

ORIGINAL ARTICLE

Growth and Yield of fenugreek (*Trigonella foenum-graecum* L.) as influenced by liquid and solid biofertilizers (*Rhizobium*, PSB and KSB)

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ABSTRACT

Present investigation was undertaken to study the efficiency of FYM and biofertilizers on growth and yield attributes of fenugreek cv. Rajendra Kanti. For this, a field experiment was carried out in Randomized Block Design with three replications. The experiment was conducted at the Horticulture Research Block of Shri Guru Ram Rai School of Agricultural Sciences, during rabi season of 2017-18 on sandy loam soil at Dehradun. For the experiment, ten treatment combinations are taken viz. T1-Control, T2 – NPK @ 40-40-20 kg/ha, T3 –FYM @5 t/ha, T4 -FYM @5 t/ha + Rhizobium, T5 -FYM @5 t/ha + PSB, T6 –FYM@ 5 t/ha + KSB, T7 -FYM @5 t/ha + Rhizobium + PSB, T8 –FYM@ 5 t/ha + Rhizobium + KSB, T9 -FYM @5 t/ha + PSB + KSB and T10 -FYM @5 t/ha + Rhizobium + PSB + KSB. The results revealed that significantly greater values of growth parameters viz., plant height, number of branches, number and dry weight of root nodules, dry matter production, crop growth rate as well as yield attributes viz., number of pods per plant, length of pods, number of seed per pod, seed yield and straw yield were recorded in the treatment T10 (FYM @5 t/ha + Rhizobium + PSB + KSB) which is being at par with treatments T2, T7, T8 and T9.

Keywords: FYM, Biofertilizers, Rhizobium, PSB, KSB, Fenugreek, Root nodules

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INTRODUCTION

Fenugreek (*Trigonella foenum-graecum* L.) commonly known as methi is an annual legume crop which belongs to family Leguminaceae and sub-family papilionaceae. Fenugreek is one of the important spice crops of India which is one of the major producer as well as exporter of fenugreek. In India fenugreek occupied an area of about 2, 11,110 hectares producing 2,99,870 tonnes of seeds [1]. In India, it is widely grown states are Rajasthan, Gujarat, Tamil Nadu, Uttar Pradesh, Himachal Pradesh, Madhya Pradesh and Andhra Pradesh. Gujarat contributes about 20 percent in total production of fenugreek in India. Chemical analysis of Fenugreek seed revealed that it contains 13.7 percent water, 26.2 percent protein, 5.8 percent fat, 3.0 percent mineral matter, 7.2 percent fibers, 4.41 per cent carbohydrates, 0.16 per cent calcium, 0.37 per cent phosphorous, 14.1 mg iron, 333 calories and 160 IU carotene per 100 gm. [2]. The maximum diosgenin 2.03 per cent was found in cotyledons germinated seeds of fenugreek [3]. Organic materials such as FYM have traditionally been used by farmers in their field. FYM supplies all macro nutrients such as N, P, K, Ca, Mg, and S, as well as micronutrients like Fe, Mn, Cu and Zn which are necessary for plant growth. Hence, it acts as a mixed organic fertilizer. FYM improves soil physical, chemical and biological properties. Biofertilizers helps to keep the soil environment rich in all kinds of macro and micro-nutrients via nitrogen fixation, phosphate and potassium solubilization or mineralization, release of plant growth regulating substances, production of antibiotics and biodegradation of organic matter in the soil providing better nutrient uptake and increased tolerance towards drought and moisture stress. Being a highly important spice crop, there was an essential need for standardization of biofertilizer packages consisting locally available organic sources integrated with chemical fertilizers. Keeping this in regard, the present experiment was carried out with the objectives to study the efficacy of organic manure and biofertilizers on different yield parameters of fenugreek.

