

Optimization of Growth and Yield of Fenugreek (*Trigonella foenum-graecum* L.) by Supplying Nutrients through Different Combinations of Organic and Inorganic Nutrient Inputs

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ABSTRACT: A field experiment was carried out during the *rabi* season of 2019-20 at Navsari, Gujarat to study the effect of various combinations of organic and in-organic inputs on growth, yield and economics of fenugreek. The results revealed that application of *Jivamrut* @ 500 l/ha per irrigation (at 1st, 2nd and 3rd irrigation) + FYM @ 2.5 t/ha + 75% RDF recorded significantly higher plant height at harvest (66.5 cm), number of branches per plant (7.28), number of pods per plant (26.25), number of seeds per pod (16.32), pod length (12.55 cm), seed yield (1712 kg/ha) and stalk yield (2935 kg/ha). The application of Bio compost @ 2.5 t/ha resulted in the lowest yield attributes and yield. From the experimental results it was inferred that application of RDF @ 75 % (15 kg N/ha - 30 kg P₂O₅/ha) along with bio compost @ 2.5 t/ha or *Jivamrut* @ 500 l/ha per irrigation (at 1st, 2nd and 3rd irrigation) + FYM @ 2.5 t/ha is effective for optimum yield and higher economic returns.

Keywords: Fenugreek, Nutrient Management, *Jivamrut*, FYM, Biocompost.

INTRODUCTION

Fenugreek is one of the most important seed spices of India. Also known as methi, its seeds are rich in protein, fiber, iron, calcium and phosphorus. Fenugreek seeds contain alkaloids 'Trigonelline' and 'Choline' which provides bitter taste to the seeds. It is useful as hair tonic, in reducing blood pressure and curing anaemia. The production of fenugreek in India was 2.26 lakh tonnes in 1.46 lakh hectares in 2022-23 (Anon., 2023). In Gujarat Banaskantha, Dahod, Patan, Surendranagar and Mehsana are areas of high productivity (Anon., 2021). Being a short duration legume, fenugreek suits well on heavy textured soils of south Gujarat also. Though it is not much prioritized in terms of nutrient inputs compared to major crops. Hence, there is an imbalance in the nutrient supplied and removed by the fenugreek crop. Furthermore, the incommensurate use of fertilizers has resulted in nutrient deficiencies in soil and has magnified imbalance of NPK ratio in soil (Lakhran *et al.*, 2015). Enhancing the soil fertility status by supplying a balanced amount of major nutrients like nitrogen, phosphorus and potassium as per the need of crop is the simplest way to increase the productivity of fenugreek (Patel *et al.*, 2021). The decomposition and mineralization of organic manure can cope with the long term nutrient requirement of the crop (Anitha *et al.*, 2015). Sole reliance on neither chemical fertilizers

nor organic manure can be effective in maintaining the productivity and sustainability of the system. An approach combining inorganic fertilizers and organic inputs *viz.*, bulky or concentrated solid as well as liquid organic manure will improve the physicochemical properties of soil along with optimum provision of all nutrients thus building up soil fertility and increasing yield and nutrient use efficiency.

MATERIALS AND METHODS

The experiment was carried out during the *rabi* season of 2019-20 at College Farm, N.M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat. The climate of this region constitutes three well defined seasons: a hot summer, mild winter and warm humid monsoon with annual rainfall about 1663 mm. During the crop period, the maximum and minimum temperature ranged between 27.5°C to 34.4°C and 8.4°C to 19.3°C, respectively. The morning and evening relative humidity ranged between 76.4 to 91.3 per cent and 39.4 to 68.6 per cent, respectively. The soil of the experimental field was clayey in texture (57.32%) with good water holding capacity and poor drainage. The organic carbon in soil was low (0.35 %) along with pH 7.68 and EC 0.55 ds/m. Also, it was low in available nitrogen (238.6 kg/ha), medium in available phosphorus (50.8 kg/ha) and high in available potassium (356.2 kg/ha). The experiment consists of 10 treatments *viz.*, T₁ (100% RDF 20-40-00), T₂ (FYM @

5 t/ha), T₃(Bio compost @ 2.5 t/ha), T₄ [*Jivamrut* @ 500 l/ha per irrigation (at 1st, 2nd and 3rd irrigation) + FYM @ 2.5 t/ha], T₅ (FYM @ 5 t/ha + 75% RDF), T₆ (Bio compost @ 2.5 t/ha + 75% RDF), T₇ [*Jivamrut* @ 500 l/ha per irrigation (at 1st, 2nd and 3rd irrigation) + FYM @ 2.5 t/ha + 75% RDF], T₈ (FYM @ 5 t/ha + 50% RDF) T₉ (Bio compost @ 2.5 t/ha + 50% RDF) and T₁₀ [*Jivamrut* @ 500 l/ha per irrigation (at 1st, 2nd and 3rd irrigation) + FYM @ 2.5 t/ha + 50% RDF] which were replicated 3 times and were laid out in Randomized Block Design (RBD). N, P and K content of FYM were 0.49%-0.2%-0.5%, respectively and N, P and K content of bio compost were 1.4%-1%-1.2%, respectively which were used in the experiment. *Jivamrut* contains 770 ppm nitrogen, 166 ppm phosphorus and 126 ppm potassium. Fertilizers and organic inputs were applied according to the treatments before sowing. Nitrogen and Phosphorus were applied through urea and diammonium phosphate respectively. The organic inputs like FYM and bio-compost were applied according to respective treatments just before the time of sowing. Following it, the fenugreek seeds were sown in furrows and covered with soil. The fenugreek variety 'Gujarat Methi – 2' was sown in last week of November at the seed rate of 25 kg/ha and inter-row spacing of 30 cm. The gross plot size was 4.0 m × 3.6 m and the net plot size was 3.0 m × 2.4 m. *Jivamrut* was applied 1st, 2nd and 3rd irrigation in respective plots along with irrigation water. Hand weeding was done at 27 days after sowing to maintain weed free condition. In each plot, five plants were tagged and the growth and yield attributes were recorded from them. The seed and stover yield were recorded from the net plot area and were converted into kilogram per hectare.

