



A STUDY ON THE EFFECT OF APPLICATION OF PSEUDOMONAS FLUORESCENS BIOFERTILIZER ON THE GROWTH & DEVELOPMENT OF FENUGREEK (TRIGONELLA FOENUM GRAECUM)

¹Sreepriya M.S, ²Divya J, ³Vasudha Ranjan

¹Post graduate Student, ²Assistant Professor, ³Research Scholar

¹Department of Environmental Science,

¹JSS Academy of Higher Education and Research, Mysore-15, India

Abstract: The world's population is growing at an accelerating rate, and the loss of natural energy resources threatens the sustainability of food and energy supplies as well as the environment. Due to the increasing demand of agricultural products which results from rapid increase in urbanization, it has become essential for a method to increase agricultural productivity by using various means to increase agricultural yields. Thus, using biofertilizers, now considered as an environmentally viable strategy. Biofertilizer improve soil health and plant growth, particularly in terms of their role in nitrogen cycle and soil nutrient characteristics. The present study was aim to investigate the impact of biofertilizer like Pseudomonas fluorescens application on the growth and development of fenugreek plants (Trigonella foenum-graecum). Various growth parameters, including the germination index, shoot length, root length, and leaf count, were measured and compared with respect to different concentrations of the biofertilizer treatments to the control. From the study, it shows that, using Pseudomonas fluorescens biofertilizer could improve the growth of fenugreek.

Index Terms - Biofertilizer, Fenugreek, Pseudomonas fluorescens, Germination index, Growth parameters.

I. INTRODUCTION

Biofertilizers are biological products made up of living microorganisms, when applied to soil, plant surfaces, or seeds, it stimulates the growth through a variety of mechanisms, including boosting the plant's ability to absorb nutrients, increase the amount of nutrients available, and increases the biomass or area of the roots [2]. Thus, there are two main reasons why biofertilizer is required. First, since more fertilizer is used, crop production rises; second, because more chemical fertilizer is used, the soil texture is harmed and other environmental issues will raise [3]. Both economically and physiologically, biofertilizers have a clear agronomic benefit over traditional chemical fertilizers. According to the farmer's survey, biofertilizers are preferred over chemical fertilizers. To promote the protection of soil health and plants, many research studies showed the major cause of shortages and the slow growth of biofertilizers usage in the Indian agricultural sector[4].

The type or group of microorganisms present in biofertilizers determines their classification into distinct categories. Among the several kinds of biofertilizers in use, to mention a few are nitrogen-fixing biofertilizers, phosphate solubilizing biofertilizer, phosphate mobilizing biofertilizer, plant growth-promoting biofertilizer, and sulfur-oxidizing biofertilizers. The phosphate solubilizing biofertilizers (PSBs) includes *Aspergillus* species, *Pseudomonas* species, and *Bacillus* species.

They function by dissolving the phosphate in the soil that is insoluble, so that the plants can utilize it. The majority of the phosphorus in the soil is found as insoluble phosphate, which is not being absorbed by the plants. Nevertheless, a number of fungi and bacteria found in soil can change these insoluble phosphates into soluble form, this can be achieved by releasing organic acids into the soil, which lower the pH and dissolve bound forms of phosphate, making them available to plants [5]. *Trigonell foenum-graecum* L., or fenugreek, is a significant condiment crop. The crop is rich in essential oils, protein, and vitamins and has a vast medicinal value. The crop is also very important to the agricultural economy because it has a great potential for export and brings in a significant amount of commercial value.

The biofertilizer which was chosen in the present study is *Pseudomonas fluorescens* (TNAV STRAIN). The *Pseudomonas fluorescens* is a bacterium that functions as a biofertilizer and has fungicidal qualities. *Pseudomonas fluorescens* is well-known for its capacity to produce a wide range of secondary metabolites, such as antifungal and antibiotic substances. *Pseudomonas fluorescens* has the ability to activate the plant's defense mechanisms. *P. fluorescens* has the ability to provide systemic resistance in plants against fungi and other pathogens. The crops that are mainly used for these biofertilizer are tomato and chilli seedling. This biofertilizer can be used in two methods one is before sowing and other is the foillar spraying. Since it is one among the most frequently used biofertilizer on most of the vegetables, there was less report on the application and the impact green leafy vegetables. Since fenugreek is used for the present study among the most commonly used green leafy vegetable in the form of healthy diet supplement.

