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EFFECT OF SHADE NET, PHOSPHORUS FERTILIZER AND BANANA PSEUDOSTEM SAP ON NUTRIENT UPTAKE OF FENUGREEK

[1]N.B. Misal, [2] R.G. Patil and [1]Krittika

[1]School of Agriculture, Lovely Professional University, Phagwara, Panjab, India-144411

[2]Navsari Agricultural University, Navsari, Gujarat-396450

Email: nmmisal70@gmail; commailto:nmmisal70@gmail.com

Abstract

The field experiment was carried out at Navsari Agricultural University, Navsari, in*rabi* season. The treatment consist of four levels of shade net *viz.,* 30% shade net (N_1), 50% shade net (N_2), 75% shade net (N_3) and open field (N_4) and two levels of P fertilizer 40:40:00 kg NPKha^{-1}(F_1)to first crop and 40:00:00 kg NPK ha^{-1} to second crop and 40:20:00 kg NPKha^{-1}(F_2) to first and second crop and two levels of enriched sap, with sap (S_1) and without sap(S_2) in FCRD design with four replications. The nitrogen, phosphorus and potassium uptake by the fenugreek (leaves, stem and root) were significantly higher with 30 per cent shade net as compared to 50% shade net (N_2), 75% shade net (N_3) and open field condition (N_4) in both crops. The application of phosphorus 40 kg ha^{-1} showed its superiority over F_2 with respect to nitrogen, phosphorus and potassium uptake by leaves, stem and root of first crop, but the trend was reversed in second crop. Spraying of banana pseudostem enriched sap (S_1) recorded significantly higher of N, P, K uptake by leaves, stem and root of fenugreek as compared to no sap application (S_2) in both the crops.

***Key words*:** Fenugreek, shade net, banana pseudostem sap, nutrient uptake

Introduction

Fenugreek is grown round the year for fresh vegetable purposes. However, its growth during early winter season is slow due to relatively higher temperature. So, it can be grown for biomass production under protected condition *i.e.*, shade net house. Fenugreek being legume crop, its phosphorus requirement is high. Fenugreek being short duration crop, it is grown one after another crop in quick succession. Under this situation, it is necessary to find out whether phosphorus application is to be done to one crop or both the crops. The fenugreek seed is the major source of protein as well it contains good amount of minerals (Misal *et al.,* 2018).

After harvest of banana crops, the remaining plant parts are waste. This plant part contains some of the macro and micronutrient essential for plant growth. The utilizing such waste plant parts, we prepare useful products such as fiber, paper, fabrics etc. After the separating of fibers from the banana pseudostem, the liquid available is known as sap after processing that sap to obtain enriched sap which contains good amount of essential plant nutrients and growth promoting substances like cytokinin and GA_3 (Patel *et al.,* 2010). There is vast scope to utilize banana pseudostem enriched sap as a foliar spray. Enriched banana pseudostem sap is one such natural product can be used for enhancing growth of fenugreek.

As the lack of information regarding these aspects of fenugreek cultivation under shade net house and nutrient management. Hence, present study was carried on to study there sponse of shade net, fertilizer and application of banana pseudostem sap (enriched) on nutrient uptake of fenugreek.

Material And Methods

The present experiment was conducted at Navsari Agricultural University, Navsari, to study the response of shade net, fertilizer and application of banana pseudostem sap (enriched) on nutrient uptake of fenugreek.The field experiment was laid out in FCRD, consist of 16 combinations of treatments, four levels of growing conditions *viz.,* 30% shade net (N_1), 50% shade net (N_2), 75% shade net (N_3) and open field (N_4) and two levels of P fertilizer 40:40:00 kg NPK ha^{-1} (F_1) to first crop and 40:00:00 kg NPK ha^{-1} to second crop and 40:20:00 kg NPK ha^{-1} (F_2) to first and second crop and two levels of enriched sap, with sap (S_1) and without sap(S_2) in FCRD design with four replications.All the treatments were repeated four times. The range of maximum temperature during first crop period was from 28^0 to 34^0 C and that of minimum was from 19.0 to 24.0^0 C. The corresponding variation in temperature during second crop period was from 25.5^0 to 31^0 C and from 8.5^0 to 17.5^0 C. With respect to relative humidity, the range recorded during first crop period was from 79 to 96 per cent in morning and 39 to 83 per cent in

