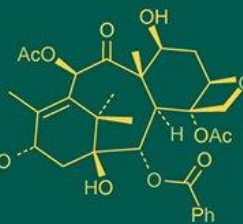
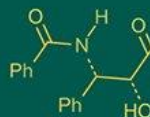


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Study of soil quality parameters as influenced by different farming system modules and fenugreek varieties

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Abstract

The field experiment was conducted at College of Horticulture, Bagalkot, Karnataka in *Rabi* season 2024-25 with split design. The effect of farming system practices and fenugreek varieties on soil quality revealed that the highest EC (0.27 dS/m) was noticed with M₄ (Package of practices farming system module) whereas M₁ (Natural farming system module) recorded least EC (0.18 dS/m) due to absence of chemical inputs which are present in M₄ module. Significantly, the highest organic carbon (0.55%) was noticed with M₁ (Natural farming system module) which was on par with M₂ (Organic farming module) of 0.54% while module M₃ and M₄ modules recorded significantly least OC value of 0.52%. The highest available nitrogen (252.37 kg/ha) was recorded with M₄ (Package of practices farming system module) and potassium (299.33 kg/ha) was recorded with M₂ (Organic farming system module). The highest available phosphorus (31.15 kg/ha) was recorded with M₄ (Package of practice farming system module) followed by M₃ and M₁. The interaction of M₄V₃ (Package of practices farming system module with AFG-4) recorded maximum available nitrogen (255.0 kg/ha), M₄V₁ (Package of practices farming system module x KPD-1) recorded maximum available phosphorous (38.97 kg/ha) followed by M₁V₂ (Natural farming system module with AFG-3 of 32.76 kg/ha).

Keywords: Fenugreek, soil quality, farming systems, nutrients, rabi experiment

Introduction

Presently agriculture is mainly dependent on fertilizer and chemicals, the increasing population pressure has forced many countries to use inorganic fertilizers to increase the crop productivity for fulfilling their ever-increasing food requirements. The prolonged indiscriminate usages of chemicals are resulted in soil and human health hazards along with environmental pollution. The productivity is decreasing and the cost of production is increasing, this has made farming much more difficult. Organic and natural farming are gaining more importance and popularity in recent days. In developing countries like India, increasing prices of chemical fertilizers along with growing concerns for sustaining soil productivity has led to draw the attention for use of organic manures as fertility restoring inputs, sources of manures are a vital resource not only for supplying plant nutrients but also for replenishing organic matter content in most of agricultural soils, particularly in the tropics and subtropical regions. This would further emphasize the need to use organic manures alone or in combination with chemical fertilizers for maintenance and improvement of soil fertility for sustainable crop production (Ghosh *et al.*, 2022) [3]. The seed spices are grown mainly for seed purpose and they are annuals, perform well under dry conditions and currently gaining importance in most of the regions of India. The research work on seed spices in south India is very meager. Hence, to improve the soil health, reduce the cost of cultivation, enhancing the production, quality and to maintain sustainability is crucial under current situation. Hence, with this background and by keeping all above factors the present investigation entitled with study of soil quality parameters as influenced by different farming system modules and fenugreek varieties was under taken.

Material and Methods

The field experiment was conducted during the *rabi* season of 2024-25 at the College of

Horticulture, UHS, Bagalkot. The site is located at 16°18' N latitude, 75°69' E longitude and 542 m above MSL, representing the northern dry zone (Zone III) of Karnataka. The soil was light black loam, slightly alkaline (pH 8.46) with low nitrogen, high phosphorus and medium potassium status. The experiment was laid out in a split-plot design with four farming system modules as main plots : Natural farming system module (M₁), Organic farming system module (M₂), Integrated farming system module (M₃), Recommended package of practices (M₄) and for subplots the four fenugreek varieties : Krishna Prabha Devimenthe 1 (V₁), AFg-3 (V₂), AFg-4 (V₃) and AFg-5 (V₄) were taken and replicated thrice. Seeds were sown at 30 x 10 cm spacing using healthy, disease-free seeds. For Natural farming system module (M₁) seed were treatment with beejamrutha (5%) and application of jeevamrutha, mulching practices were practiced. In Organic farming system module (M₂) seeds treated with *Rhizobium* and PSB [@ 500 g each/ha] + *Trichoderma viride* @ 10 g/kg of seeds, vermicompost applied on nitrogen equivalent base, panchagavya at 5 percent applied through foliar application.