Fenugreek (*Trigonella foenum-graecum*) is a fragrant herb belonging to the Fabaceae family of peas, and its flavorful, dried seeds are used as a spice. Northern Africa, western Asia, India, and central and southeast Europe are the regions where fenugreek is grown. It is indigenous to the Mediterranean region and southern Europe. Fenugreek plants are less than one meter (3 feet) tall with loose branches, erect, and have tiny white flowers and trifoliolate light green leaves. The slender, beaked pods can grow up to 15 cm (6 inches) in length and are coiled. The seeds are yellow-brown, flat rhomboids with a deep furrow that are less than 0.5 cm (0.2 inch) long. They contain the alkaloids trigonelline and choline[5]. Fenugreek is a great plant for green manure and nitrogen fixation in agriculture since it can fix nitrogen, just like other plants in the legume family.

II. RESEARCH METHODOLOGY

2.1 Collection of soil samples and designing experimental set up: A composite soil sample were collected, grinded and passed through 2 mm mesh sieve in order to get uniform size of soil particles. For the preparation of pots with different concentration of biofertilizer in soil. Seven polythene pots were collected. Carrying 1 Kg capacity of each. The soil sample that were used for the study was free from all forms of soil amendments. The biofertilizer were purchased from the agrochemical shops, which contains 0.5% W.P. of *Pseudomonas fluorescens*. Each pot were filled with processed soil sample and placed 15 fenugreek seeds and added water at tracer quantity to maintain moisture level in all the treatments. The experimental set up were kept for observation till the germination occurs. After germination, the ratio of concentration of application of *P. fluorescens* biofertilizer are presented as fallows.

Ratio of *Pseudomonas fluorescens* biofertilizer

- 2.5 g biofertilizer in 500ml water
- 5 g biofertilizer in 500ml water
- 10 g biofertilizer in 500ml water
- Control

2.3 Experimental section: The seeds of fenugreek (*Trigonella foenum-graecum*) were planted in seven distinct pots. One control and for each concentrations (2.5 g, 5 g and 10 g) two trials were maintained. The biofertilizer solutions at different concentrations were sprayed on alternate days to the fenugreek seeds till it attains germination. For the complete growth of fenugreek the total time taken was 2 months. After that, the matured fenugreek plants were taken out subjected for the evaluation of growth parameters

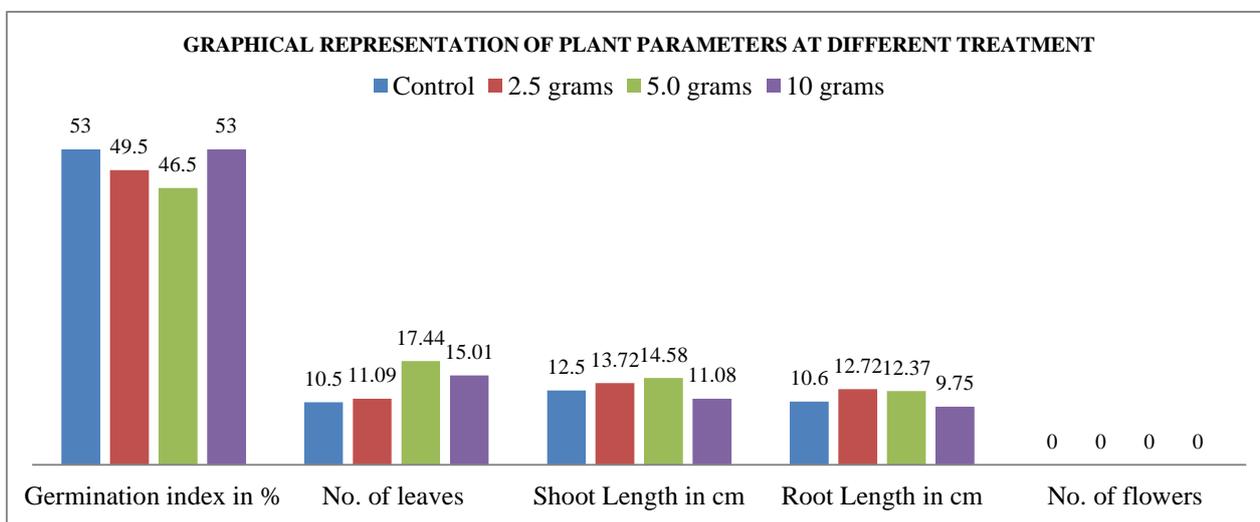
2.4 Observation of seed germination and growth parameter: After three days of sowing, the seeds begin to germinate. The total number of seeds that were germinated is counted on the twentieth day. The 20th day count served as the basis for calculating the germination percentage. After sixty days, the remaining parameters were measured.

- **Germination Index %**=Number of seeds germinated/ total number of seeds sowed x100
- **Measurement of Shoot length:** Using a centimeter scale, the shoot's length was determined from base to tip. By calculating the mean in each culture pot and recording the values, the average shoot length was determined.
- **Measurement of Root length:** A centimeter scale was used to measure the root's length from the tip to the root collar region. By calculating the mean of each treatments, the average root length was recorded.
- **Number of leaves:** The total number of leaves on the plant was counted, and the average values were recorded.