evening. The respective values during second crop period were from 29 to 100 per cent and from 14 to 54 per cent. As regards the cloud cover, it was mostly cloudy during first crop period and almost clear sky during second crop period. Two doses of chemical fertilizers were applied @ 40:40:00 and 40:20:00 to first crop and 40:00:00 and 40:20:00 NPK (kg/ha) to second crop. Full dose of phosphorus and half dose of nitrogen were applied as basal and remaining half dose of N was applied 7 days after emergence to both the crop. Nitrogen and phosphorus were applied in the form of commercial grade urea and single super phosphate, respectively.The texture is clayey and colour is dark brown. The soil samples were collected from the experimental field before and after harvest of first and second crop at a depth of 0-15 cm for different physical and chemical analysis. The physical and chemical properties of experimental plot are presented in Table 1.

The uptake of Nitrogen, Phosphorus and potassium of fenugreek leaves, stem and root were computed separately on dry weight basis with following formula.

$$\text{Nutrient uptake } (g/m^2) = \frac{\text{Nutrient content } (\%) \times \text{Yield } (g/m^2)}{100}$$

Results and Discussion

Nutrient uptake : In general, N uptake was more through leaves than stem and root. Similarly, it was more through stem than root. The nitrogen uptake of leaves, stem and root of fenugreek was significantly higher with the 30 per cent shade net house (N_1) in comparison to N_2 and N_3 but it was at par with N_4 *i.e.*, open field condition. With respect to S effect, in all the cases, N uptake by leaves, stem and root of fenugreek was significantly superior with sap application as compared to without sap application. The effect of F was not significant on N uptake only by leaves of second crop, by stem of first crop and by root of both the crops. While in case of leaves of second crop, the N uptake was significantly more with F_2 than F_1. In the case of stem of first crop, N uptake by it was more with F_1 thanF_2. Similar trend of N uptake by root was also observed for first and second crop (Table 2).

Phosphorus uptake : The uptake of phosphorus in leaves, stem and root of second crop was higher than first crop (Table 3). The P uptake by leaves, stem and root was significantly higher in N_1 (30 per cent shade) and N_4 (open field) conditions in comparison to 50 per cent and 75 per cent shade conditions. Between the spray, S_1 treatment recorded significantly superior values of phosphorus uptake of leaves, stem and root of both the crops except by stem of first crop. In case of F effect, P uptake by leaves, stem and root was significantly influenced except by leaves of first crop. In case of F effect, the P uptake by stem and root of first crop F_1 recorded significantly higher uptake than F_2, whereas the trend of second crop was reversed.

Potassium uptake : The results revealed that K uptake by stem is higher as compared to leaves and root. Among the growing conditions, higher value of K uptake by leaves, stem and root of both the crops was recorded in N_1 than N_2 and N_3 but remained at par with N_4. In case of S effect, S_1showed significantly higher potassium uptake by all the parts of plant to both crops of fenugreek except by stem and root of first crop. In cases of F effect, F_1 showed its superiority over F_2 in first crop while in case of second crop, K uptake by leaves and stem was not affected significantly due to F effect (Table 4).

Total Nitrogen uptake : The growing condition N_1registered significantly superior values of total N uptake over rest of the growing conditions of both the crops (Table 5). In first crop, the 30 per cent shade net N_1 (4.05 g m^{-2}) recorded significantly higher N uptake than N_2 (3.65 g m^{-2}) N_3 (3.36 g m^{-2}) and it was at par with N_4 (3.90 g m^{-2}). Fertilizer application, F_1 (3.90 g m^{-2}) recorded significantly higher N uptake over F_2 (3.75 g m^{-2}). In sap application, S_1 (3.93 kg m^{-2}) recorded significantly higher N uptake over S_2 (3.56 g m^{-2}). The trend was almost same for N and S effect but it was reverse for F effect during second crop. The total N uptake in F_2 (6.14 g m^{-2}) treatment was significantly higher as compared to that of F_1 (5.59 g m^{-2}).

