79	8.96	5.76	6.91		11.31	10.29	8.85

ber of seeds/pod and test weight under this treatment. This might be the fact that efficient absorption and translocation of water and nutrients and assimilation of carbon dioxide. These activities promote higher photosynthetic activities leading to the production of enough assimilates for subsequent translocation towards sink and hence the production of higher green leaf yield, seed yield, haulm yield and fenugreek equivalent yield. These results are in conformity with those obtained by Deshmukh *et al*. (2020) and, Desai *et al*. (2022). Data presented in Table 2 revealed that gross realization (₹67,320/ha), net realization (₹37,455/ha) and BCR (2.25) gave highest at 150% RDP (P_3).

Plant height in cutting management gave significantly variation in all stages. At harvest C_1 treatment with no cutting (only seed production) noted the highest plant height (55.68 cm) followed by C_2(48.46 cm). Yield parameter of fenugreek viz, number of branches per plant, number of pods per plant, length of pod (cm), number of seeds per pod and test weight (g) were recorded significantly higher with no cutting- only seed production (C_1) which being at par with cutting at 60 DAS as leafy vegetable + seed production (C_2). Significantly result obtained with number of branches per plant (9.52), number of pods per plant (22.33), length of pod (9.24 cm), number of seeds per pod (11.16) and test weight (7.30 g) @ C_2 treatment.

Data presented (Table 1) maximum green leaf yield was observed in C_3 (cutting at 85 DAS as leafy vegetable + seed production) followed by C_2 (cutting at 60 DAS as leafy vegetable + seed production). Green yield obtains from C_2 and C_3 were 8379 kg/ha and 7574 kg/ha, respectively presented. With no cutting – only seed production (C_1) were significantly higher at seed (529 kg/ha) and haulm (1336 kg/ha) yield (Table 1).

Fenugreek equivalent yield was significant with cutting management practices C_2 (cutting at 60 DAS as leafy vegetable + seed production) gave significantly the highest fenugreek equivalent yield (2322 kg/ha) followed by C_3 (1724 kg/ha) and C_1 (562 kg/ha) respectively. Suddenly reduction in seed yield is due to cutting practices because loss of photosynthetic energy by way of cutting after regrowth is not take completely like no cut plant. So that, less development of leaves, flower and seeds that decrease seed and haulm yield with increasing cutting management practices. In cutting practices no cutting has only seed and haulm yields are considered. While cutting at 60 and 85 DAS have green leaf yield, seed yield and haulm yield are included based on their prices, fenugreek equivalent yield was higher in cutting practices as compare to no cutting. The results findings with Greeshma (2017), Sowmya *et al*. (2017), Singh *et al*. (2018), Patel *et al.* (2019).

Data presented that the highest gross return (₹92,880/ha), net return (₹63,298/ha) and BCR (3.13) were incurred with the treatment C_2 (cutting at 60 DAS as leafy vegetable + seed production) followed by treatment C_3 (cutting at 85 DAS as leafy vegetable + seed production) (Table 2).

As per treatment increasing levels of phosphorus significantly increased the N, P content and uptake in seed and haulm of fenugreek showed in table 4. In 150% RDP (P_3) recorded significantly higher in N, P content and uptake in seed and haulm. The lowest N, P content and uptake was found in 50% RDP (P_1) in seed and haulm. The positive influence of phosphorus on nutrient concentration in crop appears to be due to improved nutritional environment in rhizosphere as well as metabolic activities at the cellular level probably has increased the nutrient accumulation at the time of harvesting in seed and haulm. These results are in close conformity with the findings of Nisarata and Patel (2022).

In cutting management N, P content and uptake in seed and haulm was found in C_1 (no cutting – only seed production) significantly higher while minimum N, P content and uptake in seed and haulm observed in treatment C_3 (cutting at 85 DAS as leafy vegetable + seed production). Due to cutting practices biomass is reduced with increased cutting. After cutting regeneration of leaves are slower than without cutting, so that photosynthesis and nutrient absorption

Table 2. Effect of phosphorus levels and cutting management on economics of fenugreek