III. RESULTS AND DISCUSSION

Table 3.1 Results of Fenugreek Growth Parameters

Treatments	Trials	Germination Index (%)	No. of leaves	Shoot length (cm)	Root Length (cm)	No. of flowers
Control	Trail -1	53	10.5	12.5	10.6	Nil
2.5 g	Trail -1	53	11.42	12.75	12.25	Nil
	Trail-2	46	10.75	14.7	13.2	Nil
	Mean value	49.5	11.09	13.72	12.72	Nil
5 g	Trail-1	40	23.5	17.3	13	Nil
	Trail-2	53	11.37	11.87	11.75	Nil
	Mean value	46.5	17.44	14.58	12.37	Nil
10 g	Trail -1	60	17.01	17.16	9.8	Nil
	Trail-2	46	13.01	15	9.7	Nil
	Mean value	53	15.01	11.08	9.75	Nil



During the present study, the evaluation of impact of *Pseudomonas fluorescens* Biofertilizer application on fenugreek plant was studied and the results are presented in terms of various plant growth parameters.

3.2 Variation in germination index: Germination index is calculated using the formula, the number of seeds germinated/Total no of seeds sown X100. Among the sown 15 seeds in all the treatments, the number of seeds germinated was recorded. The germination index was varied in all the treatments. The germination index in control was found to be 53%. The germination index in 2.5 g biofertilizer treatment was 49.5%. The germination index in 5 g biofertilizer treatment was 46.5%. The germination index in 10 g biofertilizer treatment was 53%. From the results, it shows that, higher percentage of germination index was observed in 10 g followed by 2.5 g and 5 g *Pseudomonas fluorescens* Biofertilizer treatments.

3.3 Variation in number of leaves: The number of leaves was counted manually. The total number of leaves in each plant was counted, the mean values of two trials were recorded. In all the treatments, the variation in number of leaves was observed. The average number of leaves produced in control was 10.5. The number of leaves in 2.5 g was 11.09. The number of leaves in 5 g was 17.44. The number of leaves observed in 10 g was 15.01. From the study, it was observed that, 5 g biofertilizer treatment showed greater number of leaves formation in fenugreek plant.

3.4 Variation in shoot length: The shoot length was measured from the base to the tip of the shoot using centimeter scale. It was observed that, the average mean value of the shoot length of the plants in control was found to be 12.5 cm. The shoot length in 2.5 g biofertilizer treatment was 13.72 cm. The average shoot length in 5 g biofertilizer treatment was 14.58 cm. The average shoot length in 10 g biofertilizer treatment was found to be 11.08 cm.

3.5 Variation in root length: The length of the root was varied in all treatments. The average root length of plant in control was 10.6 cm. The average root length in 2 g biofertilizer treatment was 12.72 cm. The average root length in 5 g biofertilizer treatment was 12.37 cm. The average root length in 10 g biofertilizer treatment was 9.75 cm.

IV. SUMMARY AND CONCLUSION

From the present investigation, the following observation has been made. In control, the roots and shoot development were found normal. The average germination index was found to be as 53%. The average shoot length observed was 12.5 cm. The average root length was 10.6 cm. The average leaf count was 10.5. In 2.5 g treatments, the average germination index was 49.5%. The average shoot length was 13.72 cm, the average root length was 12.72 cm and the average leaf count was found to be 11.09. In 5 g treatments, the fenugreek plants growth parameters were found to be slightly higher than the control values. The average shoot length observed was 14.58 cm and the average root length was found to be 12.37 cm with average leaf count was 17.44. In case of 10 g treatments, the growth parameters showed, germination index of 53%. The average shoot length was 11.08 cm. The average root length was 9.75 cm. The average leaf count was 15.01. From the experimental study, it was observed that, during the study period, in all the treatments, the flowers formation was not found. The current study shows the impact of application of *Pseudomonas*

fluorescens biofertilizer on growth and development of fenugreek (*Trigonella foenum-graecum*) plants. From the results obtained, one can state that, even though few growth parameters found varied in all the treatments, the ideal concentration was found to be 5 g with moderate rate of germination percentage with greater growth of fenugreek plant. Similarly, in 10 g treatments, the reduction in the growth parameters like shoot length and root length was observed in comparison to control. So even though good germination index was observed in 10 g treatment, the higher rate of application of *Pseudomonas fluorescens* biofertilizer will have a negative effect on the growth and development of fenugreek. From the study, one can suggest that, appropriate rate of application of *Pseudomonas fluorescens* biofertilizer is essential in order to reduce the negative impact.

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VI. REFERENCES

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