EFFECT OF USED TEA POWDER ON FENUGREEK SEEDS GERMINATION AND PLANT DEVELOPMENT

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Running title: Used tea powder effect on Fenugreek germination

Abstract

Effect of various concentrations of bio waste, used tea powder on the emergence of seedlings, and growth of Fenugreek (Trigonella foenum-graecum) plant is observed in the experiment. There is a significant variation in the results among the treatments [2gm (2t) and 5gm (5t) used tea powder respectively) when compared with the control. The percentage of emergence of cotyledons, secondary roots and leaves of Fenugreek was more in the treatments of 5t2, 2t2, 2t1 as compared with control. The development of secondary roots was noteworthy in 5t2 treatment. The survival percentage of plantlet was more in 5t2, 2t1 and 2t2 when compared with control. The length of plantlet also followed the same trend. In all the above parameters best results were observed in the 5t2 set. The organic waste i.e. used tea powder in 1:1 proportion with soil is good source for fenugreek plant growth.

Key words: *Used Tea powder, Fenugreek, organic fertilizer, seed germination*

1. Introduction

India produces a wide range of spices and holds a prominent position in world spice production. Fenugreek (*Trigonella foenum-graecum*) is an annual plant in the family Fabaceae, with leaves consisting of three small obviate to oblong leaflets. The seeds are used as spice worldwide, whereas the leaves are used as green leafy vegetables in the diet. It is eaten as a vegetable in some places and is used as fodder in northern Africa. This plant decreases the blood glucose level and also have antioxidant and antibacterial activity (Saleh A. A. et al., 2024). This is an old medicinal plant which contains active constituents such as alkaloids, flavonoids, steroids, Saponins etc (Branch, 2013). Fenugreek seeds and leaves are anticholesterolemic, anti-inflammatory, antitumor, carminative, demulcent, deobstruent, emollient, expectorant, febrifuge, galactogogue, hypoglycaemic, laxative, parasiticide, restorative and uterine tonic, and useful in burning sensation (Moradi kor et al. 2013).

The major nutrients present in inorganic fertilizers are nitrogen, phosphorus and potassium which, when applied in large quantities to the plant are harmful for soil and environment. The excessive use of chemical fertilizers reduces soil fertility, alters soil pH, decrease useful microorganisms in soil which reduces the plant performance causing its stunted growth (Pahalvi et al., 2021, Adediran et al. 2005). At the same time the use of organic manures is being neglected due to several reasons even though they have substantial advantages over chemical fertilizers.

The degradation of environment due to chemical fertilizers can be reduced by practicing organic farming. Bio fertilizers are eco-friendly and add nutrients through the natural processes of nitrogen fixation, solubilizing phosphorus, and stimulating plant growth through the synthesis of growth promoting substances (Quintern 2006; Suhag 2016). Most of the agriculture waste can also be used as fertilizer which improves quality of soil (Anand et al. 2020) and thus minimize the pollution by this waste. This organic waste provides various nutrients to the soil and increases its productivity (Tejada and Gonzalez 2006, Tejada et al. 2007, Padmavathiamma et al. 2008). The tea leaves contain various important plant growth nutrients like potassium (K), phosphorous (P), Nitrogen (N) and Tannic acid, which increase the soil nutrients, strengthen root system of plants and improves overall plant growth through tea decomposition (Wazir et al., 2018). Composting is an eco-friendly process for recycling organic matter and nutrients. This study compared municipal solid waste (MSW) and agricultural composts in terms of nutritional quality, physico-chemical properties, and heavy metal concentrations. Both composts met EPA safety standards, though MSW compost had higher salts and metal ions. Germination tests with Fenugreek showed that MSW compost was more favorable for growth. The study concluded that both composts are safe for agricultural use, with MSW compost offering added micronutrients beneficial for soil enrichment (Shyamala and Belagali, 2015)

Hence, a project study was taken up with an aim to investigate the effect of bio waste i.e. used tea powder on the seedling's emergence, growth and productivity of Fenugreek.