RESULTS AND DISCUSSION

A. Growth Parameters and Yield Attributes

The data on different growth parameters viz., plant height at harvest and number of branches per plant and yield attributes viz., number of pods per plant, number of seeds per pod and pod length are presented in Table 1. The results revealed that application of *Jivamrut* @ 500 l/ha per irrigation (at 1st, 2nd and 3rd irrigation) + FYM @ 2.5 t/ha + 75% RDF (T₇) was found significantly higher which remained at par with the treatments T₅ and T₆. The treatment T₇ recorded significantly taller plants at harvest (66.5 cm) and number of branches per plants (7.28). It might be due to combined effect of both liquid and solid bulky organic manure along with inorganic fertilizers which results in enhanced microbial activity along with optimum and prolonged availability of nutrients- nitrogen and phosphorus that increases cell division and elongation of meristematic regions which results in increased height and vegetative growth. Patel *et al.* (2010); Raiyani *et al.* (2018) also reported similar result of effect on plant growth characters. The yield attributing characters viz., number of pods per plant, seeds per pod and pod length were influenced due to different nutrient sources. Application of *Jivamrut* @ 500 l/ha per irrigation (at 1st, 2nd and 3rd irrigation) + FYM @ 2.5 t/ha + 75% RDF (T₇) recorded significantly higher number of pods per plant (26.25), seeds per pod (16.32) and pod length (12.55 cm) which was at par with treatments T₅ and T₆. This might be attributed to the integration of chemical fertilizers, FYM and *Jivamrut*, which results in better flowering and fruiting which in-turn increases the number of pods and pod length, while better partitioning of photosynthates and protein synthesis increases the number of seeds. The results were in close conformity with the findings of Patel *et al.* (2010); Raiyani *et al.* (2018); Husain *et al.* (2022).

Table 1: Effect of treatments on growth parameters and yield attributes of fenugreek.

Treatments		Plant height (cm) at harvest	No. of branches per plant	Pods per plant	Seeds per pods	Pod length (cm)
T ₁	RDF@100% (20-40-00 kg N-P ₂ O ₅ -K ₂ O/ha)	60.3	6.39	22.09	13.80	10.93
T ₂	FYM @ 5 t/ha	55.3	5.28	19.66	12.33	9.46
T ₃	Bio compost @ 2.5 t/ha	53.9	5.12	19.39	12.05	9.18
T ₄	<i>Jivamrut</i> @ 500 l/ha per irrigation (at 1 st , 2 nd and 3 rd irrigation) + FYM @ 2.5 t/ha	54.8	5.53	20.74	12.48	9.57
T ₅	FYM @ 5 t/ha + 75% RDF	64.2	6.75	23.68	14.79	11.34
T ₆	Bio compost @ 2.5 t/ha + 75% RDF	62.7	7.06	23.10	15.77	11.21
T ₇	<i>Jivamrut</i> @ 500 l/ha per irrigation (at 1 st , 2 nd and 3 rd irrigation) + FYM @ 2.5 t/ha + 75% RDF	66.5	7.28	26.25	16.32	12.55
T ₈	FYM @ 5 t/ha + 50% RDF	54.2	6.25	21.62	13.42	10.05
T ₉	Bio compost @ 2.5 t/ha + 50% RDF	56.0	5.85	21.12	12.84	10.28
T ₁₀	<i>Jivamrut</i> @ 500 l/ha per irrigation (at 1 st , 2 nd and 3 rd irrigation) + FYM @ 2.5 t/ha + 50% RDF	58.9	6.36	22.52	13.60	10.62
S.E.m.±		2.04	0.30	1.10	0.80	0.49
C.D. at 5%		6.07	0.88	3.27	2.38	1.46
C.V. %		6.03	8.29	8.67	10.11	8.07

*RDF- Recommended Dose of Fertilizers

B. Yield.

Significantly higher seed yield (1712 kg/ha) and stalk yield (2935 kg/ha) were recorded under the treatment T₇ (*Jivamrut* @ 500 l/ha per irrigation (at 1st, 2nd and 3rd irrigation) + FYM @ 2.5 t/ha + 75% RDF) which was at par with the treatments T₅ and T₆, while the treatment T₃ (Bio compost @ 2.5 t/ha) recorded the lowest seed and stalk yield. This is evidently due to increased number of pods per plant, pod length and number of seeds per pod due to combined application of organic and inorganic nutrient sources while the higher stalk yield can be attributed to improved growth parameters viz., plant height and number of branches per plant. The results are similar to those reported by Laharia *et al.*

(2013); Patil and Udmale (2016); Shivran *et al.* (2016); Sharma *et al.* (2017).

