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RESPONSE OF ORGANIC AND INORGANIC SOURCE OF NUTRIENTS ON GROWTH, YIELD AND NUTRIENTS UPTAKE STATUS OF FENUGREEK (*Trigonella foenum-graecum*) CV. RMT–1

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ABSTRACT : A field experiment was conducted during 2012-13 at Department of Horticulture, JNKVV, Jabalpur (M.P.). The present study revealed that fenugreek cv. RMT–1 responded best in terms of yield and its attributing traits. Treatment T_6 (10 t FYM + 50% N + *Rhizobium*) was found significantly superior as compared to other treatments. Highest morphological characters *i.e.* plant height, number of branches per plant and dry weight plant^{-1}) and yield attributes *i.e.* number of pods plant^{-1}, pod length, number of seeds plant^{-1}, test weight, vegetative yield plant^{-1} and seed yield plant^{-1}, per plot and ha^{-1}) were recorded in T_6 (10 t FYM + 50% N+ *Rhizobium*) followed by T_5 (10 t FYM + 50% Nitrogen). The earliest first flowering, 50% flowering and maturity were recorded under treatment T_3 (20 t FYM). Nitrogen content and uptake was observed significantly higher with the application of T_{12} (5 t Poultry manure + *Rhizobium*) whereas, uptake of phosphorus was maximum with T_{12} (5 t Poultry manure + *Rhizobium*). Potassium content (seed and straw) and uptake increased with application of T_{14} (5 t PM + 50% N + *Rhizobium*). It is revealed from the data that a significantly maximum seed yield of 23.48 q/ha was recorded in variety RMT– 1 in treatment combination T_6 (10 t FYM + 50% N + *Rhizobium*) along with net return of ₹ 65,273/ha and cost benefit ratio of 1: 3.28.

Keywords : *Fenugreek, organic, inorganic, nutrient uptake, yield.*

Fenugreek (*Trigonella foenum-graecum* L.), locally known as Methi, is a multipurpose crop grown in Northern Indian states like Rajasthan, Gujarat, Madhya Pradesh, Maharashtra, Haryana, Punjab, Uttar Pradesh and Andhra Pradesh, during winter season. Every part of this plant is utilized as leafy vegetable, fodder and condiments (Khiriya and Singh, 7). Its seeds are a good source of protein, vitamins, alkaloid trigonellin and essential oil and have an immense medicinal value particularly against digestive disorders (Bhunia *et al.,* 2). Seeds are used for the treatment of diabetes, dysentery, diarrhoea and rickets. Diosgenin, which is extracted from the seeds is used in synthesis of sex hormones. Its roots are endowed with mini factory to synthesize nitrogen for plant. Thus, its cultivation enriches the soil in nitrogen.

Bio fertilizer also play an important strategy in order to improve the biological, chemical and physical conditions of the soil, acquiring each time greater importance not only for the yields usually reached but also for the economic application and contribution to environment protection. Farm yard manure or vermicompost when integrated with reduced doses of inorganic fertilizers result in improved soil fertility, growth and yield of plant. Chemical fertilizers have deleterious effect on soil fertility leading to unsustainable yields; while integrations of chemical fertilizers with organic manures and bio-fertilizers would be able to maintain soil fertility and sustain crop productivity. Nutrient supply plays an important role in the crop production but under intensive cultivation use of chemical fertilizers alone for long period could result in deterioration of soil fertility and quality of produce. The use of organic manure in combination with inorganic fertilizers has been recommended for balancing soil fertility by several workers. In view of better quality, higher demand and more economic returns of fenugreek grown by adopting INM as evident from the above cited literature, the present study was carried out to find out the response of organic and inorganic source of nutrients on growth, yield and nutrients up taking status of fenugreek.

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MATERIALS AND METHODS

The present investigation on "response of organic and inorganic source of nutrients on growth, yield and nutrients up take status of fenugreek (*Trigonella foenum- graecum*) cv. RMT–1" was carried out during 2012-13 at Horticultural Farm, Department of Horticulture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.). The experimental material

for the present investigation was comprised of 14 treatment combinations of inorganic, organic and biofertilizers. The experiment was laid out in Randomized Complete Block Design (RCBD) with 3 replications to observe morphological, phonological, yield, quality characters and nutrient uptake and to estimate the economic viability. Observations were recorded on the basis of five random competitive plants selected from each treatment separately for morphological, phonological, yield and quality characters. The observations were evaluated as per standard procedure and the nutrient uptake and economics were also evaluated. The procedure for working out economics of different treatments under consideration was used as suggested by Malhotra *et. al.* (10). Determination of available nitrogen was done by alkaline permanganate method as suggested by Kumar (8). The estimation of available P was done by using Olsen's extract (0.5 N sodium bicarbonates solution of pH 8.5) as referenced by Tuncturk *et al.* (16). The available amount of potassium was determined by using normal neutral ammonium acetate Flame photometer (Giridhar and Sarada (6).