Treatment	Gross realization (×10³₹/ha)	Cost of cultivation (×10³₹/ha)	Net realization (×10³₹/ha)	Benefit : cost ratio
Phosphorus (P)				
P_1, 50% RDP	53,360	27,915	25,445	1.91
P_2, 100% RDP	63,640	28,886	34,754	2.20
P_3, 150% RDP	67,320	29,865	37,455	2.25
Cutting management (C)				
C_1, No cutting (only seed production)	22,480	26,315	-3,835	0.85
C_2, Cutting at 60 DAS as leafy vegetable + seed production	92,880	29,582	63,298	3.13
C_3, Cutting at 85 DAS as leafy vegetable + seed production	68,960	30,769	38,191	2.24

Table 3. Interaction effect of phosphorus and cutting management on fenugreek equivalent yield (kg/ha)

Phosphorus (P)	Cutting management (C)			
	C_1, No cutting (only seed production)	C_2, Cutting at 60 DAS as leafy vegetable + seed production	C_3, Cutting at 85 DAS as leafy vegetable + seed production	Mean
P_1, 50% RDP	442	1,999	1,561	1,334
P_2, 100% RDP	601	2,401	1,771	1,591
P_3, 150% RDP	644	2,567	1,839	1,683
Mean	562	2,322	1,724	
SEm±		53		
CD (P=0.05)		154		
CV%		8.85		

RDP, Recommended dose of phosphorus; DAS, days after sowing; RDF, 20 : 40 : 00 NPK kg/ha FEY, fenugreek equivalent yield 50% RDP, 20 kg P_2O_5/ha, 100%; RDP, 40 kg P_2O_5/ha; 150% RDP, 60 kg P_2O_5/ha

Rate of various inputs

Sale price of green cutting at C2, ₹10/kg and at C3, ₹7/kg; sale price of fenugreek seed, ₹40/kg; sale price of fenugreek haulm : ₹1/kg; urea :267 per 45 kg bag; SSP, 362/50 kg bag; *rhizobium*, 150/liter

are less at time of seed formation. Therefore, increasing cuttings nutrient content and uptake in seed and haulm are decreased.

Interaction Effect

The interaction effects between phosphorus and cutting management (P × C) with respect to number of branches per plant, number of pods per plant, seed yield, haulm yield and fenugreek equivalent yield were found to be significant. In treatment combination P_3C_2 gave significantly the highest fenugreek equivalent yield (2567 kg/ha) as compare to other treatment combination. P_1C_1 combination recorded the lowest in fenugreek equivalent yield (442 kg/ha) (Table 3).

In light of the results obtained from this investigation, it is concluded that 60 kg P_2O_5/ha (100% RDP) and cutting management at 60 DAS as leafy vegetable and its seed production gave higher fenugreek equivalent yield and net

Table 4. Effect of phosphorus and cutting management on N and P content (%) and uptake (kg/ha) in seed and haulm of fenugreek

Treatment	N content (%)		P content (%)		N uptake (kg/ha)		P uptake (kg/ha)	
	Seed	Haulm	Seed	Haulm	Seed	Haulm	Seed	Haulm
Phosphorus (P)								
P_1, 50% RDP	3.126	0.791	0.456	0.187	10.04	6.96	1.47	1.66
P_2, 100% RDP	3.254	0.826	0.493	0.196	13.57	8.46	2.04	2.01
P_3, 150% RDP	3.271	0.840	0.516	0.205	14.73	9.26	2.30	2.25
SEm±	0.057	0.014	0.009	0.003	0.55	0.32	0.08	0.07
CD (P=0.05)	NS	0.040	0.025	0.008	1.61	0.94	0.23	0.22
Cutting management (C)								
C_1, No cutting (only seed production)	3.422	0.853	0.520	0.209	17.98	11.48	2.74	2.81
C_2, Cutting at 60 DAS as leafy vegetable + seed production	3.269	0.811	0.485	0.192	13.08	8.84	1.94	2.09
C_3, Cutting at 85 DAS as leafy vegetable + seed production	2.960	0.794	0.460	0.187	7.26	4.36	1.13	1.02
SEm±	0.057	0.014	0.009	0.003	0.55	0.32	0.08	0.07
CD (P=0.05)	0.165	0.040	0.025	0.008	1.61	0.96	0.23	0.22
Interaction effect (P×C)								
SEm±	0.10	0.02	0.02	0.005	0.96	0.56	0.14	0.14
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS
CV%	6.12	5.81	6.16	4.97	14.99	13.50	14.25	13.69

return in fenugreek (Pusa Early Bunching) under North Gujarat Agro climatic conditions.

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