MATERIALS AND METHODS

The present experiment was carried out in D-4 plot of Horticulture Research Block of School of Agricultural Sciences, SGRRU, Dehradun, Uttarakhand (29°58' N, 77°34' E) during *Rabi* season of 2017-18. The soil of the experimental plot was sandy loam in texture and slightly acidic in reaction with pH 6.8 and EC 0.55 dS/m. The soil was low in available nitrogen (283 kg/ha), high in available phosphorus (69 kg/ha) and medium in available potash (233 kg/ha). Ten treatments comprising of T₁-Control, T₂ - NPK @ 40-40-20 kg/ha, T₃ -FYM @5 t/ha, T₄ -FYM @5 t/ha + *Rhizobium*, T₅ -FYM @5 t/ha + PSB, T₆ -FYM@ 5 t/ha + KSB, T₇ -FYM @5 t/ha + *Rhizobium* + PSB, T₈ -FYM@ 5 t/ha + *Rhizobium* + KSB, T₉ -FYM @5 t/ha + PSB + KSB and T₁₀ -FYM @5 t/ha + *Rhizobium* + PSB + KSB with three replications. The improved cultivar "Rajendra Kanti" was used for sowing with seed rate of 25 kg/ha on 18th November during 2017. The seeds were placed at 3-5 cm depth, keeping inter row spacing of 30 cm and covered with the soil. The crop was uniformly fertilized with 20 kg/ha nitrogen and 40 kg/ha P₂O₅ in the form of urea and diammonium phosphate, respectively as a basal application just before sowing in only treatment plots.

RESULTS AND DISCUSSION

Growth parameters

Among different growth parameters *viz.*, plant height at 30, 60 DAS and at harvest (Table 1); number of branches per plant at harvest, number and weight of root nodules/plant at 60 DAS, dry matter per plant at 30, 60 DAS and at harvest were having significantly highest value recorded under the treatment T₁₀ (FYM @5 t/ha + *Rhizobium* + PSB + KSB), which remained statistically at par with the treatment T₂ (N-P₂O₅-K₂O @40-40-20 kg/ha), T₇ (FYM @5 t/ha + *Rhizobium* + PSB), T₈ (FYM@ 5 t/ha + *Rhizobium* + KSB) and T₉ (FYM @5 t/ha + PSB + KSB). Among the various treatments, significantly the maximum CGR at 30-60 DAS recorded with treatment T₁₀ (FYM @5 t/ha + *Rhizobium* + PSB + KSB) which remain statistically at par with treatment T₂ (40-40-20 kg N-P₂O₅-K₂O/ha). This might be attributed to fact that FYM increase the absorptive power of the soil for cation and anion and these ions were released slowly during the entire period of crop growth. The FYM also produce hormones and growth promoting substances that help to promote the plant growth. The inoculation of Biofertilizer like *Rhizobium* increase the number of such microorganisms in the soil rhizosphere and consequently improve the extent of microbiologically fixed nitrogen for plant growth. They were used to fix nitrogen as well as to solubilise the plant nutrients like phosphate. Phosphate solubilising microorganism solubilises the unavailable bound phosphate of the soil and makes them available to plants which increase overall plant growth. The increase in growth characteristics due to the solubilization of nutrients in the soil by producing organic acids by KSB was also observed and are conformity with the findings of Summauria and Yadav [9] and Meena *et al.* [7].

Table 1: Effect of various INM treatments on growth parameter of Fenugreek cv. Rajendra Kanti

Treatments	Plant height (cm)			No. of branches per plant	No of root nodules at 60 DAS	Weight of root nodules at 60 DAS (mg)	Dry matter per plant (g) at			CGR (g/day) at 30-60 DAS
	At 30 DAS	At 60 DAS	At Harvest				At 30 DAS	At 60 DAS	At Harvest	
T ₁	11.29	31.17	49.46	5.00	26	134.64	0.23	0.92	3.17	0.023
T ₂	14.75	37.68	61.80	6.93	31	167.55	0.60	2.70	4.74	0.070
T ₃	11.49	31.73	52.93	5.10	27	141.07	0.24	1.10	3.18	0.029
T ₄	12.62	33.83	57.03	6.06	30	156.28	0.42	2.15	3.89	0.058
T ₅	12.55	33.04	55.85	5.70	29	152.77	0.35	1.88	3.78	0.051
T ₆	12.35	32.10	54.54	5.37	28	146.71	0.30	1.35	3.35	0.035
T ₇	14.69	36.80	60.90	6.60	31	165.42	0.56	2.40	4.64	0.061
T ₈	13.52	35.13	58.93	6.14	30	158.27	0.43	2.21	4.20	0.059
T ₉	14.29	35.74	60.01	6.18	30	160.67	0.50	2.25	4.35	0.058
T ₁₀	15.25	38.28	62.59	7.15	33	168.41	0.60	3.00	5.53	0.080
S.Em. ±	0.73	1.63	2.70	0.33	1.42	7.26	0.02	0.10	0.45	0.001
CD at 5%	2.17	4.84	8.03	0.97	4.22	21.58	0.07	0.30	1.32	0.01
CV %	9.52	8.16	8.15	9.4	8.34	8.11	9.49	8.52	9.62	11.29