The objectives of the present study are: 1. To evaluate the effect of bio waste on the emergence of seedlings of Fenugreek 2. To evaluate the effect of bio waste on the growth parameters such as plantlet length 3. To evaluate the effect of bio waste on the biomass of Fenugreek plant 4. To evaluate the reuse of bio waste from plant origin (Used Tea powder) as a bio fertilizer 5. Comparative study of various concentrations of bio waste i.e. used tea powder on the Fenugreek.

MATERIALS AND METHODS

Experimental setup: Experiment was carried out from 20th January to 27th February, 2024 at Zoology department of Dr D. Y. Patil College, Pimpri, Pune M/S India.

The experiment was conducted in Randomized Completely Block Design (RCBD) comprising of two different ratios of soil and used tea powder mixtures.

Fenugreek (Trigonella foenum-graecum) plant was selected for the present study. Bio waste (Used Tea powder): Used tea powder was collected from the local tea stall.

Fenugreek seeds were procured from the agricultural shop.

Seeds germination experimental design:

1. Seeds in used tea powder solution for 96 h (Ten replicates of 2t1): 2gm Used tea powder + 8gm Soil
2. Seeds in used tea powder solution for 24 h then in normal water (Ten replicates of 2t2): 2gm Used tea powder + 8gm Soil
3. Seeds in used tea powder solution for 96 h (Ten replicates of 5t1): 5gm Used tea powder + 5gm Soil
4. Seeds in used tea powder solution for 24 h then in normal water (Ten replicates of 5t2): 5gm Used tea powder + 5gm Soil
5. Seeds in normal water for 96 h (C): Untreated control:

Pot germination experimental design:

1. Seeds in used tea powder (Ten replicates of 2t): 2gm Used tea powder + 8gm Soil
2. Seeds in used tea powder (Ten replicates of 5t): 5gm Used tea powder + 5gm Soil
3. Seeds in soil (C): Untreated control

Seed germination:

A mixture of two grams of tea powder and eight grams of soil was taken in glass funnel and water was added. The mixture was stirred for some time and allowed to settle. Later the supernatant was collected in a test tube and added in a petridish. 50 seeds were kept in it for 96 hours and three sets of it was made (2t1a, 2t1b and 2t1c). Another three sets (2t2a, 2t2b and 2t2c) were made as mentioned above in which 50 seeds were kept in petridish containing above mixture for 24 hours and in normal water for another 72 hours. Then three sets (5t1a, 5t1b and 5t1c) were made in which the ratio of soil and tea powder in the supernatant which was substrate in petridish was 5:5. These three sets consisting of 50 seeds in each petridish were also kept for 96 hours. Another three sets (5t2a, 5t2b and 5t2c) were made as mentioned above in which 50 seeds were kept in petridish containing above mixture for 24 hours and in normal water for another 72 hours. One set with 50 seeds were kept in petridish containing water for 96 hours maintained as control. After four days germination was observed.

Pot experimental design:

37 plastic glasses each with a diameter of 5.5 cm at the top and 2.3 diameter at the bottom were taken. These glasses were filled with the loamy soil and the tea powder mixture. In 2t1 sets and 2t2 sets ratio of tea powder and soil was 2:8 in which the quantity of soil was 800 gm and quantity of tea powder was 200gm in 1kg of mixture. Three sets of these were made. In the 5t1 sets and 5t2 sets ratio of tea powder and soil was 5:5 in which the quantity of soil and tea powder were 500gm each in 1kg of mixture. Three sets of these were made. In the control sets (C1 and C2) only soil was added.

Used tea powder was collected from tea stalls around our college campus and from our house. Fenugreek seeds were bought from Shrinath fertilizer shop, Loni Kalbhor, Tal. Haveli, Dist.: Pune 412201. Four germinated seeds were sown in each glass.

Growth of roots, leaf and cotyledons were observed. The changes in the seedling were noted at intervals of 2 to 3 days. The complete data of the experiment was presented.

