



## EFFECT OF ORGANIC AND INORGANIC FERTILIZERS ON GROWTH AND NUTRIENT STATE OF *TRIGONELLA FOENUM GRAECUM* L.

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### Abstract:

The study emphasized on the growth, yield-attributing qualities of fenugreek *Trigonella foenum graecum* L., (Fabaceae) is well-known for its culinary and medicinal value. In this experiment, the biological properties of Fenugreek plant were recorded at regular intervals on 15, 30 and 45 days. The best results for growth parameters after 45 days viz. plant height (14.34 cm), the number of leaves (19.01) and the number of branches per plant (6.01) were recorded in pots with vermicompost. The organic treatment increased fresh and dry weight fenugreek plants compared to inorganic and control. Biochemical characters like protein and chlorophyll content were considered. The treatments consisted of organic fertilizers as mixture of soil-50%, vermicompost-25%, cocopeat-15%, farmyard manure-10%, 100% recommended NPK and Control (without fertilizer). The study revealed that growing Fenugreek with vermicompost resulted in significantly higher plant growth, as studied parameters were showed healthy and vigorous growth in vermicompost promoting environmental friendly agricultural practices.

**Keywords:** Fenugreek, Vermicompost, Inorganic Fertilizer.

### Introduction

Fenugreek (*Trigonella foenum-graecum* L.) 2n=16, commonly referred to as 'Methi', is a member of the Leguminaceae family and the Papilionaceae sub-family. It is extensively recognized for its therapeutic benefits globally, and it holds significant value as a spice in Indian culture. Approximately 260 species of *Trigonella* are distributed across the world. (1). Fenugreek is an annual legume, diploid plant (2) that exhibits no aneuploidy (3, 4,5). Morphologically, it is an erect, aromatic annual that closely resembles a large clover. Fenugreek exhibits various pharmacological properties, including antimicrobial, anticholesterolemic, carminative, emollient, febrifuge, laxative, restorative, uterine tonic, expectorant, galactagogue, anti-carcinogenic, anti-inflammatory, antiviral, antioxidant, demulcent, and hypotensive effects (6). Organic fertilizers serve as outstanding sources of nutrients for crop production and enhance the physical and chemical properties of soil (7). At present, our thriving

plant is suffering from declining soil health as a result of the careless use of synthetic fertilizers, pesticides, and fungicides. Inorganic fertilizers predominantly depend on synthetic-organic or inorganic substances, and they are also commonly referred to as mineral fertilizers (8). The application of various organic materials, particularly cow dung, poultry droppings, and farmyard manure, as soil amendments is effective in promoting crop production (9). Therefore, fertilizers are necessary and are applied to restore nutrients depleted from the soil due to crop harvesting, and they are also used to provide additional nutrients to improve crop yield (10). Taking into accounts the comparative study of organic and inorganic fertilizers effects on fenugreek growth, the present piece of research work was undertaken by keeping the objectives like effect of organic and inorganic fertilizers on different growth parameters of the fenugreek plant and estimate the concentration of protein and chlorophyll content in the fenugreek leaves that were grown in two different fertilizers application.

D. Sharmila *et al.* examined how vermicompost affects the growth and traits of Fenugreek (*Trigonella foenum-graecum*). Seedlings were grown with 20% to 100% vermicompost mixed with soil. Results showed a strong positive correlation between morphological traits and vermicompost concentration. The findings indicated that vermicompost significantly improves yield parameters compared to standard soil, with higher compost levels enhancing plant growth, root and shoot lengths, and germination rates. (11)

So, the present study was undertaken to evaluate the effect of organic fertilizer (combination of vermicompost, FYM and cocopeat with soil) and inorganic fertilizer (NPK 15:15:15) on the growth of Fenugreek. Along with the growth parameters biochemical characters like protein content and chlorophyll content were considered.

