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Effect of organic nutrients, biofertilizers and biocontrol agents on growth and yield of fenugreek (*Trigonella foenum-graecum* L.)

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Abstract

A field experiments on “Effect of organic nutrients, biofertilizers and biocontrol agents on growth and yield of fenugreek (*Trigonella foenum-graecum* L.)” was conducted at Horticultural College and Research Institute, Periyakulam. The fenugreek variety NRCSS – AM-1 used in this study. The seeds were sown in line at the distance of 20 x 10 cm in the raised beds of uniform size. The experiment was laid out in a Randomized Block Design (RBD) and replicated thrice. Biometrical observations on growth, pod and yield parameters were recorded and datas’ were analysed statistically. The results revealed that combined application of recommended dose of inorganic fertilizers along with *Azospirillum* (50g/bed), *Phosphobacteria* (50g/bed), *Pseudomonas fluorescense* (50g/bed) and vermicompost (100g/bed) (T9) resulted in the highest values of growth characters viz., plant height (35.27 cm), number of primary (6.90) and secondary branches (14.63), days taken for 50 per cent flowering (48.25 days) and intermodal length (2.70 cm) followed by T7 (RDF + *Azospirillum* (50g/bed), *Phosphobacteria* (50g/bed)). Control (T10) registered the lowest values for all the traits (22.67 cm; 5.20; 10.77; 56.25 days; 2.20 cm). In the case of yield characters, T9 recorded the highest values of the traits viz., number of pods per plant (48.25), pod length (11.25 cm). number of seeds per pod (15.67), seed yield per plot (85.97 g) and estimated yield (429.67 kg/ha). The control (T10) observed the lowest values of all the yield characters (33.20; 8.40 cm; 10.33; 52.00 g; 329.67 kg/ha). Regarding B:C ratio, T9 registered the highest ratio of 1.89 and it was followed by T7 (1.80) where as the lowest B:C ratio was recorded by control (T10) of 1.25. It was noticed that treatment T9 (*Azospirillum*, *Phosphobacteria*, *Pseudomonas fluorescense* and vermicompost) recorded 40 per cent increased yield over the control.

Keywords: Fenugreek, *Azospirillum*, *Phosphobacteria*, *Pseudomonas fluorescense*, yield

Introduction

Fenugreek (*Trigonella foenum-graecum* L.) is popularly known as “Methi”, is native of South – Eastern Europe and Western Asia and belongs to the family fabaceae. India is one of the major producer and exporter of fenugreek. In India Rajasthan, Gujarat, Uttar Pradesh, Maharashtra, Madhya Pradesh, Haryana, Tamil Nadu, Andhra Pradesh and Punjab are the major producing states. Besides India, France, Egypt, Argentina, Spain, Morocco, China, Turkey and China are also the major fenugreek growing countries of the world. Fenugreek seeds, stem and leaves are mainly used as a spice and to some extent for medicinal purposes. Seeds are rich in protein, minerals, and vitamins. Now a days, biofertilizers and bio control agents plays a vital role on enhancing the herbage yield, quality and seed yield of spices. *Pseudomonas* is phosphorus solublizing bacteria, which solublizes excess/unused phosphorus in soil and provides to the plant in soluble/available form. It is well known fact that using the PSB increase the phosphatic fertilizers use efficiency (Singh *et al.*, 2010) [12]. Application of biofertilizers ensures a partial saving of applied nitrogenous fertilizers as reported in several horticultural crops. Besides, the microorganisms present in the biofertilizers help in the improvement of soil health. Earlier, several scientist viz., Selvarajan and Chezian, (2001) [9] in fenugreek; Selvarajan and Chezian, (2001) [10] in coriander and turmeric and Arumugam *et al.* (2001) [11] in senna had attempted and reported the influence of biofertilizers on growth and yield. The use of inorganic manures along with biofertilizers and biocontrol agents, encouraging the plant health and also showed reduced incidence of plant diseases. With this background, the present study on “Integrated nutrient management studies on fenugreek for sustainable growth and yield” was undertaken at Horticultural College and Research Institute, Periyakulam.

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Materials and methods

The present experiment on “Effect of organic nutrients, biofertilizers and biocontrol agents on growth and yield of fenugreek (*Trigonella foenum-graecum* L.)” was conducted at Horticultural College and Research Institute, Periyakulam with an objective to study the influence of inorganic fertilizers, bio-fertilizers and bio-control agents on growth and yield of fenugreek. The var. NRCSS-AM1 used in this study. Raised beds of 2m x 1m were prepared for sowing of seeds. The seeds were sown in line at a distance of 20 cm x 10 cm. The experiment was laid out in a Randomized Block Design (RBD) and replicated thrice. The recommended dose of fertilizers (RDF) viz., 10, 40 and 60 kg of NPK per ha was applied as basal and another 10kg of nitrogen is applied as top dressing at 30 days after sowing. Besides, 4 kg of farmyard manure per bed was also applied uniformly in all the beds. The biofertilizers and biocontrol agents were applied in two ways viz., soil application @ 50 g per bed and seed treatment. Vermicompost was applied @ 100g per bed as per the treatment (5t/ha). The growth and yield traits were recorded from randomly selected ten plants in each treatment and replication. The observations viz., plant height (cm), number of primary branches, number of secondary branches, days to 50 per cent flowering, internodal length (cm), number of pods per pod, pod length (cm), number of seeds per pod, 1000 seed weight (g), seed yield per plot (kg) and estimated seed yield (kg/ha) were recorded and analysed statistically as suggested by Panse and Sukhatme (1978).