RESULTS AND DISCUSSION

Response on growth and yield of fenugreek

A persual of Table 1 and Fig. 1 revealed that significantly maximum pods per plant, pod length, number of seeds per pod, test weight and vegetative yield per plant were observed in treatment combinations T_6 (10 t FYM + 50% Nitrogen + *Rhizobium*), T_5 (10 t FYM + 50% Nitrogen), T_2 (R.D.F. + *Rhizobium* 2.5 g/plant) and T_{14} (5 t PM + 50% nitrogen + *Rhizobium*) which were at par with each other. The lowest pods/plant were found in T_{11} (5 t Poultry manure). This may be due to increased supply of major plant nutrients which are required in larger quantities for growth and development of plants. Nitrogen accelerates the development of growth and reproductive phases and protein synthesis, thus promoting pods plant^{-1}. Similar results have been reported by Patel *et al.* (13) and Mehta *et al.* (12) for number of pods plant^{-1} Kumar *et al.* (8), Giridhar and Sarada (6), Mehta *et al.* (12), Tuncturk *et al.* (17), and Choudhary *et al.* (3) for pod length and Thapa *et al.* (16) and Mehta *et al.* (12) for test weight. The probable reason for enhanced seed yield may be due to cumulative effects of nutrient (macro and micro) on vegetative growth which ultimately lead to more photosynthetic activities while, application of organic, inorganic and bio-fertilizers enhanced carbohydrate and nitrogen metabolism of pectic substances, as well as improved the water metabolism and water relation in the plants. Findings corroborate with results obtained by Kumar (8), Kumar *et al.* (9), Singh *et al.* (15), Patel *et al.* (13), Choudhary *et al.* (3) Malik and Tehlan (11) and Mehta *et al.* (12).

Table 1: Influence of organic and inorganic source of nutrients on growth and yield of fenugreek

Treatments		No. of pods plant^{-1}	Pod length (cm)	No. of seeds pod^{-1}	Test weight (g)	Vegetative yield plant^{-1} (g)	Seed yield plant^{-1} (g)	Seed yield/ ha (q)	C:B ratio
T_1	RDF (30 kg N + 30 kg P_2O_5 + 50 kg K_2O/ha)	27.35	11.69	15.27	13.87	14.67	6.73	17.25	1: 2.51
T_2	RDF + *Rhizobium*(2.5 kg/ha)	29.33	12.65	17.20	16.00	16.90	8.37	20.44	1: 2.97
T_3	20t FYM(Farm yard manure)	27.68	11.73	15.73	14.17	14.85	7.27	17.51	1: 2.49
T_4	20t FYM + *Rhizobium*	28.67	12.22	16.14	14.50	15.83	7.83	18.47	1: 2.61
T_5	10t FYM + 50% Nitrogen	29.67	12.86	17.40	16.30	17.00	8.54	21.95	1: 3.08
T_6	10 t FYM+50% Nitrogen+ *Rhizobium*	29.68	13.28	17.47	16.33	17.50	10.77	23.48	1: 3.28
T_7	5t VC (Vermicompost)	27.33	11.54	15.20	13.80	14.47	6.40	16.81	1: 1.66
T_8	5t VC + *Rhizobium*	28.34	11.73	15.80	14.27	15.27	7.65	17.51	1: 1.72
T_9	2.5t PM + 50% Nitrogen	28.67	12.09	15.87	14.43	15.38	7.77	18.44	1: 2.64
T_{10}	2.5 t PM+ 50% Nitrogen +*Rhizobium*	28.68	12.27	16.33	14.67	16.00	7.87	18.66	1: 2.67
T_{11}	5t PM(Poultry manure)	26.70	11.09	14.94	13.14	12.83	5.10	15.55	1: 2.31
T_{12}	5t Poultry manure + *Rhizobium*	27.00	11.27	15.00	13.67	13.17	5.50	16.14	1: 2.39
T_{13}	5t PM + 50% Nitrogen	28.68	12.33	16.47	15.17	16.67	8.00	19.66	1: 2.75
T_{14}	5t PM+50% Nitrogen+*Rhizobium*	29.33	12.38	17.00	15.17	16.73	8.33	19.88	1: 2.78
	C.D. (P=0.05)	0.73	0.86	1.54	1.65	1.01	1.52	1.84	1: 2.97

Available soil NPK

Data pertaining to change in soil properties over their initial status after the final harvesting of crop under different treatments (Table 2) releaved that the properties *viz.,* soil pH (6.89), electrical conductivity (EC) (0.17), organic content g/kg OC (5.8), available nitrogen (217), phosphorus (12.3) and potassium (186) content deviated from their initial status after the completion of crop cycle in most cases due to effect of different treatments. These findings are in agreement with the findings reported by Giridhar and Sarada (6) where they revealed that the bacterization of seed could sustain the NPK content in soil. Patel *et al.* (13) showed that the application of balanced fertilizer dose of N40 + P17.5 + K20 + S30 significantly increased all the yield attributes, yield and uptake of N, P, K and S by the crop. The available nutrient status of experimental soils assessed after harvest of fenugreek crop was also found higher when compared with the available nutrient status of control plot soils.