## **Materials and Methods**

### **1. Study location**

The present experiment was conducted at Chikodi; Belagavi district located in Karnataka state. Chikodi Taluk enjoys semi-arid climate. The area falls under the Northern transitional agroclimatic zone of Karnataka state. The normal annual rainfall in Chikodi Taluk is 716mm. Agriculture is the main occupation in Chikodi. Major Kharif crops are Maize, Bajra, Jowar, Tur and vegetables. The main crops of Rabi season are Maize, Bajra, Jowar and Sunflower. Water intensive crops like sugarcane and paddy are grown in 36% of total crop area. The soils of Chikodi Taluk can broadly be classified into Black cotton soils and red soils. (12)

### **2. Collection of required materials for experiment**

The required materials like red soil, vermicompost, cocopeat, farmyard manure and pots were obtained from local plant nursery in Chikodi. The Fenugreek seeds and NPK 15:15:15 fertilizer (manufactured by Rashtriya Chemicals and Fertilizers Limited) were obtained from local market in Chikodi.

### **3. Preparation of Growing media for experiment**

The soil was subjected to preliminary analysis like pH and electrical conductivity. The pH of the soil was observed 6.9 and electrical conductivity was 0.34dS/m.

The preparation of growing media for organic fertilizer the materials taken are Soil-50%, Vermicompost-25%, Cocopeat-15%, Farmyard manure-10%. The total amount media prepared is 1.5kg per pot in triplicates. The preparation of growing media for inorganic fertilizer, 1 gram of NPK 15:15:15 is mixed with 2.5kg of soil per pot in triplicates. The preparation of growing media for control, 2.5 kg of soil was used per pot in Triplicates.

### **4. Experimental design**

The experiment was performed in plastic pots of 16cm X16cm (Height and Diameter) and total 8 pots were used 3 for organic fertilizer, 3 for inorganic fertilizer and 2 for control. In each pot 15 seeds were sown and before

sowing the seeds were surface sterilized with 2 % Sodium Hypochlorite solution for 5 minutes and again washing 2 times with distilled water. Regular weeding was done around the base by hand picking, the plants were watered 4-5 days once and plants were subjected for sunlight 3-4 hours a day. During the growing period, the following observations were made at different intervals of time. Number of days required for the germination of seeds, plant height of each plant, number of leaves per plant, number of branches per plant, fresh weight of plants, dry weight of plants, estimation of protein and total chlorophyll concentration.

### **5. Plant protection**

Plant protection was carried out throughout the duration of plant growth because there was a problem with either pests or diseases in the experiment.

### **6. Estimation of protein concentration and chlorophyll content**

For estimation of both the parameters leaves of fenugreek were used after 50 days of the sowing. Estimation of both the parameters were carried out using UV-Visible spectrophotometer.

#### **A) Estimation of protein**

Extraction of protein: 0.5grams of leaves are weighed and ground in pestle and mortar using 10ml distilled water to get homogenized mixture. Then this homogenized mixture was centrifuged to get clear supernatant for protein estimation. The Lowry's method (1951) was used for estimating protein concentration. According to these method different concentrations of standard protein that is Bovine serum albumin has prepared and into this solution 5ml of alkaline copper solution was added. Then these setups were kept for 10minutes to incubate at room temperature. Further 0.5 ml of Folin Ciocalteau reagent was added rapidly with immediate mixing well and incubated at room temperature in the dark for 30 minutes. Finally, the absorbance has measured at 660nm against the blank. The standard calibration curve was obtained by Bovine serum albumin. (13)

#### **B) Estimation of Chlorophyll**

Extraction of Chlorophyll: 0.5grams of leaves are weighed and ground in pestle and mortar using 10ml 80% acetone to get homogenized mixture. Then this homogenized mixture was centrifuged to get clear supernatant for chlorophyll estimation.

Estimation of Chlorophyll was performed according to Arnon 1949 (14). The supernatant taken after centrifuging was subjected to reading the absorbance using UV spectrophotometer. The concentrations of chlorophyll a, chlorophyll b and total chlorophyll were calculated using the following equation:

Total chlorophyll:  $20.2(A_{645}) + 8.02(A_{663})$

Chlorophyll a:  $12.7(A_{663}) - 2.69(A_{645})$

Chlorophyll b:  $22.9(A_{645}) - 4.68(A_{663})$

### **Result and Discussion**

#### **Effect of organic and inorganic fertilizer on plant height**

Crop growth is highly relevant on plant height. To explore the impact of various treatments on the plants individually and in combination, plant heights were measured on three time intervals 20 Days, 40 Days, and 60 Days. The results reported in the table 1 show that plant heights vary significantly across treatments.