The treatment details are as follows.

T1- RDF (20, 40 & 60 kg/ha) along with *Azospirillum* (50g/bed)

T2 - RDF along with *Phosphobacteria* (50g/bed)

T3 - RDF along with *Pseudomonas* (50g/bed)

T4 - RDF along with *Azospirillum* + *Phosphobacteria* (50g/bed)

T5 - RDF along with *Azospirillum* (50g/bed) + *Pseudomonas* (50g/bed)

T6 - RDF along with *Phosphobacteria* (50g/bed) + *Pseudomonas* (50g/bed)

T7 - RDF along with *Azospirillum* (50g/bed) + *Phosphobacteria* (50g/bed) + *Pseudomonas* (50g/bed)

T8 - RDF along with Vermicompost (5t/ha) (100g/bed)

T9 - RDF along with *Azospirillum* (50g/bed) + *Phosphobacteria* (50g / bed) + *Pseudomonas* (50g / bed) + Vermicompost (100g/bed)

T10 - Control (RDF).

Results and discussion

The result of growth characters are presented in Table 1. From the results it was observed that, the treatments showed significant difference for all the traits studied. The combined effect of inorganic and biofertilizers showed a positive influence. Among the ten treatments of the present study, the treatment T9 (RDF along with *Azospirillum* (50g/bed) + *Phosphobacteria* (50g/bed) + *Pseudomonas fluorescens* (50g/bed) + Vermicompost (100g/bed)) recorded the highest plant height values of 7.60 cm and 35.27 cm at 45 days and 100 days after sowing. It was followed by T7 (RDF along with *Azospirillum* (50g/bed) + *Phosphobacteria* (50g / bed) + *Pseudomonas fluorescens* (50g / bed)) which recorded 7.46 cm and 32.97 cm as plant height values at 45 and 100 days after sowing. The lowest plant height values of 4.33 cm and 22.67 cm at 45 and 100 days after sowing was recorded by T10 (control). Number of primary branches per plant ranged from 6.90 (T9) to 5.20 (T10). The highest number of primary

branches per plant was registered by T9 (6.90) and it was followed by T7 (6.13). Whereas the lowest number of primary branches (5.20) were registered by control (T10). Similar trend was also noticed for number of secondary branches per plant. The highest number of secondary branches per plant was registered by T9 (14.63) and it was followed by T7 (13.17) whereas the lowest number of secondary branches per plant (7.77) were observed in control (T10). This is in agreement with the findings of Selvarajan and Chezhian (2001) [11] stated that *Azospirillum* treated seeds produced more number of primary branches. This accelerated growth due to the combined application of inorganic fertilizers and biofertilizers could be explained that the inoculated bacteria mediate fixation of atmospheric nitrogen and release of P from insoluble phosphate with simultaneous uptake of nutrients by the plants (Vimala and Natarajan, 1999) [15]. Tien *et al.* (1979) [14] reported that synthesis of IAA from tryptophan by *Azospirillum* that caused an increased uptake of nutrients which might have resulted in better plant growth. Application of vermicompost can be attributed to improve the physical conditions of soil which in turn provides a balanced nutritional environment both in the soil rhizosphere and plant system (Reddy *et al.*, 1998) [7]. Treatment T7 registered the next best values in all the vegetative traits. This might be due to the combined application of inorganic fertilizers, biofertilizers combined with biocontrol agents.

Regarding flowering characters, days to 50 per cent flowering showed a significant difference among the treatments. Treatment T9 registered the earliest flowering (48.25 days) and it was followed by T7 (49.89 days). The longest days to 50 per cent flowering (53.25 days) was recorded by control (T10). Early flowering observed by the treatment T9 might be due to the presence of plant growth promoting hormones in biofertilizers resulted in increasing uptake of nutrients from the inorganic fertilizers which resulted in early flowering. Similar trend was also noticed in internodal length. Results of the present study revealed that the highest internodal length was registered by T9 (2.70 cm) and it was followed by T7 (2.66 cm) whereas the lowest internodal length (2.20 cm) was observed by control (T10). This could be attributed to the presence of growth promoting hormones present in *Azospirillum* which resulted in increased internodal length when compared to control.

The yield attributing characters are presented in Table 2. The highest number of pods per plant was registered by T9 (48.25) followed by T7 (44.21). The lowest number of pods per plant (33.20) was recorded in control (T10). Regarding pod length, treatment T9 recorded the highest value of 11.25 cm followed by T7 (10.23 cm), where as the lowest pod length (8.40 cm) was observed in control (T10). The same trend was noticed in seeds per pod characters also. The highest number was observed in T9 (15.67) and it was followed by T7 (15.0). The lowest number of seeds per pod (10.33) was recorded in T10 (control). Similar trend was also noticed for the trait 1000 seed weight. The treatment T9 recorded the highest 1000 seeds weight of 15.57g and it was followed by T7 (14.87 g). The lowest value of 1000 seed weight (12.04 g) was observed by T10.