Total Phosphorus uptake : The 30 per cent shade net (N_1) reported significantly higher total P uptake as compared to N_2 and N_3 except N_4 of first crop. Sap application treatment S_1 recorded significantly higher total P uptake than S_2 in both the crops. In case of F effect, in first crop F_1 recorded significantly higher total P uptake over F_2, while in second crop F_2 recorded significantly higher total P uptake than F_1. As a result of this, in pooled analysis, the differences failed to reach the level of significance. During second crop, total P uptake recorded with growing conditions, sap application and fertilizer treatments were significantly higher than those of first crop.

Total Potassium uptake : Among the growing conditions, the 30 per cent shade net (N_1) recorded significantly higher total K uptake as compared to N_2 and N_3 except N_4. Application of banana pseudostem sap (S_1) recorded significantly higher total K uptake than S_2 in both crops. In case of F effect, in first crop F_1 recorded significantly higher total K uptake than F_2, while in second crop it was reverse. In general, total K uptake by second crop was significantly higher than first crop.

Here, an attempt has been made to discuss the total uptake (leaves + stem + root) of N, P and K in relation to main effect of shade net, phosphorus fertilizer and sap application. As like biomass yield, total uptake of N, P and K was invariably higher by second crop in comparison to first crop. Similarly, among the growing conditions, 30 per cent shade house (N_1) showed superiority over remaining growing conditions with respect to N, P and K uptake. Of course, the total uptake of N, P and K by fenugreek recorded with open field conditions was at par with N_1 in some of the cases.

In the case of phosphorus application schedule, here also in first crop F_1 recorded significantly higher total uptake of N, P and K in comparison to F_2 and exactly reverse was true for second crop i.e. $F_2 > F_1$. As regards the sap application to fenugreek, it enhanced the total uptake of N, P and K significantly as compared to no application of sap. The reasons given for individual factor responsible for increasing biomass yield are equally tenable for total uptake of N, P and K. The results of present study also prove that uptake of N, P and K is totally governed by the biomass yield by the fenugreek crop. The results of present study are in agreement with Padampriya *et al*. (2009) for growing conditions.

Conclusions

Fenugreek grown either under 30 per cent shade net or open field conditions resulted in more removal of nitrogen, phosphorus and potassium content than 50 per cent and 75 per cent shade net house. The highest uptake was recorded under 30 per cent shade net as compared to 50%, 75% and open field conditions. Applications of recommended manures maintain the soil fertility status after harvest of fenugreek crop.

Table 1: Physical and chemical properties of soil of experimental plot.

Soil characteristics	**Soil depth (0-15 cm)**
(A) Mechanical	
Coarse sand (%)	0.69
Fine sand (%)	9.17
Silt (%)	24.94
Clay (%)	65.20

(B) Chemical	**N_1**	**N_2**	**N_3**	**N_4**	**Mean**
Organic carbon (%)	0.30	0.41	0.38	0.33	0.35
Available N (kg/ha)	215	193	183	186	194
Available P_2O_5 (kg/ha)	52	29	30	47	40
Available K_2O (kg/ha)	425	428	392	390	409

Table 2: Response of different treatments on nitrogen uptake (g m^{-2}) of leaves, stem and root of fenugreek at harvest

Treatments	**Nitrogen uptake on leaves**		**Nitrogen uptake on stem**		**Nitrogen uptake on root**	
	First crop	**Second crop**	**First crop**	**Second crop**	**First crop**	**Second crop**
N_1	2.95	5.07	0.99	1.97	0.12	0.21
N_2	2.64	4.03	0.93	1.34	0.09	0.14
N_3	2.51	3.09	0.78	1.13	0.08	0.10
N_4	2.84	4.58	0.97	1.61	0.10	0.17
SEm±	0.087	0.186	0.029	0.062	0.004	0.007
CD at 5%	0.25	0.53	0.08	0.18	0.01	0.02
F_1	2.81	3.98	0.99	1.46	0.10	0.15
F_2	2.65	4.40	0.85	1.57	0.09	0.16
SEm±	0.061	0.131	0.020	0.044	0.003	0.005
CD at 5%	NS	0.37	0.06	NS	0.01	0.01
S_1	2.88	4.45	0.95	1.66	0.10	0.17
S_2	2.59	3.94	0.88	1.37	0.09	0.15
SEm±	0.061	0.131	0.020	0.044	0.003	0.005
CD at 5%	0.17	0.37	0.06	0.12	NS	0.01
CV%	13	18	13	16	17	17

