Biological Forum – An International Journal **13(3a): 210-213(2021)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Effect of Varying Fertility Levels and Biofertilizer on Growth, Yield and Economics of Fenugreek

Riddhi Patel[1*], J.C. Shroff[2], P.M. Parmar[3] and S.N. Shah[4]

[1]M.Sc. Scholar, Department of Agronomy, Anand Agricultural University, Anand-388110, (Gujarat), India.
[2]Associate Professor, Department of Agronomy, Anand Agricultural University, Anand-388110, (Gujarat), India.
[3]Ph.D. Scholar, Department of Agronomy, Anand Agricultural University, Anand-388110, (Gujarat), India.
[4]Associate Director of Research, Anand Agricultural University, Anand-388110, (Gujarat), India.

(Corresponding author: Riddhi Patel)*
(Received 01 July 2021, Accepted 09 September, 2021)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: A field experiment was conducted at the College Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat to assess the effect of Varying fertility levels and biofertilizer on the growth, yield and economics of fenugreek during the *rabi* season of the year 2020-2021. The experiment was laid out in factorial randomized block design with three replications. Treatment combinations include three fertility levels *viz.*, 50% RDF, 75% RDF and 100% RDF (20 kg N/ha & 40 kg P_2O_5/ha) and four levels of biofertilizer *viz.*, control, seed treatment with Bio NP, drenching of Bio NP, seed treatment with Bio NP + drenching of Bio NP at 30 DAS. The results revealed that application of 100% RDF recorded significantly the highest plant height at 30 DAS, 60 DAS and at harvest, number of branches per plant at 30 DAS, 60 DAS and at harvest, dry weight of nodules/plant at 45 DAS, green biomass yield at 30 DAS (1057 kg/ha), number of pods/plant, pod length, number of seeds/pod, test weight, seed yield (2259 kg/ha) and straw yield (3198 kg/ha). The maximum gross return and net return with maximum BCR were obtained when 100 percent RDF (20 kg N /ha and 40 kg P_2O_5/ha) was applied. Among different biofertilizer levels application of Bio NP as seed treatment at the time of sowing followed by drenching of Bio NP at 30 DAS registered significantly higher plant height at 30 DAS, 60 DAS and at harvest, number of branches per plant at 30 DAS, 60 DAS and at harvest, dry weight of nodules/plant at 45 DAS, green biomass yield (925 kg/ha), number of pods/plant, pod length, number of seeds/pod, test weight, seed yield (2071 kg/ha) and straw yield (2923 kg/ha). Seed treatment with Bio NP + Drenching of Bio NP at 30 DAS exerted higher gross and net realization with BCR of 4.98.

Keywords: Fenugreek, Bio-fertilizers, Bio NP, Drenching, Economics

INTRODUCTION

Fenugreek commonly known as *methi* (*Trigonella foenum-graecum* L.) belonging to the family *fabaceae* is a multipurpose crop being utilized as a leafy vegetable, spices, condiments, green fodder and also used sometimes as green manure crop (Khiriya *et al.*, 2001). Methi seeds and leaves are important particularly against digestive disorders (Sheoran *et al.* 1999). It is a good source of protein (27.7 to 38.6%), vitamins (A and C), minerals (3.4 to 6.8%), alkaloid trigonelline (0.12 to 0.38%), essential oil (0.02%) and fatty acids. India is the largest producer of fenugreek, where it is the third largest spice after coriander and cumin. In India major fenugreek growing states are Rajasthan, Gujarat, Tamil Nadu, Utter Pradesh, Himachal Pradesh, Madhya Pradesh and Andhra Pradesh. Gujarat is the third largest producer of fenugreek in India followed by Madhya Pradesh and Rajasthan. For higher yield and also for the quality of seed, an optimum supply of nutrients is very important. Altering the soil nutrients and fertility status by providing a balanced and adequate dose of major nutrients like nitrogen phosphorus as per the crop requirement is one of the easiest ways to boost up the productivity of fenugreek. Nitrogen is common plant nutrition that promotes vegetative developments in a plant. It plays a key role in the synthesis of chlorophyll andis also important for producing herb, folium and seed yield in medicinal and spice plants. It is an essential constituent of compounds like amino acids, protein, nucleic acid, porphyrin, flavin, pyridine, nucleotides, enzyme, coenzymes and alkaloids which contributes to the growth of the plant. The general role of phosphorus in plant metabolism is known to enhance the symbiotic nitrogen fixation, improves grain quality, imparts hardiness to shoot, regulates the photosynthesis, helps root enlargement and govern physic-bio-chemical processes. It participates in metabolic activities as a constituent of nucleoprotein and nucleotides and also plays a key role in the formation of energy rich bond phosphate like Adenosine diphosphate and Adenosine triphosphate (Tisdale *et al.*, 1985). Using biofertilizers, healthy plants can be grown, while enhancing the sustainability and health of the soil. Therefore, they are extremely advantageous in enriching soil fertility and fulfilling plant nutrient requirements by supplying the organic nutrients through microorganism and their byproducts. The seed inoculation with *Rhizobium* has been reported to boost the growth, yield and quality