For Integrated farming system module (M₃) seed treatment with 50% RPP + vermicompost @ 2t/ha + FYM 5 t/ha. In recommended package of practices (M₄) seed treatment with fungicide (carbendazim @ 2.5 g/kg seed) at the time of sowing, NPK @ 50: 25: 40 kg/ha + FYM 10 t/ha were followed. Full dose of phosphorus, potash and half dose of nitrogen is applied at the time of sowing as basal dose and remaining 50 percent of nitrogen applied 30 days after sowing. Nutrient and crop management practices were followed as per respective modules. The soil quality parameters were estimated with varied methods viz Soil pH with potentiometric method, Electrical conductivity (dS/m) with conductometric method, Organic carbon (%) with Walkley and Black, wet oxidation method (Walkey and Black, 1934) ^[12], Available nitrogen (kg/ha) with alkaline KMnO₄ method (Subbiah and Asija, 1956) ^[8], Available phosphorus (kg/ha) with Olsen's method (Olsen *et al.*, 1954) ^[5], Available potassium (kg/ha) with flame photometric method (Jackson, 1973) ^[4] results were estimated using split plot design.



Fig 1: Steps in ghanajeevamrutha preparation



Fig 2: Steps in panchagavya preparation

Result and Discussion

a. Effect of farming system modules

Significantly, the highest EC (0.27 dS/m) was noticed (Table 1) with M₄ (Package of practices farming system module) whereas M₁ (Natural farming system module) recorded least (0.18 dS/m) EC due to absence of chemical inputs which are present in M₄ module. Significantly, the highest organic carbon (0.55%) was noticed with M₁ (natural farming system module) which is on par with M₂ (Organic farming module) of 0.54%. while module M₃ and

M₄ modules recorded significantly least OC value of 0.52%. Similar results were also noticed with Tania *et al.* (2024) where application of vermicompost (5 t/ha) + lime (250 kg/ha) in fenugreek improved soil organic carbon (+ 0.38%), available N, P, K and micronutrients leading to improved soil quality and results of Devakumar *et al.* (2014) ^[2] also supports the obtained experiment results where Jeevamruth peaked on the 9th day after preparation with microbial counts of 8.55×10^7 cfu/ml (bacteria), 2.9×10^5 (fungi), 6.9×10^6 (N fixers) and 8.0×10^6 (P-solubilizers).

These formulations were effective in enriching soil microbial diversity and nutrient cycling. The highest (Table 2) available nitrogen (252.37 kg/ha) and potassium (299.33 kg/ha) was recorded with M₂ (Organic farming system module). Similar results were recorded by Soyam *et al.* (2012) [7] where activity of Rhizobium + PSB increased available nitrogen, phosphorus and potash in fenugreek soils after harvest. The higher level of available potassium (299.33 kg/ha) was recorded with M₂ (Organic farming system module) due to the slow releasing potential of vermicompost, its high organic matter improves cation exchange capacity (CEC), reducing nutrient losses and keeping K more available in soil. Similar results were recorded with Choudhary *et al.* (2011) [1] and Singh *et al.* (2018) [6]. The highest available phosphorus (31.15 kg/ha) was recorded with M₄ (package of practice farming system module) followed by M₃ and M₁. The similar results were also recorded by Thamaraiselvi and Arulmozhiselvan (2020) [11] in saline and sodic soils, even though some P from DAP gets fixed, the relatively lower fixation rate means a significant amount of phosphorus remains available in soil

after application. Srivastava *et al.* (2016) [9] were also recorded the similar results.

b. Effect of fenugreek varieties

The soil quality parameters viz., pH, OC, Available nitrogen and potassium were differed non significantly due to the impact of varieties. Higher EC of 0.25 (dS/m) was noticed with V₄ and more available phosphorous with V₁ (30.35 kg/ha).

c. Interaction effect

The soil quality parameters influenced non significantly for interaction effect except for EC, available nitrogen and phosphorous. However, the different farming practices played a major role in reduced soil pH from 8.46 (before sowing) to 8.20 (after harvesting) especially in natural and organic farming systems, among the interaction M₂V₄ shown lowest pH (8.02). Numerically increased soil OC and also available potassium were noticed for interaction effect. Overall, this soil quality parameters were having positive impact on crop performance and enhanced yield levels.