Nutrient uptake by crop plants

Data pertaining to nitrogen, phosphorus and potassium uptake as affected by different treatments (Table 3) revealed the different treatments affected the uptake of above mentioned nutrients.

Nitrogen uptake

The maximum 37.84 kg/ha nitrogen uptake by fenugreek plants was recorded in the treatment combination of T_{12} (5 t Poultry manure + *Rhizobium*) followed by T_8 (5 tonnes VC + *Rhizobium*) (36.38 kg/ha), T_4 (20 tonnes FYM + *Rhizobium*) (29.83 kg/ha) and T_2 (RDF + Rhizobium (2.5 kg/ha) (28.46 kg/ha). The lowest 13.10 kg/ha nitrogen uptake was recorded in treatment combinations of T_{11} (5 t PM). Similar

Table 2 : Influence of treatments on available soil nutrient status of fenugreek.

Treatments	Soil pH	EC dS/m	OC (g/kg)	Available nutrient		
				N	P	K
RDF (30 kg N + 30 kg P_2O_5 + 50 kg K_2O/ha)	7.15	0.16	5.9	219	12.9	206
RDF + *Rhizobium*(2.5 kg/ha)	6.85	0.18	6.9	259	8.8	502
20t FYM(Farm yard manure)	7.03	0.12	7.0	261	9.4	209
20t FYM + *Rhizobium*	6.72	0.19	6.2	230	10.2	351
10t FYM + 50% Nitrogen	6.87	0.11	4.8	196	12.7	181
10t FYM+50% Nitrogen+*Rhizobium*	6.82	0.14	5.6	209	11.2	125
5t VC (Vermicompost)	6.86	0.18	7.6	271	10.9	169
5t VC + *Rhizobium*	6.94	0.15	4.4	187	11.3	168
2.5t PM + 50% Nitrogen	6.67	0.14	7.6	271	10.2	297
2.5t PM+ 50% Nitrogen +*Rhizobium*	6.78	0.14	3.2	156	13.0	207
5t PM(Poultry manure)	6.70	0.21	3.3	158	12.4	181
5t Poultry manure + *Rhizobium*	6.81	0.19	8.3	287	13.3	184
5t PM + 50% Nitrogen	6.84	0.20	5.1	201	14.8	235
5t PM+50% Nitrogen+*Rhizobium*	7.12	0.11	4.8	196	9.9	169

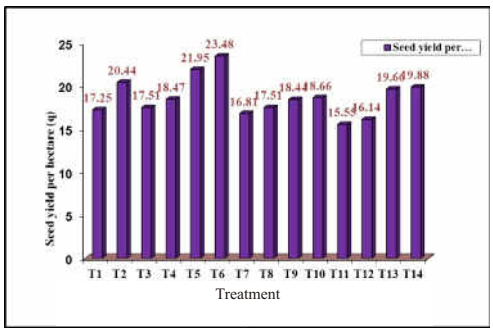

Fig. 1. Effect of different treatments on seed yield per hectare (q) of fenugreek.

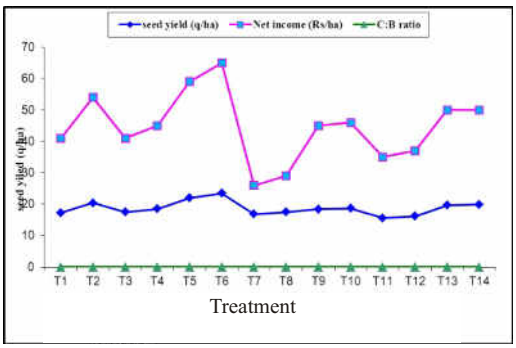

Fig. 2. Economics of different treatments of organic, inorganic and biofertilizer for fenugreek.

Table 3 : Influence of different treatments on nutrients up take and economics of fenugreek.