attributes in fenugreek and green gram (Jat and Shaktawat, 2001). PSB are capable of transforming insoluble phosphorus into a soluble form. Inoculation of fenugreek seed with *Rhizobium* and PSB improves the growth and yield of fenugreek (Godara *et al.,* 2018). Keeping all facts in view the present field experiment was planned to test the 'Effect of varying fertility levels and biofertilizer application on growth, yield and economics of fenugreek in middle Gujarat condition'.

MATERIALS AND METHODS

The field experiment was conducted at the College Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand (Gujarat) during *rabi* season of year 2020-2021. The soil of the experimental site was loamy sand with pH 7.97 having 0.38 percent organic carbon and 189.41, 37.57, and 288.1 kg/ha available N, P_2O_5 and K_2O respectively. The experiment laid out in factorial randomized block design comprising three fertility levels *viz.*,50% RDF, 75% RDF and 100% RDF (20 kg N/ha & 40 kg P_2O_5/ha) and four levels of biofertilizer*viz.,* Control, Seed treatment with Bio NP, Drenching of Bio NP, Seed treatment with Bio NP + Drenching of Bio NP at 30 DAS. The seed of variety Gujarat Methi-2 was sown keeping seed rate of 20 kg/ha. Seeds of fenugreek were sown at row to row spacing of 30 cm. The half dose of nitrogen in the form of urea and the entire dose of phosphorus in the form of SSP was applied as basal application as per treatment. The remaining half dose of nitrogen was applied as top dressing at 30 DAS. Bio NP was applied as seed treatment and soil drenching at the time of sowing and at 30 DAS according to treatments. Weeds are controlled by manual hand weeding and interculturing as per need of the crop. The harvest index for each treatment was worked out by using the formula given by Donald and Hamblin, (1976). Statistical analysis of data was done by procedure prescribed by Cochran and Cox (1967).

RESULTS AND DISCUSSION

A. Effect of Fertility Levels

(i) Growth attributes: The results from Table 1 showed that significantly the highest plant height and number of branches per plant recorded at 30 DAS, 60 DAS and at harvest were recorded under the application of 100% RDF (20 kg N & 40 kg P_2O_5/ha) followed by application of 75% RDF. Application of recommended dose of nitrogen and phosphorus produces a huge number of branches and tallest plant, this might be due to the fact that the cell division, cell, elongation and meristematic activity encouraged by an optimum dose of nitrogen and phosphorus. Mehta *et al*., (2012); Godara *et al.,* (2018); Ali *et al*., (2009) also reported similar findings. Significantly higher dry weight of nodules (11.75 mg) was found when the crop received 100% of recommended dose of fertilizer (20:40:00 NPK kg/ha) but it was found at par with the application of 75% RDF. The increasing rate of nodulation per plant with increasing rate of fertility levels might be due to the improvement in N & P status of soil resulted in better availability of nutrients for growth and development of nodules/plant. These results are supported by Godara *et al.,* (2018).