In the 15th day of vermicompost treatment show  $9.05 \pm 0.3$ cm, followed by NPK  $8.62 \pm 0.4$  cm and control  $8.25 \pm 0.5$  cm of plant height mentioned in the table 1 and represented in the Fig. 1. Similar growth of plant height was observed after 30 days and 45 days too. Plant height differences were induced by both genetic and environmental factors [Goyal *et al.*, 1999].

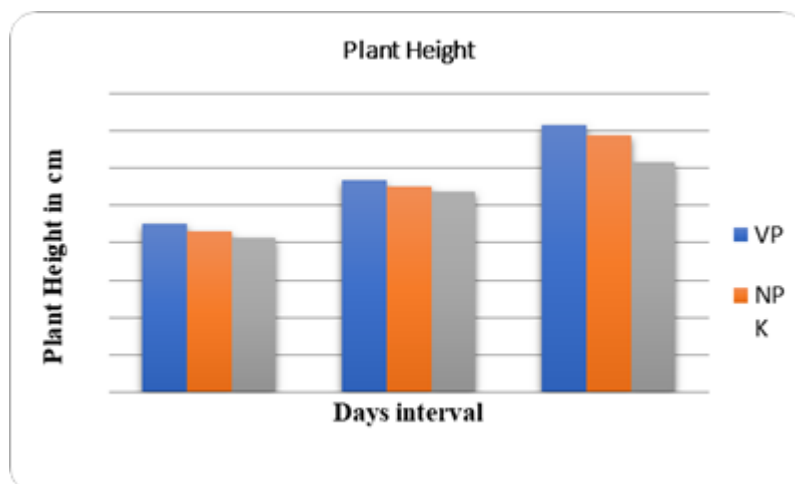


Figure 1: Effect of Organic and Inorganic fertilizer on plant height

Table 1: Effect of Organic and Inorganic fertilizer on plant height

Growth Media	Days Interval		
	15 Days Height (cm)	30 Days Height (cm)	45 Days Height (cm)
VP	9.05 ± 0.3	11.34 ± 0.3	14.34 ± 0.1
NPK	8.62 ± 0.4	11.04 ± 0.4	13.74 ± 0.1
Ctrl	8.25 ± 0.5	10.74 ± 0.4	12.29 ± 0.1

**Effect of organic and inorganic fertilizer on number of leaves**

The number of leaves in response to the organic and inorganic fertilizer is presented in Figure 2. The results showed that the organic and inorganic treatments produced higher number of leaf than those on control treatment.