RESULTS AND DISCUSSIONS

Used tea power is good source of fertilizer. It contains lignin cellulose, secondary metabolites, minerals, amino acids etc.

In the present study, after 96 hours of respective treatments in the petridish, the sprouting of the seeds of fenugreek was observed. Then the seeds were sown. After one week of sowing the seeds of fenugreek, the emergence of the seedlings was observed. The development of the roots was observed, the number of seedlings giving rise to the cotyledons and leaves were noted and the percentage of roots, cotyledons and leaves emergence was calculated. The survival percentage of the plantlet was also calculated. The length of plantlet from the sets were measured and the average length of plantlet present in each set was calculated.

The seeds of the sets 2t1 and 5t1 which were given water treatment for continuous 96 hours with the various ratios (2:8 and 5:5) of supernatant of tea powder and soil water did not sprout. While the other set 2t2 and 5t2 with 24 hours of water treatment with supernatant and 72 hours of normal water treatment showed good sprouting when compared with the control set (C) (Figure.1).

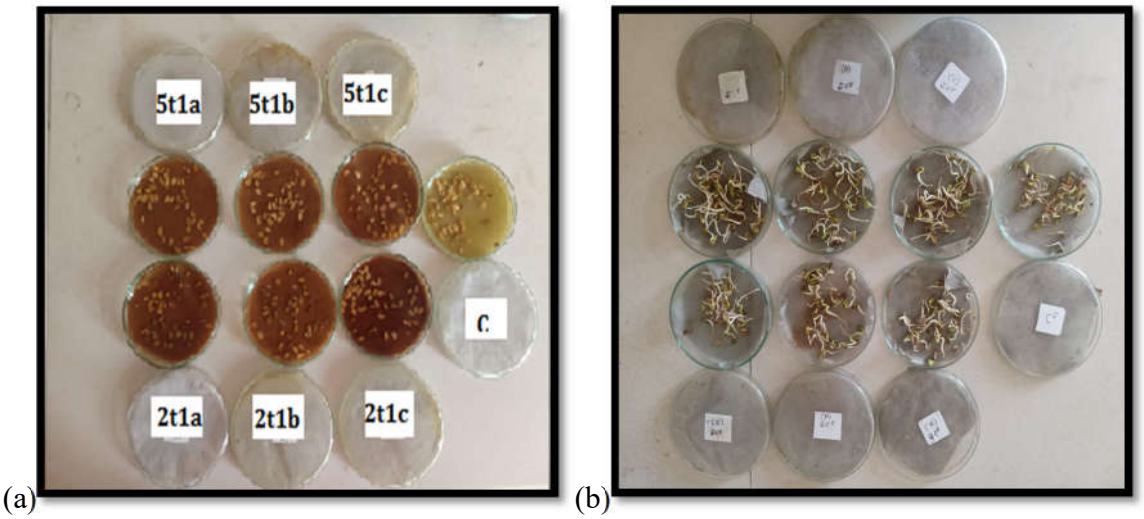


Figure 1: The germination of Fenugreek seeds after 96 hours of respective supernatant treatment (a) Experimental setup (0 hrs), (b) Experimental setup (96 hrs)

The treatment of seedlings with various ratios of the soil and tea powder showed significant result. The number of seedlings giving rise to cotyledons was highest in the 5t2, then the moderate result of 2t2 and 2t1 with the lowest result of 5t1 set when compared with the control (Figure 2). The number of seedlings giving rise to secondary roots was highest in the 5t2 set followed by 2t2, 2t1 and the lowest result of 5t1 set when compared with the control. Thus, the development of secondary root was better in 5t2 set compared to other sets (Figure 3a). A similar trend was observed after approx. two weeks of sowing. After one week of sowing no

leaves emerged out from any set. After second week of sowing the number of seeds giving rise to the leaves were same in 5t2, 2t1, and 2t2 with the lowest result of 5t1 upon comparison with control set (Figure 3b). Bhavana et al., (2021) had reported that Different pre-sowing seed treatments, including various leaf extracts, cow dung, and cow urine, were tested against untreated seeds (control) for effects on seed quality. Neem leaf extract at 10% (T2) resulted in the highest germination, seedling length, and vigor, followed by lemongrass extract at 5% (T9), with the control showing the lowest results. This simple, low-cost method using Neem extract can enhance seed germination, vigor, and seedling establishment without expensive equipment or chemicals.