Table 1: Growth attributes as influenced by fertility levels and biofertilizer.

Treatments	Plant height (cm)			Number of branches per plant			Dry weight of nodules (mg)
	At 30 DAS	At 60 DAS	At harvest	At 30 DAS	At 60 DAS	At harvest	At 45 DAS
Fertility levels							
F_1: 50% RDF (10:20:00 NPK kg/ha)	11.50	23.74	51.60	3.39	4.49	4.73	7.35
F_2: 75% RDF (15:30:00 NPK kg/ha)	12.27	26.67	56.14	3.90	4.90	5.20	10.17
F_3: 100% RDF (20:40:00 NPK kg/ha)	13.06	28.59	60.09	4.43	5.72	6.02	11.75
S.Em±	0.23	0.64	1.14	0.10	0.10	0.11	0.22
CD (P = 0.05)	0.68	1.89	3.36	0.30	0.31	0.33	0.66
Biofertilizer							
B_0: Control	11.54	23.77	52.12	3.42	4.54	4.75	8.89
B_1:Seed treatment with Bio NP (5ml/kg seed)	12.60	27.94	57.28	4.04	5.10	5.40	10.00
B_2: Drenching of Bio NP (1 lit/ha)	12.33	26.67	56.27	3.77	4.95	5.26	9.87
B_3: B_1+ Drenching of Bio NP at 30 DAS	12.63	27.95	58.10	4.41	5.55	5.86	10.26
S.Em±	0.26	0.74	1.32	0.11	0.12	0.13	0.26
CD (P=0.05)	0.78	2.18	3.88	0.34	0.36	0.38	0.76
F×B	NS	NS	NS	NS	NS	NS	NS
CV(%)	6.53	8.47	7.09	9.10	7.36	7.34	8.00

(ii) Yield and yield attributes: The yield and yield attributes as influenced by different fertility levels are presented in Table 2. Among the different yield attributes significantly the highest green biomass yield at 30 DAS, number of pods/plant, pod length, number of seeds/pod and test weight recorded with application 100% RDF (20 kg N and 40 kg P_2O_5 kg/ha). Significant improvement in yield attributes might be due to the fact that the balanced proportion of availability of nitrogen and phosphorus helped to promote the flowering and fruiting by enhanced CO_2 fixation and effective partitioning of assimilates to the reproductive parts which plays vital role in the pod and seed development and hence it had positively reflected

into the seed weight. These results are in close accordance with the findings of Sheoran *et al.,* (2016); Chaudhary and Chaudhari (2017); Deshmukh *et al.,* (2020); Swain *et al.,* (2020); Nair *et al.,* (2021). Significantly the highest seed yield and straw yield recorded with 100 % RDF compared to other fertility levels might be due to optimum supply of nitrogen and phosphorus which plays a crucial role in physiological processes in a plant which resulted in increased growth and ultimately resulted in increased yield. These are in conformity with Bhunia *et al.,* (2006); Kumar *et al.* (2009); Mehta *et al.,* (2012); Godara *et al.,* (2018).

Table 2: Yield attributes, yield and economics as influenced by fertility levels and biofertilizer.