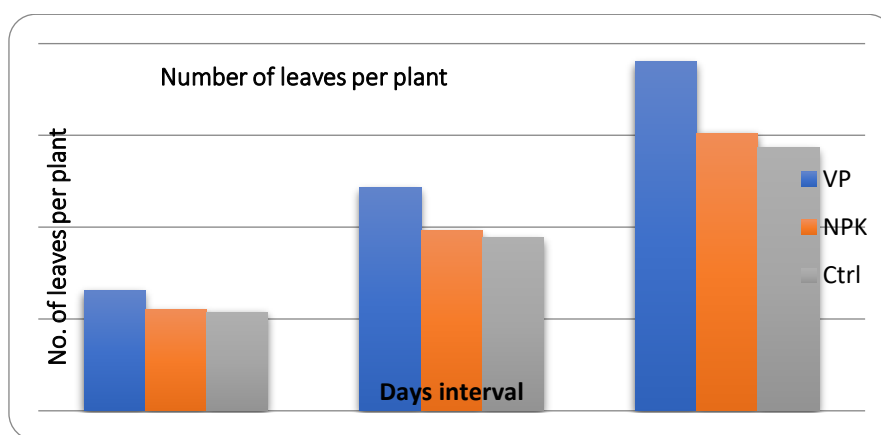


Figure 2: Effect of Organic and Inorganic fertilizer on Number of Leaf

The effects of growth media treatments on the leaf number are shown in fig 2. Organic (vermicompost) treatment showed relatively higher number of leaves compared to inorganic (NPK) treatment (Table 2). Quantitatively, the highest number of leaves 6.53 ± 0.6 plant<sup>-1</sup> was achieved after 15 days of organic treatment; meanwhile the organic treatment and control resulted in lower leaf number, *i.e.* 5.51 ± 0.3 and 5.38 ± 0.5 plant<sup>-1</sup>, respectively. In

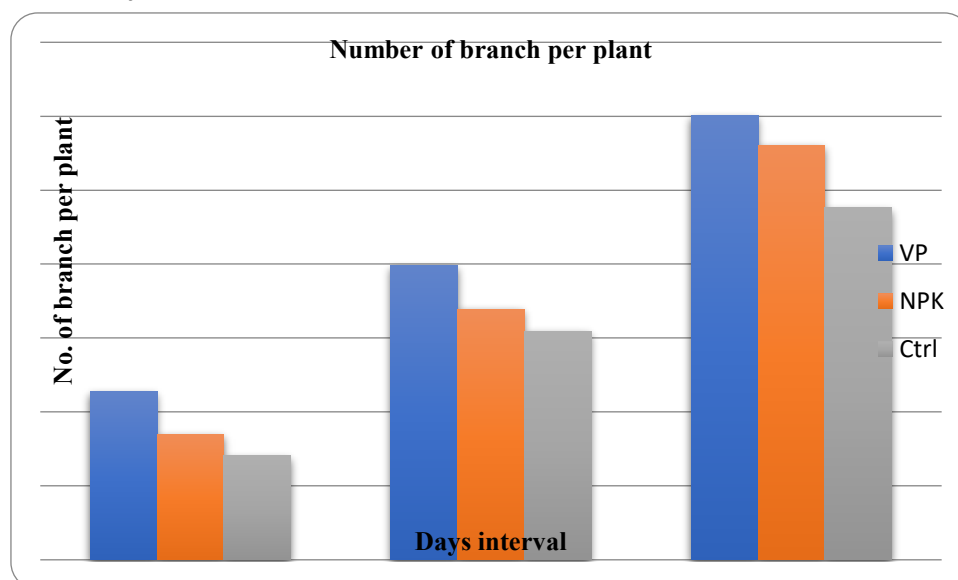
addition, 30 and 45 days after organic treatment showed highest leaf number that is  $12.14 \pm 0.3$  plant<sup>-1</sup> and  $19.01 \pm 0.5$  plant<sup>-1</sup> respectively then followed by Inorganic treatment and then control showed lower leaf number (Table 2). Genetic and environmental factors influence varietal features such as leaf number (16).

**Table 2: Effect of Organic and Inorganic fertilizer on Number of Leaf**

Growth Media	Days Interval		
	15 Days	30 Days	45Days
VP	$6.53 \pm 0.6$	$12.14 \pm 0.3$	$19.01 \pm 0.5$
NPK	$5.51 \pm 0.3$	$9.8 \pm 0.4$	$15.13 \pm 0.4$
Ctrl	$5.38 \pm 0.5$	$9.43 \pm 0.08$	$14.32 \pm 0.1$