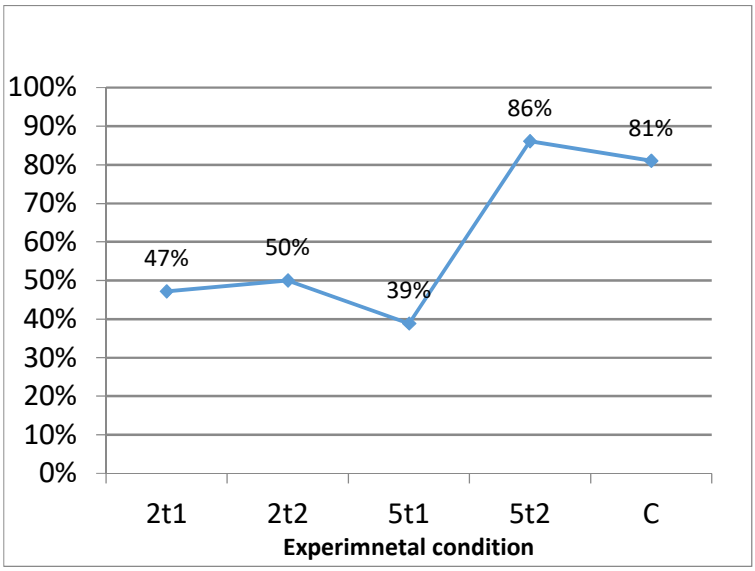
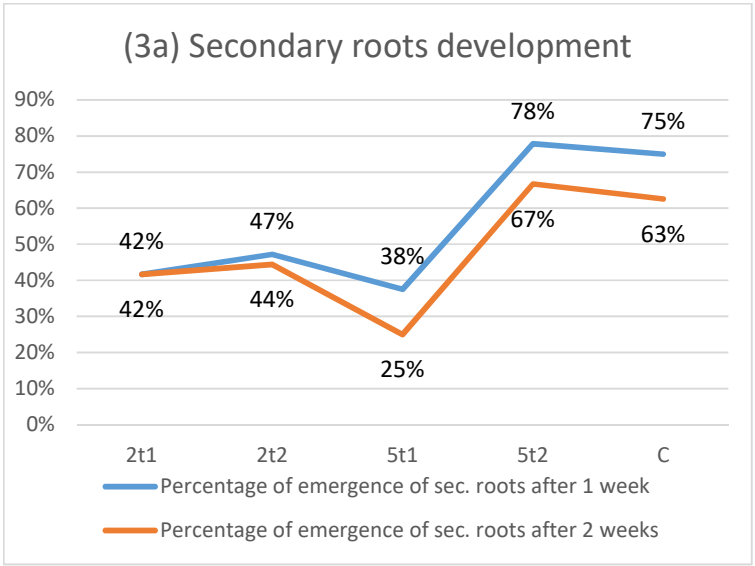


Fig 2: Effect of tea powder on the emergence of cotyledons after one week of sowing of Fenugreek seeds in comparison with controls