Treatments	Green biomass yield at 30 DAS (kg/ha)	Number of pods/plant	Pod length (cm)	Number of seeds/pod	Seed yield (kg/ha)	Straw yield (kg/ha)	Harvest index (%)
Fertility levels							
F_1: 50% RDF (10:20:00 NPK kg/ha)	658	22.42	9.86	12.03	1602	2249	41.70
F_2: 75% RDF (15:30:00 NPK kg/ha)	922	26.06	10.99	14.05	1956	2826	40.77
F_3: 100% RDF (20:40:00 NPK kg/ha)	1057	30.04	12.16	16.79	2259	3198	41.41
S.Em ±	19	0.67	0.20	0.33	46	65	0.81
CD (P=0.05)	56	1.96	0.58	0.98	135	190	NS
Biofertilizer							
B_0: Control	791	23.34	9.95	12.82	1737	2511	40.73
B_1:Seed treatment with Bio NP (5ml/kg seed)	916	26.78	11.39	14.68	1981	2809	41.43
B_2: Drenching of Bio NP (1 lit/ha)	884	26.26	10.86	14.03	1968	2788	41.40
B_3: B_1+ Drenching of Bio NP at 30 DAS	925	28.31	11.82	15.63	2071	2923	41.63
S.Em ±	22	0.77	0.23	0.38	53	75	0.93
CD (P = 0.05)	64	2.27	0.67	1.13	156	220	NS
F×B	NS	NS	NS	NS	NS	NS	NS
CV (%)	7.52	8.87	6.30	8.15	8.23	8.16	6.80

(iii) Economics: Data presented in Table 3 indicated that there was an appreciable increase in net realization and cost benefit ratio with the increasing rate of fertility level. The maximum gross return (120690 ₹/ha) and net return (99558 ₹/ha) were obtained under treatment F_3 where 100 percent RDF (20:40:0 NPK) was applied. In terms of BCR, 100 % RDF (20:40:0 NPK) recorded the maximum BCR of 4.72. The higher profitability in 100% RDF (F_3) was mostly due to the crop achieved optimal fertility, which aids in improved growth and development. As a result, these treatments recorded the highest values of growth and yield attributing features, resulting in increased seed and straw yield. Increasing trend in net realization and BCR was observed with increasing fertility levels. The results are supported by findings achieved by Ali *et al*., (2009).

Table 3: Economics of different fertility levels and biofertilizer on gross realization, net realization and benefit cost ratio (BCR).

Treatments	Gross realization (₹/ha)	Total cost of production (₹/ha)	Net realization (₹/ha)	BCR
Fertility levels				
F_1: 50% RDF (10:20:00 NPK kg/ha)	87003	19944	67059	3.37
F_2: 75% RDF (15:30:00 NPK kg/ha)	107111	20527	86584	4.22
F_3: 100% RDF (20:40:00 NPK kg/ha)	120690	21132	99558	4.72
Biofertilizer				
B_0: Control	94914	18374	76540	4.17
B_1:Seed treatment with Bio NP (5ml/kg seed)	108291	18578	89713	4.83
B_2: Drenching of Bio NP (1 lit/ha)	107405	18694	88711	4.75
B_3: B_1+ Drenching of Bio NP at 30 DAS	112974	18898	94076	4.98

B. Effect of Biofertilizer

(i) Growth attributes: Plant height and number of branches/plant recorded at 30 DAS, 60 DAS and at harvest as well as dry weight of nodules/plant recorded at 45 DAS were observed significantly higher in treatment B_3 (Seed treatment of Bio NP + Drenching of Bio NP at 30 DAS) which was remained at par with treatment B_1 (seed treatment with Bio NP) and B_2 (Drenching of Bio NP).Improved growth parameters with the application of biofertilizer might be due to *Rhizobium* which helps in nitrogen fixation and eventually plant obtains more nitrogen which is primary nutrient for growth and development as well as PSB improve the availability of phosphorus which improve root proliferation and helped to increase nutrient absorption which was ultimately led to increase the growth of the plant. This result corroborated with the results obtained by Meena *et al.*, (2014); Ali *et al.*, (2009); Shivram *et al.*, (2017); Godara *et al.*, (2018).

