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## **EFFECT OF *SPIRULINA PLATENSIS* ON GROWTH OF FENUGREEK AS A BIOFERTILIZER**

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### **ABSTRACT**

An experiment was conducted on the campus of Women's Christian College, Chennai during May-June 2022 to evaluate the effect of *Spirulina platensis* as a biofertilizer to enhance the growth of fenugreek. The experiment was conducted with five treatments viz Control, Macronutrients (NPK), Micronutrients, foliar application of *Spirulina* and seeds coated with *Spirulina* following completely randomized complete block design with three replications. The foliar application of *Spirulina platensis* and seeds coated with *Spirulina* showed an increase in yield as compared to Control. The efficacy of the treatment proved that *Spirulina platensis* is a suitable bio stimulant for safe and organic crops.

**Keywords:** *Spirulina platensis* · Foliar application · Seed coating · Biostimulant · Biofertilizer

### **INTRODUCTION**

Healthy soil help plants to grow well and yield their maximum productivity. Indian soils are deficient of the primary nutrients (Nitrogen, Phosphorus and Potassium) and secondary nutrients (Sulphur, Calcium and Magnesium) and micronutrients (Boron, Zinc, Copper and Iron) in most parts of the country. Besides the three primary nutrients (N, P, K), deficiency of Sulphur and micro

nutrients like Zinc, Boron, Iron, Manganese and Molybdenum become a limiting factor in increasing food productivity. The decrease in soil fertility could be due to various parameters such as continuous cultivation, soil erosion, nutrient loss and un-balanced nutrient compensation [1]. To increase food supply, chemical fertilizers have been used for cultivating various

crops. It is a well-known fact that these chemical fertilizers have detrimental effects on the environment as they cause accumulation of nitrogen and phosphorus. At high concentrations, chemicals do not have a significant impact on crop yield [2].

The use of algal formulations, especially cyanobacteria enhance soil fertility, crop growth yield in sustainable agriculture. The use of dried cyanobacteria to inoculate soil in order to increase fertility is called “algalization”. Cyanobacterial biomass improves soil physicochemical characteristics such as water-holding capacity and mineral status of the degraded soils [3].

Cyanobacteria have been known to make soil porous and produce adhesive substances, excrete vitamins, amino acids and phytohormones [4,5], improve the water - holding capacity of the soil, decrease soil salinity [6], control weed growth, absorb heavy metals [7] and improve the availability of soil phosphate [8].

*Spirulina* formulations are biostimulants used for plant growth. *Spirulina platensis* is a rich source of nutrients for plants. It is an efficient biofertilizer as microalgal biomass provides a rich source of metabolites in agriculture [9]. *Spirulina platensis* is capable of fixing atmospheric nitrogen which plays an important role in

building soil fertility. Researchers have shown that the concentration of soil nutrients such as organic carbon, nitrogen, phosphorus and potassium are a good indicator of soil quality and soil productivity which is due to the favorable effects on the physico-chemical and biological properties of the soil. Application of biofertilizers are increasing daily because of their non-toxic nature and they are a solid source of nutrition for the plant [10]. Liquid organic fertilizers contain essential plant nutrients that will improve soil fertility through increased nutrient availability and efficient nutrient uptake by the plants leads to crop growth and development [11,12].

## MATERIALS AND METHODS

The experimental design was factorial split plot design. The experiment was conducted with five treatments viz Control, Macronutrients (NPK), Micronutrients, foliar application of *Spirulina* and seeds coated with *Spirulina* following completely randomized complete block design with three replications. Fenugreek seeds were used in this experiment and *Spirulina platensis* as a dried powder was used as a biofertilizer.

The pots had a mixture of red soil: sand: vermicompost in the ratio 1:1:1. The second treatment had macronutrients viz NPK fertilizer in addition to the soil

mixture. The composition of NPK added was 6% N, 12 % P and 6% K. The third treatment had micronutrients with 7 % magnesium, 1.8% zinc, 0.8 % iron, 0.3 % boron, 0.3 % copper and 0.1% molybdenum. In the fourth treatment, 1g of the dried *Spirulina platensis* powder was diluted in 1 litre of RO water and applied as a foliar application. Foliar application was done daily. Seeds were coated with 500 µl per 1 g of fenugreek seeds and the sown seeds were watered daily.

Fenugreek seeds were soaked for 24 hours before sowing in the pots. Each pot had 10 seeds and weeding was done periodically. After a period of 10 days, the plants were chosen and the efficacy of the treatments were evaluated on the basis of shoot length, root length, fresh mass, and greenness index of the leaves.

Seedling shoot and root length of randomly selected seedlings from each replication were measured at the time of harvest (14 days after treatment application) by using a scale. After final count, final germination percent (FGP) were calculated by the following formulae [13,14].

$$FGP = \frac{\text{Number final germinated seeds}}{\text{Total number of seed tested}} \times 100$$

#### Chemical analysis

500 mg of fresh leaf material was homogenized in 80% acetone and ground in a mortar with a pestle. The solution was centrifuged at 3000 rpm for 15 minutes and

the supernatant was stored. Residue was re-extracted with 5 ml of 80% acetone. The extract was used for chlorophyll estimation. Absorbance was read at 645 nm and 663 nm in Shimadzu UV spec [15].