Treatments	Nutrient uptake by crop plants (kg/ha)			Economics of treatment combinations				
	N	P	K	Seed yield (q/ha)	Gross income (Rs/ha)	Expen diture (Rs/ha)	Net income (Rs/ha)	C:B ratio
RDF (30 kg N + 30 kg P_2O_5 + 50 kg K_2O/ha)	25.22	4.87	104.98	17.25	69000	27442	41558	1: 2.51
RDF + *Rhizobium*(2.5 kg/ha)	28.46	5.35	111.49	20.44	81760	27542	54218	1: 2.97
20t FYM(Farm yard manure)	26.25	8.15	130.77	17.51	70040	28170	41870	1: 2.49
20t FYM + *Rhizobium*	29.83	8.55	119.13	18.47	73880	28270	45610	1: 2.61
10 t FYM + 50% Nitrogen	24.09	10.34	95.08	21.95	87800	28547	59253	1: 3.08
10t FYM+50% Nitrogen+*Rhizobium*	26.91	9.36	139.08	23.48	93920	28647	65273	1: 3.28
5t VC (Vermicompost)	22.18	8.11	113.66	16.81	67240	40570	26670	1: 1.66
5t VC + *Rhizobium*	36.38	5.98	90.41	17.51	70040	40670	29370	1: 1.72
2.5t PM + 50% Nitrogen	22.16	7.47	117.50	18.44	73760	27897	45863	1: 2.64
2.5t PM+ 50% Nitrogen +*Rhizobium*	16.04	5.39	60.14	18.66	74640	27997	46643	1: 2.67
5 t PM (Poultry manure)	13.10	6.16	142.32	15.55	62200	26870	35330	1: 2.31
5 t Poultry manure + *Rhizobium*	37.84	14.25	141.49	16.14	64560	26970	37590	1: 2.39
5 tonnes P.M. +50% Nitrogen	19.57	11.85	127.48	19.66	78640	28547	50093	1: 2.75
5 tonnes PM+50% Nitrogen+*Rhizobium*	23.15	5.44	175.29	19.88	79520	28647	50873	1: 2.78

results have been reported by Thapa *et al.* (16), Deora *et al.* (4) and Patel *et al.* (13) who observed that the nitrogen content and uptake was observed significantly higher with the application of vermicompost 5 t along with *Rhizobium* + 40 kg N ha^{-1}.

Phosphorus uptake

Phosphorus uptake was markedly influenced due to different treatments. Treatment T_{12} (5 t Poultry manure + *Rhizobium*) had higher phosphorus uptake (14.25 kg/ha) followed by T_{13} (5 t PM + 50% nitrogen) (11.85 kg/ha) and T_5 (10 t FYM + 50% Nitrogen) (10.34 kg/ha). While the lowest 4.87 kg/ha phosphorus uptake was recorded by T_1 (RDF 30 kg N + 30 kg P_2O_5 + 50 kg K_2O/ha). These finding are in agreement with the findings reported by Patel *et al.* (13), Bhalavi (1), Purbey *et al.* (14) and Dubey *et al.* (5) reported that the P content and their uptake increased significantly up to 60 kg P_2O_5/ha.

Potassium uptake

Different treatments varied for potassium uptake. It was maximum (175.29 kg/ha) under treatment combinations of T_{14} (5 t PM + 50% nitrogen + *Rhizobium*) which was followed by T_{11} (5 t PM) (142.32 kg/ha), T_{12} (5 t Poultry manure + *Rhizobium*) (141.49 kg/ha) and T_6 (10 t FYM + 50% Nitrogen + *Rhizobium*) (139.08 kg/ha). However, the lowest 60.14 kg/ha potassium uptake was found under the treatment combination of T_{10} (2.5 t PM + 50% Nitrogen + *Rhizobium*). Similar results have been reported by Tuncturk *et al.* (17) and Dubey *et al.* (5) .The results indicated that in general, plants with high yield removed high N P and K. A positive relationship was observed between uptake of the major nutrients and yield, probably through better uptake of N, P and K and their utilization in protein synthesis. Deora *et al.* (4), Singh *et al.* (15) and Bhalavi (1) reported that the application of fertilizer significantly increased the N, P, K contents and their uptake by crop.

Economics of fenugreek

The higher money value and less cost of cultivation are desirable traits for getting higher returns. Hence, economics of the treatments was work out. The data pertaining to economics of different treatments as depicted in Table 3 and Fig 2 revealed that a significantly maximum seed yield of 23.48 q/ha was recorded in fenugreek variety RMT–1 in treatment combination T_6 (10 t FYM + 50% Nitrogen + Rhizobium) along with net return of ₹ 65,273/ha and cost benefit ratio 1: 3.28 followed by T_5 (10 t FYM + 50% Nitrogen) (21.95 q/ha., ₹ 59,253/ha and 1:3.08 seed yield, net return and cost benefit ratio respectively). While, minimum cost benefit ratio 1: 1.66 was obtained in the treatment combination T_7 (5 t Vermicompost) due to higher expenditure ₹ 40,570/ha and comparatively low seed yield 16.81q/ha as compared to other treatments. Similar results in

fenugreek cv. RMT–1 have been reported by Kumar *et al.* (8), Giridhar and Sarada (6), Kumar *et al.* (9), Patel *et al.* (13) and Choudhary *et al.* (3).

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