(ii) Yield and yield attributes: Among different biofertilizer application methods, Bio NP as seed treatment at the time of sowing followed by drenching of Bio NP at 30 DAS registered significantly higher green biomass yield, number of pods/plant, pod length, number of seeds/pod, test weight, seed yield and straw yield. They were found at par with treatment B_1 (seed treatment with Bio NP) and B_2 (Drenching of Bio NP).Application of biofertilizer produced higher yield over control might be due to biofertilizer which consists *Rhizobium* and PSB are extremely advantageous in

enriching soil fertility and fulfilling plant nutrient requirements by supplying the organic nutrients through symbiotic nitrogen fixing and transforming insoluble phosphorus to a soluble form, as a result nitrogen and phosphorus increased all growth and development of plant which eventually helps in increase the growth, yield attributes and yield. These results are in compliance with Ali *et al.*, (2009); Mehta *et al.*, (2012); Meena *et al.*, (2014); Chaudhary and Chaudhari (2017); Godara *et al.*, (2018); Nair *et al.*, (2021).

(iii) Economics: Data displayed in Table 3 indicated that treatment B_3 (seed treatment + Drenching of Bio NP at 30 DAS) exerted higher gross and net realization of 112974 ₹/ha and 94076 ₹/ha, respectively, followed by treatment B_1 and B_2. Concerning BCR, treatment B_3 obtained a maximum BCR of 4.98 while the lowest BCR of 4.17 was recorded in treatment B_0. This proved that seed inoculation with Bio NP + drenching of Bio NP at 30 DAS (B_3), Seed treatment of Bio NP (B_1) and drenching of Bio NP (B_2) provided higher net realization and benefit cost ratio as compare to treatment B_0 (no application of biofertilizer). This might be due to biofertilizer application enhanced the availability of nutrients and therefore produced appreciable amount of green biomass yield, seed yield and straw yield which attributed to total returns. These findings are in close agreement with Meena *et al.*, (2014); Chaudhary and Chaudhari (2017).

CONCLUSION

Based on results obtained from the present experiment, it can be stated that for accruing higher green biomass, seed yield and net returns from fenugreek crop (*cv*. GM 2), crop should be fertilized with 20 kg nitrogen and 40 kg phosphorus per hectare and application of biofertilizer either as seed treatment with Bio NP (5 ml/kg seed) or drenching of Bio NP (1 lit/ha) at the time of sowing or both seed treatment with Bio NP (5 ml/kg seed) and drenching of Bio NP (1 lit/ha) at 30 DAS is suitable in middle Gujarat condition.

Acknowledgment. The authors are thankful to Department of Agronomy, Anand Agricultural University, Anand, Gujarat, India for providing all the necessary facilities for the research work.

Conflict of Interest: Nil.

REFERENCES

Ali, A., Sammauria, R., & Yadav, R. S. (2009). Response of Fenugreek (*Trigonella foenum - graecum* L.) to Various Fertility Levels and Biofertilizer Inoculations. *Indian Journal of Agricultural Sciences, 79*(2): 145-147.

Bhunia, S. R., Chauhan, R. P. S., Yadav, B. S., & Bhati, A. S. (2006). Effect of Phosphorus, Irrigation and Rhizobium on Productivity, Water use and Nutrient uptake in Fenugreek (*Trigonella foenum- graecum* L.). *Indian Journal of Agronomy*, *51*(3): 239-241.

Chaudhary, C. G., & Chaudhari, P. P. (2017). Effect of Phosphorus and PSB on Gowth and Yield of Fenugreek (*Trigonella foenum-graecum* L.). *The bioscan an international quarterly journal of life sciences*, *12*(3): 1799-1801.

Cochran, W. G., & Cox, G. M. (1967). *Experimental designs*. John Willey and sons Inc, New York, 546-568

Deshmukh, A. A., Nagre, P. K., & Wagh, A. P. (2020). Effect of Nitrogen and Phosphorus Levels on Yield and Quality of Fenugreek (*Trigonella-foenum graecum*). *Journal of Pharmacognosy and Phytochemistry*, *9*(4): 1567-1571.

Donald, C. M., & Hambling, J. (1976). The Biological Yield and Harvest Index of Cereals as Agronomic and Plant Breeding Criteria. *Advances in Agronomy*, *28*: 361-405.