Table 3: Response of different treatments on phosphorus uptake (g m^{-2}) of leaves, stem and root of fenugreek at harvest

Treatments	Phosphorus uptake on leaves		Phosphorus uptake on stem		Phosphorus uptake on root	
	First crop	Second crop	First crop	Second crop	First crop	Second crop
N_1	0.27	0.49	0.19	0.44	0.025	0.042
N_2	0.22	0.37	0.17	0.24	0.016	0.025
N_3	0.20	0.27	0.14	0.18	0.014	0.019
N_4	0.26	0.44	0.19	0.31	0.018	0.032
SEm±	0.009	0.017	0.005	0.011	0.001	0.001
CD at 5%	0.03	0.05	0.01	0.03	0.002	0.004
F_1	0.25	0.37	0.19	0.28	0.02	0.03
F_2	0.23	0.42	0.16	0.30	0.02	0.03
SEm±	0.006	0.012	0.003	0.008	0.001	0.001
CD at 5%	NS	0.04	0.01	0.02	0.002	0.003
S_1	0.25	0.42	0.18	0.31	0.02	0.03
S_2	0.23	0.36	0.17	0.27	0.02	0.03
SEm±	0.006	0.012	0.003	0.008	0.001	0.001
CD at 5%	0.02	0.04	NS	0.02	NS	0.003
CV%	15	18	11	16	17	18

Table4: Response of different treatments on potassium uptake(g m^{-2}) of leaves, stem and root of fenugreek at harvest

Treatments	Potassium uptake leaves		Potassium uptake stem		Potassium uptake root	
	First crop	Second crop	First crop	Second crop	First crop	Second crop
N_1	2.16	4.83	2.93	5.46	0.20	0.34
N_2	1.95	3.79	2.54	3.49	0.15	0.24
N_3	1.87	2.94	2.37	2.95	0.14	0.18
N_4	2.10	4.34	2.93	4.63	0.17	0.30
SEm±	0.060	0.169	0.074	0.166	0.007	0.012
CD at 5%	0.17	0.48	0.21	0.47	0.02	0.03
F_1	2.11	3.87	2.85	4.08	0.18	0.24
F_2	1.93	4.08	2.53	4.19	0.15	0.29
SEm±	0.042	0.119	0.053	0.118	0.005	0.008
CD at 5%	0.12	NS	0.15	NS	0.01	0.02
S_1	2.13	4.26	2.75	4.43	0.17	0.28
S_2	1.90	3.69	2.63	3.84	0.16	0.25
SEm±	0.042	0.119	0.053	0.118	0.005	0.008
CD at 5%	0.12	0.34	NS	0.33	NS	0.02
CV%	12	17	11	16	17	18

Table 5: Response of different treatments on total Nitrogen, Phosphorus and potassium uptake (g m^{-2}) of fenugreek (leaves, stem and root)

Treatments	Nitrogen uptake		Phosphorus uptake		Potassium uptake	
	First crop	Second crop	First crop	Second crop	First crop	Second crop
N_1	4.05	7.25	0.49	0.97	5.28	10.63
N_2	3.65	5.52	0.41	0.64	4.64	7.52
N_3	3.36	4.33	0.36	0.47	4.37	6.08
N_4	3.90	6.36	0.47	0.78	5.21	9.28
SEm±	0.10	0.24	0.013	0.028	0.117	0.328
CD at 5%	0.30	0.68	0.04	0.08	0.33	0.93
F_1	3.90	5.59	0.45	0.68	5.14	8.19
F_2	3.75	6.14	0.41	0.75	4.61	8.56
SEm±	0.074	0.17	0.009	0.020	0.083	0.232
CD at 5%	0.21	0.48	0.03	0.06	0.24	NS
S_1	3.93	6.27	0.45	0.77	5.05	8.97
S_2	3.56	5.45	0.41	0.66	4.70	7.78
SEm±	0.074	0.17	0.009	0.020	0.083	0.232
CD at 5%	0.21	0.48	0.03	0.06	0.24	0.66
CV%	11	16	12	16	10	16

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