**Effect of organic and inorganic fertilizer on number of branches per plant**

All over the experiment, the number of branches per plant was recorded at regular intervals on 15, 30 and 45 days. The study found that applying organic fertilizers enhanced the number of branches per plant. Organic fertilizer Treatment, which contained vermicompost, had the most branches per plant ( $2.27 \pm 0.3$ ), while the control had the fewest (1.41). The number of branches per plant at 30 Days differed considerably across treatments. Organic fertilizer, which included vermicompost, produced the most branches per plant ( $3.98 \pm 0.2$ ) when compared to the other treatments. In contrast, the control had the fewest branches per plant ( $3.09 \pm 0.03$ ). Furthermore, after 45 Days, all treatments demonstrated a significant increase in the number of branches per plant. Organic fertilizer had the most branches per plant ( $6.01 \pm 0.2$ ) of any treatment, while inorganic fertilizer had  $5.61 \pm 0.4$  and control had the fewest ( $4.76 \pm 0.13$ ) branches per plant. Varieties grown in appropriate agronomic and climatic conditions could exhibit variability in overall growth, which could be related to genetics and photosynthesis. This improves the absorption and utilization of radiant energy, resulting in maximum dry matter accumulation and the number of primary and secondary branches. Genetic and environmental factors can both contribute to variation (17).



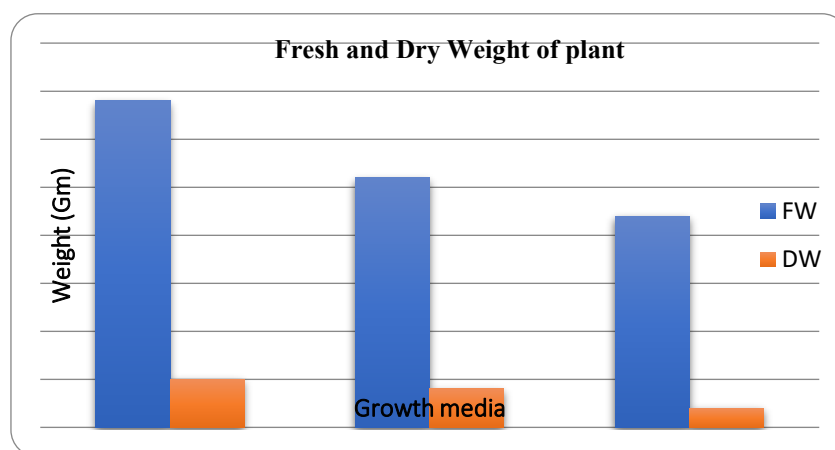
**Figure 3: Number of branch per plant**

**Table 3: Number of branches per plant**

Growth Media	Days Interval		
	15 Days	30 Days	45Days
VP	2.27± 0.3	3.98 ± 0.2	6.01 ± 0.2
NPK	1.7± 0.16	3.39 ± 0.4	5.61 ± 0.4
Ctrl	1.41 ± 0.09	3.09 ± 0.03	4.76 ± 0.13

**Effect of organic and inorganic fertilizer on plant fresh and dry weight**

Table 4 shows that the treatment of organic fertilizer showed significant increases in fresh weight as compared to inorganic and control.



**Figure 4: Fresh and Dry Weight of plant**

The organic treatment increased fresh and dry weight fenugreek plants compared to inorganic and control. The highest fresh and dry weight of fenugreek plant was achieved in organic treatment (vermicompost). (18) reported that the use of phosphate solubilizing microorganisms significantly improved maize plant growth, both qualitatively and quantitatively.

**Table 4: Fresh and Dry Weight of plant**

Growth media	Fresh Weight (Gm)	Dry Weight (Gm)
VP	0.34	0.05
NPK	0.26	0.04
Ctrl	0.22	0.02

**Chlorophyll and protein content of plant**

The vermicompost treatment significantly increased the chlorophyll and protein content in fenugreek plants (Table 5 & 6). The maximum protein content in and chlorophyll content in leaves (0.29, 0.1 and 0.4 mg g<sup>-1</sup>) was recorded treatments as compared to inorganic and control. This might be due to the application of vermicompost to legume crop increased the availability of nitrogen. Nitrogen is one of the main constituents required for protein and chlorophyll synthesis, therefore increased nitrogen absorption enhanced the seed protein and chlorophyll content (19).