Godara, A. S., Singh, R., & Chouhan, G. S. (2018). Soil Fertility, Growth and Productivity of Fenugreek (*Trigonella foenum-graecum* L.) as Influenced by Fertilizer Levels, Biofertilizers and Brassinosteroid. *International Journal of Current Microbiology and Applied Science*, *7*(9): 462-468.

Jat, B. L., & Shaktawat, M. S. (2001). Effect of Phosphorus, Sulphur and Bio-fertilizers on Productivity and Soil Fertility of Fenugreek (*Trigonell foenum-graecum* L.) and their Residual effect on Pearl millet (*Pennisetum glaucum*). *Annals of Agricultural Research*, *24*(2):383-389.

Khiriya, K. D., Sheoran, R. S., & Singh, B. P. (2001). Growth Analysis of Fenugreek (*Trigonella foenum-graecum* L.) under Various Levels of Farmyard Manure and Phosphorus. *Journal of Spices and Aromatic Crops*, *10*(2): 105-110.

Kumar, S., Singh, D., & Nepalia, V. (2009). Performance of Fenugreek (*Trigonella foenum-graecum*) Varieties at Various Fertilizer Levels and Bio-fertilizer Inoculations. *Indian Journal of Agricultural Sciences*, *79*(1): 80-83.

Meena, S. S., Mehta, R. S., Bairwa, M., & Meena, R. D. (2014). Productivity and Profitability of Fenugreek (*Trigonella foenum-graecum* L.) as Influenced by Bio-fertilizers and Plant Growth Regulators, *Legume Research*, *37*(6):646-650.

Mehta, R. S., Anwer, M. M., Aishwath, O. P., & Meena, R. S. (2012). Growth, Yield and Quality of Fenugreek (*Trigonella foenum-graecum* L.) as Influenced by Nitrogen, Phosphorus and Bio-fertilizers. *Indian Journal of Horticulture*, *69*(1): 94-97.

Mehta, R. S., Patel, B. S., and Bhagirathram (2012). Yield and nutrient uptake of Fenugreek (*Trigonella foenum graecum* L) as influenced by Nitrogen, Phosphorus and Bio-fertilizer. *Annsld of Agricultural Research, New Series*, *33*(1-2): 45-52.

Nair, R., Pandey, S. K., & Jyothsna, J. (2021). Growth and Yield of Fenugreek (*Trigonella foenum graecum* L.) in Response to Different Levels of Phosphorus and Biofertilizer (*Rhizobium* and PSB) under Kymore Plateau and Satpura Hill Agro-climatic Zone of Madhya Pradesh. *The Pharma Innovation Journal*, *10*(1): 419-422.

Sheoran, R. S., Sharma, H. C., & Pannu, P. K. (1999). Efficiency of phosphorus fertilizer applied to Fenugreek (*Trigonella foenum-graecum* L.) Genotypes under different dates of Sowing. *HAU Journal of Research, 29*: 101-107.

Shivran, A.C., Jat, N. L., Singh, D., Rajput, S. S. and Mittal, G.K. (2016). Effect of integrated nutrient management on productivity and economics of fenugreek (*Trigonella foenum-graecum*). *Legume Research*, 39(2) 279-283.

Swain, A. A, Nayak, D. A., Mahapatra, P., Nandi, A., Jena, N. K., & Panda, J. (2020). Effect of Bio-fertilizers on Growth and Leaf Yield of Coriander (*Coriandrum sativum* L.). *International Journal of Current Microbiology and Applied Sciences*, *9*(4): 826-832.

Tisdale, S. L., Nelson, W. S., & Beaton, J. D. (1985). Soil fertility and fertilizers. 4th Edition, *Macmillan Publishing Company*, New York.

How to cite this article: Patel, R., Shroff, J.C., Parmar, P.M. and Shah, S.N. (2021). Effect of Varying Fertility Levels and Biofertilizer on Growth, Yield and Economics of Fenugreek. *Biological Forum – An International Journal*, *13*(3a): 210-213.