Chl a  $12.7 A_{663} - 2.69 A_{645}$

Chl b  $22.9 A_{645} - 4.68 A_{663}$

Total chlorophyll (mg/ml) = Chl a + Chl b

#### Soil Fertility Analysis

Soil fertility parameters (OC %, available Nitrogen, phosphorus and potassium, Electrical conductivity and pH) were quantitatively analyzed after the plant harvest. The soil samples were submitted for soil analysis to Tamil Nadu Soil testing lab in Chennai.

### RESULT AND DISCUSSION

#### Morphological analysis of *Trigonella foenum-graecum* plants

The experimental evidence proved that the plants cultivated in the soil enriched with *Spirulina* showed an increase in plant height when compared to the Control group and seeds germinated in soil enriched with NPK or micronutrients. In the present study, when all the data was examined, it was observed that application of *Spirulina* in the soil has a positive effect on seed germination and the growth of the plant (**Figure 1**). *Spirulina platensis* accelerates seed germination and has a biostimulant effect for the plant growth (**Table 1**). Grzsesik *et al.*, 2017 [16] observed that

application of cyanobacteria increased the height of willow plants.

### Biochemical analysis of *Trigonella foenum-graecum* plants

Pigments also play a role as an index of plant growth and production of organic matter. Chlorophyll pigment extraction using Arnon's method [15] was measured by a spectrophotometer. The total chlorophyll content was highest in the Control plants and then the plants enriched with NPK, *Spirulina* and seeds primed with *Spirulina* (Table 2). The addition of soil nutrients should enhance the physiological and growth processes in the plants.

### Soil Fertility Analysis

Soil fertility parameters (OC %, available nitrogen, phosphorus and potassium, Electrical conductivity and pH) were quantitatively analyzed after the plant harvest. Soil treated with *Spirulina* and

pots which contained seeds primed with *Spirulina* showed higher values of nitrogen, phosphorus, potassium and EC as compared to the soil in the Control pots. This could be due to the fact that *Spirulina* is involved in nitrogen fixation and has a synergistic effect with the roots of the plant enhancing its growth. The organic carbon % was maximum in the Control pots and in the pots with *Spirulina* and seeds coated with *Spirulina*. The EC varied from 0.12 to 0.370 ds/m and pH range varied from 6.42 to 9.26 (Table 3).

*Spirulina platensis* has been shown to act as a biofortification agent, enhancing plant growth and increasing crop yield [17,18]. Dried algal biomass grown by anaerobic digestion from dairy manure increased plant available nitrogen and phosphorus in soils over three weeks thereby improving cucumber and corn seedling growth [19].



Figure 1: Growth of the *Trigonella foenum graecum*

Table 1: Morphological parameters of *Trigonella foenum graecum* in soil

S. No.	Treatment	Germination %	Shoot length (cm)	Root length (cm)	Fresh weight (g)
1	Control	100	6.72	2.78	2.56
2	NPK	97	6.12	1.19	2.70
3	Micronutrients	97	4.43	1.64	1.79
4	<i>Spirulina</i>	100	7.93	2.55	5.12
5	Seeds coated with <i>Spirulina</i>	97	6.72	1.77	4.10

Table 2: Determination of Chlorophyll a, b and total chlorophyll of *Trigonella foenum graecum* using spectrophotometric absorbance

Plant Pigments (mg/g fresh weight)	Control	NPK	Micronutrients	<i>Spirulina</i>	Seeds coated with <i>Spirulina</i>
Chlorophyll a	0.282	0.107	0.080	0.110	0.083
Chlorophyll b	0.100	0.028	0.016	0.025	0.033
Total Chlorophyll	0.382	0.135	0.096	0.135	0.116

Table 3: Physicochemical properties of soil

Treatment	Organic carbon (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)	EC (ds/m)	pH
Control	22.58	0.03	0.08	0.03	0.120	9.26
NPK	8.52	0.22	0.29	0.09	0.301	6.89
Micronutrients	6.30	0.272	0.18	0.09	0.370	6.42
<i>Spirulina</i>	18.80	0.421	0.27	0.086	0.160	7.92
Seeds coated with <i>Spirulina</i>	10.72	0.169	0.29	0.06	0.122	8.36

## CONCLUSION

This study has shown that application of *Spirulina* in the soil acts as a suitable biostimulant which increases the germination rate and growth of the fenugreek plants. Farmers can easily apply this to the soil or prime the seeds in order to increase organic crop production. *Spirulina* has been shown to enhance plant growth and improve the soil's physico-chemical properties. Biofertilizers which contain cyanobacteria are natural and have an edge over chemical fertilizers as they are highly beneficial to plants and increase the plant's productivity.

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## CONFLICT OF INTEREST

The authors have no potential conflict of interest. The disclosure of potential conflict of interest in the prescribed format has been obtained from all the authors.

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