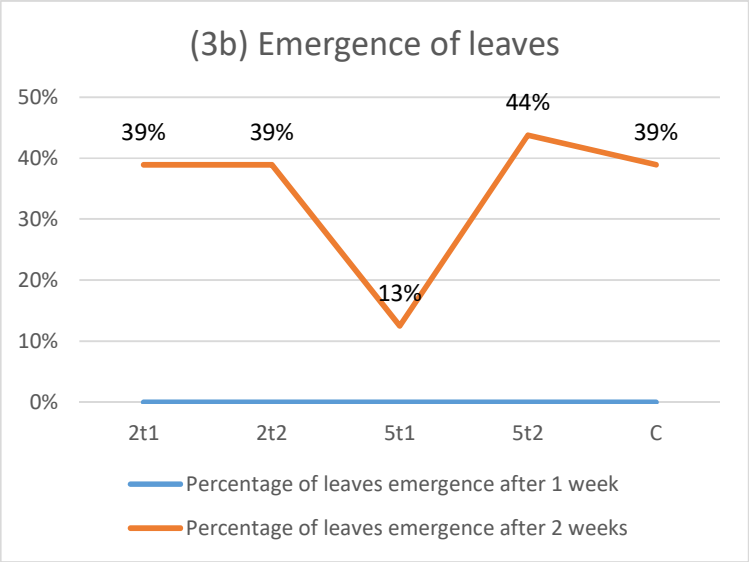


Fig 3: (a) Effect of used tea powder on secondary roots of Fenugreek, (b) Effects of used tea powder on leaves of Fenugreek