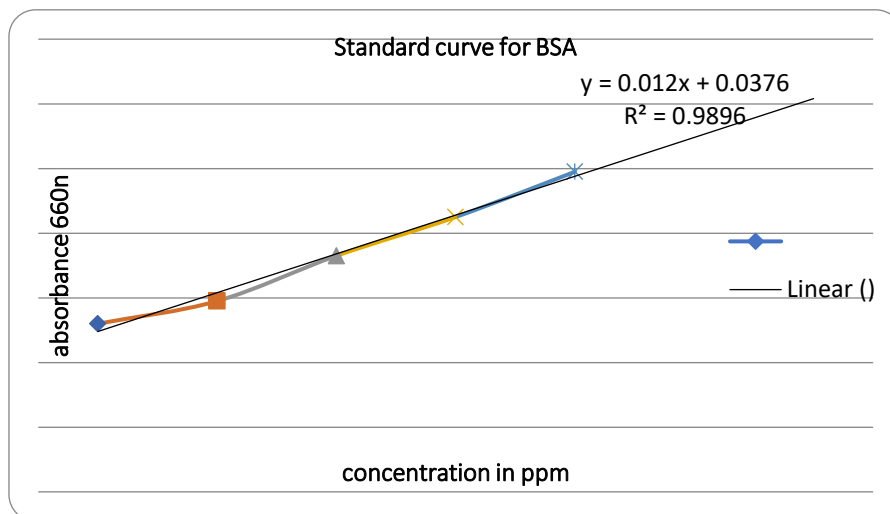


Figure 5: Standard curve of Bovin serum albumin

Table 5: Protein concentration

Growth media	Protein concentration(µg/ml)
VP	13.03
NPK	7.95
Ctrl	7.45

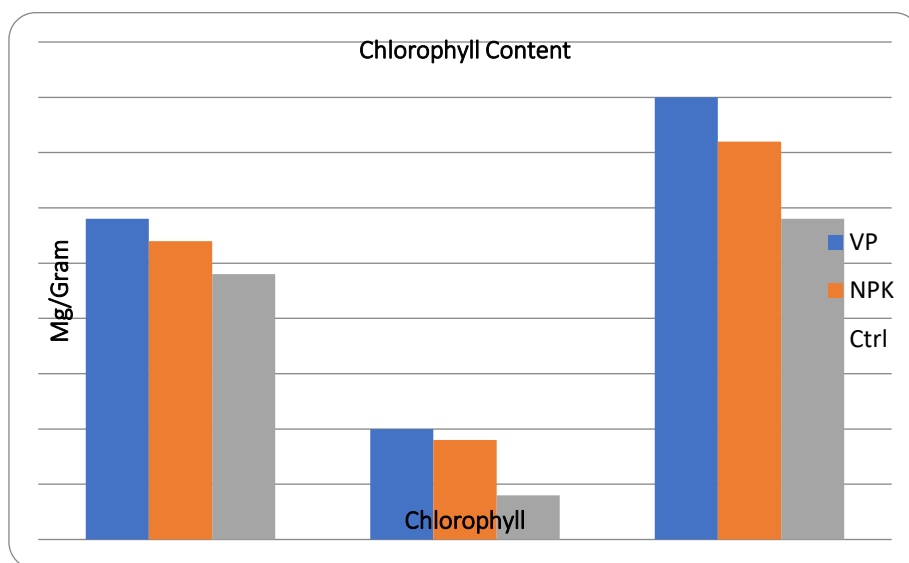


Fig 6: Chlorophyll content of plants

Table 6: Chlorophyll content of plants

Growth media	Chl-a (mg g-1)	Chl-b (mg g-1)	Total Chl (mg g-1)
VP	0.29	0.1	0.4
NPK	0.27	0.09	0.36
Ctrl	0.24	0.04	0.29

## Conclusion

Vermicompost considered a valuable organic fertilizer as it supplies nutrients for the crop which results in saving cost of chemical fertilizers. Besides, it provides all the essential macro and micro nutrients in readily available forms, enhances uptake of these nutrients by the plants and play a major role in improving growth and yield of crops. vermicompost also acts as a niche for microbes and enriches the soil with a variety of the indigenous microflora and fauna. The study revealed that growing Fenugreek *Trigonella foenum graecum* with vermicompost resulted in significantly higher plant growth, as studied parameters were showed healthy and vigorous growth in vermicompost treatment.

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