Yield parameters

The yield influencing characters such as number of pod per plant, number of seeds per pod, pod length were significantly recorded highest value under the treatment T₁₀ (FYM @5 t/ha + *Rhizobium* + PSB + KSB) and it was found statistically analogous to treatments T₂ (N-P₂O₅-K₂O @40-40-20 kg/ha), T₇ (FYM @5 t/ha + *Rhizobium* + PSB) and T₉ (FYM @5 t/ha + PSB + KSB). The seed yield, stover yield and biological yield were also recorded significantly higher in treatment T₁₀ (FYM @5 t/ha + *Rhizobium* + PSB + KSB), T₂ N-P₂O₅-K₂O @40-40-20 kg/ha), T₇ (FYM @5 t/ha + *Rhizobium* + PSB) and T₉ (FYM @5 t/ha + PSB + KSB) as compared to other treatments. These observations might be attributed due to application

of FYM which helps to increase the photosynthetic activity in fenugreek and the translocation of photosynthates in plant. Improvement of all the yield parameters might be due to the better availability of nutrients and their translocation resulted in significantly higher seed and stover yield in fenugreek under *Rhizobium* inoculation along with PSB and KSB in soil application. The results corroborated with the observations of Mehta *et al.* [8], Shivran *et al.* [10] and Godara *et al.* [5].

Table 2: Effect of various INM treatments on growth and yield parameter of Fenugreek cv. Rajendra Kanti

Treatments	No. of Pods per plant	Pod length (cm)	No. of seeds per pod	Seed yield (kg/ha)	Stover yield (kg/ha)	Biological yield (kg/ha)
T ₁	19.73	9.34	12.08	1021	1901	2922
T ₂	23.43	11.33	15.77	1632	2767	4399
T ₃	20.06	9.59	12.32	1254	2124	3378
T ₄	21.70	10.31	13.38	1351	2480	3831
T ₅	21.23	10.11	12.84	1323	2267	3589
T ₆	20.93	9.69	12.49	1285	2198	3483
T ₇	23.01	11.19	14.75	1508	2660	4168
T ₈	22.10	10.61	13.63	1354	2302	3657
T ₉	22.47	10.87	14.35	1402	2540	3942
T ₁₀	25.49	11.49	16.29	1712	2814	4525
S.Em. ±	1.09	0.49	0.80	82.33	119.59	141.86
CD at 5%	3.24	1.45	2.39	244.61	355.32	421.51
CV %	8.57	8.08	10.09	10.16	8.53	6.41

Treatment details: T₁ (Control), T₂ (40-40-20 kg N-P₂O₅-K₂O/ha), T₃ (FYM @5t/ha), T₄ (FYM @5 t/ha + *Rhizobium*), T₅ (FYM @5 t/ha + PSB), T₆ (FYM @5 t/ha + KSB), T₇ (FYM @5 t/ha + *Rhizobium* + PSB), T₈ (FYM @5 t/ha + *Rhizobium* + KSB), T₉ (FYM@ 5 t/ha + PSB + KSB) and T₁₀ (FYM @5 t/ha + *Rhizobium* + PSB + KSB)

Note: a. *Rhizobium* seed treatment @ 30 ml/kg seeds; b. PSB soil application @ 3 L/ha; c. KSB soil application @ 3 L/ha;

d. The treatment T₂ was kept outside the organic plot

CONCLUSION

Based on experimental results, it seems quite logical to conclude that higher production of fenugreek cv. "Rajendra Kanti" can be obtained by application of FYM @ 5 t/ha along with Seed treatment of *Rhizobium* @ 30 ml/kg seed and soil application of PSB + KSB @ 3 L/ha each on sandy loam soil under low hill regions of Uttarakhand.

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