Table 1: The pH, EC and organic carbon of soil before sowing and after harvesting of fenugreek (*Trigonella foenum-graecum* L.) varieties as influenced by different farming system modules

Treatments	pH					EC (dS/m)					OC (%)				
Before sowing	8.46					0.15					0.51				
Farming system modules (M)	Fenugreek varieties (V)														
	V ₁	V ₂	V ₃	V ₄	Mean	V ₁	V ₂	V ₃	V ₄	Mean	V ₁	V ₂	V ₃	V ₄	Mean
	KPD-1	AFg-3	AFg-4	AFg-5		KPD-1	AFg-3	AFg-4	AFg-5		KPD-1	AFg-3	AFg-4	AFg-5	
M ₁ : Natural farming system module	8.29	8.12	8.15	8.24	8.20	0.17	0.13	0.23	0.20	0.18	0.53	0.55	0.54	0.56	0.55
M ₂ : Organic farming system module	8.38	8.29	8.12	8.02	8.20	0.28	0.33	0.19	0.17	0.24	0.54	0.53	0.55	0.53	0.54
M ₃ : Integrated farming system module	8.22	8.36	8.23	8.25	8.27	0.17	0.20	0.31	0.27	0.24	0.53	0.52	0.52	0.53	0.52
M ₄ : Package of practices farming system module	8.34	8.19	8.39	8.31	8.31	0.18	0.31	0.22	0.35	0.27	0.52	0.52	0.52	0.51	0.52
Mean	8.31	8.24	8.22	8.21	8.25	0.20	0.24	0.24	0.25	0.23	0.53	0.53	0.53	0.53	0.53
	S. Em±				CD at 5%	S. Em±				CD at 5%	S. Em±				CD at 5%
Main Plot (M)	0.03				NS	0.005				0.020	0.01				0.02
Subplot (V)	0.08				NS	0.005				0.015	0.01				NS
Interaction (M × V) at same level	0.16				NS	0.010				0.030	0.01				NS
Interaction (M × V) at same or different level	0.14				NS	0.010				0.035	0.01				NS

Note: KPD-Krishna Prabha Devimenthe 1, AFg-Ajmer fenugreek, EC-Electrical conductivity, OC-Organic carbon

Table 2: Available primary nutrient status of the soil before and after sowing of fenugreek (*Trigonella foenum-graecum* L.) varieties as influenced by different farming system modules

Treatments	Available nitrogen (kg/ha)					Available phosphorus (kg/ha)					Available potassium (kg/ha)				
Before sowing	219.52					23.98					270.44				
Farming system modules (M)	Fenugreek varieties (V)														
	V ₁	V ₂	V ₃	V ₄	Mean	V ₁	V ₂	V ₃	V ₄	Mean	V ₁	V ₂	V ₃	V ₄	Mean
	KPD-1	AFg-3	AFg-4	AFg-5		KPD-1	AFg-3	AFg-4	AFg-5		KPD-1	AFg-3	AFg-4	AFg-5	
M ₁ : Natural farming system module	240.00	232.66	237.00	240.00	237.41	28.28	32.76	25.62	23.69	27.59	288.00	290.20	296.00	290.00	291.17
M ₂ : Organic farming system module	236.66	237.33	233.33	231.00	234.58	25.13	24.08	25.42	27.29	25.48	298.00	302.00	291.00	305.30	299.33
M ₃ : Integrated farming system module	247.33	248.33	247.67	246.00	247.33	29.03	28.47	29.26	28.79	28.89	284.50	288.00	280.00	285.00	284.42
M ₄ : Package of practices farming system module	251.21	253.61	255.00	249.66	252.37	38.97	29.35	28.41	27.86	31.15	294.00	298.00	297.00	294.00	296.00
Mean	243.80	242.99	243.25	241.67	242.92	30.35	28.66	27.18	26.91	28.27	288.67	292.25	288.92	291.08	290.23
	S. Em±				CD at 5%	S. Em±				CD at 5%	S. Em±				CD at 5%
Main Plot (M)	2.97				10.30	0.33				1.13	1.73				6.09
Subplot (V)	1.59				NS	0.45				1.33	1.58				NS
Interaction (M × V) at same level	3.19				NS	0.91				2.65	3.17				NS
Interaction (M × V) at same or different level	4.31				14.61	0.83				2.82	3.27				NS

Note: KPD-Krishna Prabha Devimenthe 1, AFg-Ajmer fenugreek

Conclusion

The highest OC (0.55%) was noticed with M₁ (Natural farming system module) which was on par with M₂ (Organic farming module) of 0.54%. The highest available nitrogen (252.37 kg/ha) and available phosphorus (31.15 kg/ha) was recorded with M₄ (package of practices farming system). The natural farming system module recorded

highest soil quality parameters (EC and OC) compared to other farming systems.

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