In respect to seed yield per plot, the treatment T9 recorded the highest seed yield per plot of 85.97 g and it was followed by T7 (80.97 g). Control (T10) registered the lowest seed yield per plot of 52.0 g. For trait estimated yield per ha also the same trend was occurred. Treatment T9 recorded the highest seed yield of 429.67 kg per ha and it was followed by T7 (404.67 kg per ha). The lowest estimated yield (259.67 kg per

ha) was observed in T10 (control). The increased seed yield observed in the present study is due to the combined application of inorganic fertilizers, *Azospirillum*, *Pseudomonas* and *Phosphobacteria*. Treatment T9 registered 40 per cent increased yield over the control (T10). This could be attributed due to biosynthesis of growth promoting substances viz., vitamin B12 (Sankaram, 1960) [8], auxin (Naumova *et al.*, 1962) [5] and GA (Barea, 1976) [2] present in the biofertilizers viz., *Azospirillum* and *Phosphobacteria*. Associative effect of *Rhizobium* and *phosphobacteria* would have also caused increase yield in fenugreek owing to increased and balanced availability of both N and P. *Azospirillum* produces phytohormones which stimulate root

growth and induce changes in root morphology which in turn affect the assimilation of nutrients (Sumner, 1990) [13]. The yield increases associated with inoculated plants were also attributed to the highest amounts of plant growth hormones like IAA, IBA produced by *Azospirillum* (Fallik *et al.*, 1989) [3]. Application of biofertilizers along with the chemical fertilizers would have favoured the availability of nutrients in the soil and uptake of nutrients by the crop reflecting the higher yield with better fruit traits (Mohanrajsamuel, 1984) [4]. In the present study treatment T9 recorded the highest B:C ratio value of 1.89 and it was followed by T7 (1.80) where as the lowest B:C ratio was recorded by control (T10) of 1.25.

Table 1: Effect of inorganic and organic fertilizers, biofertilizers and biocontrol agents on growth characters of fenugreek

Treatment	Plant height at 45 DAS (cm)	Plant height at 100 DAS (cm)	Number of primary branches/ plant	Number of secondary branches/ plant	Days taken for 50% flowering (days)	Length of Internodes (cm)
T ₁	6.57	31.87	5.56	12.63	50.21	2.44
T ₂	6.47	30.00	5.60	12.20	50.15	2.51
T ₃	6.90	27.23	5.93	11.50	48.95	2.48
T ₄	6.83	30.20	5.93	13.13	49.75	2.60
T ₅	5.53	28.73	5.83	11.60	48.58	2.55
T ₆	6.76	31.87	5.77	13.30	49.25	2.57
T ₇	7.46	32.97	6.13	13.17	49.89	2.66
T ₈	4.57	26.17	5.36	11.63	50.15	2.54
T ₉	7.60	35.27	6.90	14.63	48.25	2.70
T ₁₀	4.33	22.67	5.20	10.77	53.25	2.20
SEd	0.04	1.09	0.20	0.28	1.65	0.02
CD (P=0.05%)	0.07	2.29	0.50	0.59	2.20	0.055

Table 2: Effect of inorganic and organic fertilizers, biofertilizers and biocontrol agents on pod and yield characters of fenugreek

Treatment	Number of pods/ plant	Pod length (cm)	Number of seeds per pod	1000 seeds weight (g)	Seed yield per plot (2m ²) (g)	Estimated Seed Yield (kg/ha)	B:C ratio
T ₁	42.56	9.88	12.00	13.60	73.07	365.33	1.65
T ₂	45.63	9.75	12.67	14.03	72.00	360.00	1.60
T ₃	42.13	9.65	14.33	14.50	71.33	356.33	1.62
T ₄	40.04	9.50	14.33	14.20	75.63	378.00	1.72
T ₅	43.83	9.42	14.67	14.23	77.50	387.33	1.75
T ₆	42.02	9.35	14.00	14.70	75.23	376.00	1.70
T ₇	44.21	10.23	15.00	14.87	80.97	404.67	1.80
T ₈	40.89	9.75	12.33	12.57	71.33	346.33	1.64
T ₉	48.25	11.25	15.67	15.57	85.97	429.67	1.89
T ₁₀	33.20	8.40	10.33	12.04	62.00	329.67	1.25
SEd	1.85	0.28	0.99	0.25	0.66		
CD (P=0.05%)	3.89	0.62	2.08	0.54	1.39		

Conclusion

In the present study it could be concluded that the combined application of inorganic fertilizers, biofertilizers, biocontrol agents and vermicompost (T9) recorded the highest vegetative vigour, yield attributing traits like seed yield per ha and also registered B:C ratio of 1.89 in fenugreek followed by T7 treatment. The treatment T9 recorded the 40 per cent increased yield over the control.

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