C. Economics

The study revealed that maximum net returns of ₹ 62839/ha with BCR of 3.45 was recorded with treatment T₇: *Jivamrut* @ 500 l/ha per irrigation (at 1st, 2nd and 3rd irrigation) + FYM @ 2.5 t/ha + 75% RDF followed by application of FYM @ 5 t/ha + 75% RDF (T₅) in terms of net returns (₹55845) and T₆ in terms of BCR (3.31). Furthermore, the lowest net return of ₹37988 with BCR 2.41 were obtained with application of FYM @ 5 t/ha (T₂).

Table 2: Effect of treatments on seed yield and stover yield of fenugreek.

Treatments		Seed yield (kg/ha)	Stover yield (kg/ha)
T ₁	RDF@100% (20-40-00 kg N-P ₂ O ₅ -K ₂ O/ha)	1402	2482
T ₂	FYM @ 5 t/ha	1254	2286
T ₃	Bio compost @ 2.5 t/ha	1211	2240
T ₄	<i>Jivamrut</i> @ 500 l/ha per irrigation (at 1 st , 2 nd and 3 rd irrigation) + FYM @ 2.5 t/ha	1285	2314
T ₅	FYM @ 5 t/ha + 75% RDF	1632	2850
T ₆	Bio compost @ 2.5 t/ha + 75% RDF	1508	2664
T ₇	<i>Jivamrut</i> @ 500 l/ha per irrigation (at 1 st , 2 nd and 3 rd irrigation) + FYM @ 2.5 t/ha + 75% RDF	1712	2935
T ₈	FYM @ 5 t/ha + 50% RDF	1351	2411
T ₉	Bio compost @ 2.5 t/ha + 50% RDF	1300	2322
T ₁₀	<i>Jivamrut</i> @ 500 l/ha per irrigation (at 1 st , 2 nd and 3 rd irrigation) + FYM @ 2.5 t/ha + 50% RDF	1390	2478
S.E.m.±		98.84	133.66
C.D. at 5%		293.67	397.12
C.V. %		12.19	9.27

Table 3: Effect of treatments on economics of production of fenugreek.

Treatments		Total cost of cultivation (Rs. /ha)	Gross income (Rs. /ha)	Net income (Rs. /ha)	BCR
T ₁	RDF@100% (20-40-00 kg N-P ₂ O ₅ -K ₂ O/ha)	21641	72565	50924	3.35
T ₂	FYM @ 5 t/ha	26998	64986	37988	2.41
T ₃	Bio compost @ 2.5 t/ha	21998	62790	40792	2.85
T ₄	<i>Jivamrut</i> @ 500 l/ha per irrigation (at 1 st , 2 nd and 3 rd irrigation) + FYM @ 2.5 t/ha	24073	66564	42491	2.77
T ₅	FYM @ 5 t/ha + 75% RDF	28605	84450	55845	2.95
T ₆	Bio compost @ 2.5 t/ha + 75% RDF	23605	78081	54476	3.31
T ₇	<i>Jivamrut</i> @ 500 l/ha per irrigation (at 1 st , 2 nd and 3 rd irrigation) + FYM @ 2.5 t/ha + 75% RDF	25680	88519	62839	3.45
T ₈	FYM @ 5 t/ha + 50% RDF	28069	69944	41875	2.49
T ₉	Bio compost @ 2.5 t/ha + 50% RDF	23070	67322	44252	2.92
T ₁₀	<i>Jivamrut</i> @ 500 l/ha per irrigation (at 1 st , 2 nd and 3 rd irrigation) + FYM @ 2.5 t/ha + 50% RDF	25147	71962	46815	2.86

CONCLUSIONS

The integration of organic and inorganic sources for fulfilling the nutrient requirements of crop plants is essential for sustainable crop production. Based on one year field experiment, it can be concluded that the fenugreek crop should be fertilized with RDF @ 75 % (15 kg N/ha - 30 kg P₂O₅/ha) along with bio compost @ 2.5 t/ha or application of *Jivamrut* @ 500 l/ha per irrigation (at 1st, 2nd and 3rd irrigation) + FYM @ 2.5

t/ha + 15 kg N/ha - 30 kg P₂O₅/ha (RDF @ 75 %) under south Gujarat condition.

FUTURE SCOPE

With the advent of degradation of soil health, the focus needs to be shifted to the integrated use of various nutrient sources in order to maintain soil health without lowering the productivity. More studies should be conducted to gain better understanding of nutrient

dynamics in relation to plant growth and yield as well as its feasibility for farmers.

Conflict of Interest. None.

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