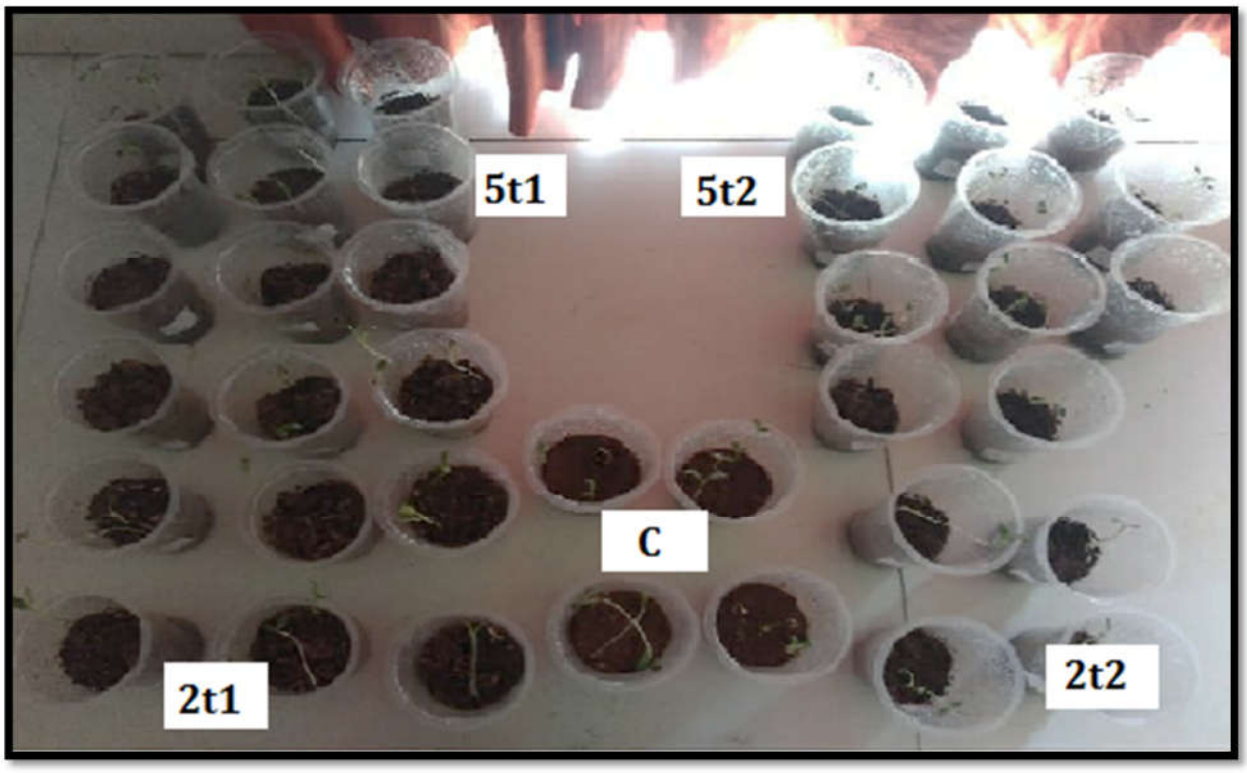


Fig 4: Fenugreek plants at the time of harvest in different treatments

The survival percentage of plantlet also followed the same trend it was the highest in the 5t2 and the moderate result of 2t1 and 2t2 while the lowest result of 5t1 as compared to the control (Figure 4 and 5). The moderate length of 2t1, 5t2 and 2t2 with the smallest length of 5t1 after comparison with control set (Figure 6 and 7).

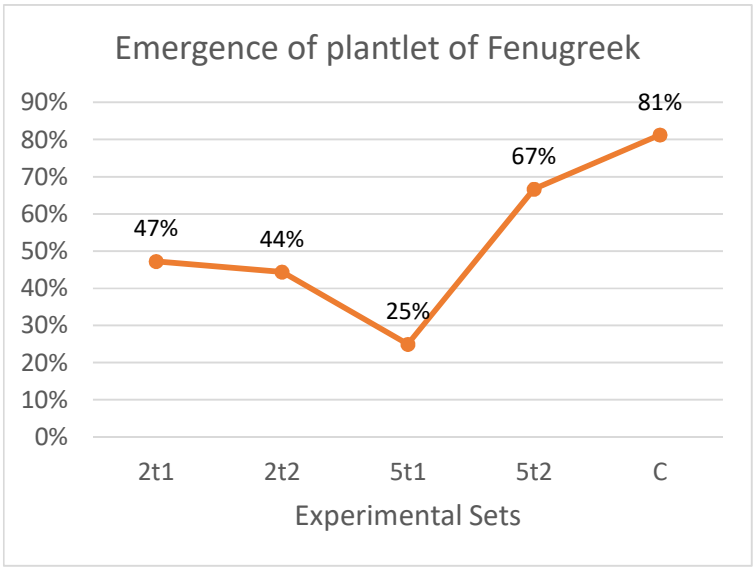


Figure 5: Effect of tea powder percentage of emergence of plantlet of Fenugreek

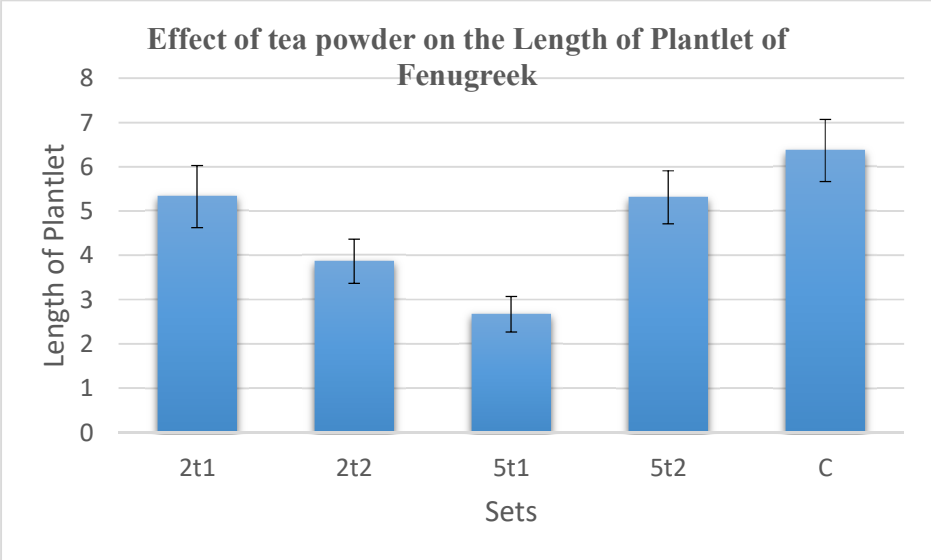


Figure 6: Effect of tea powder on the Length of Plantlet of Fenugreek

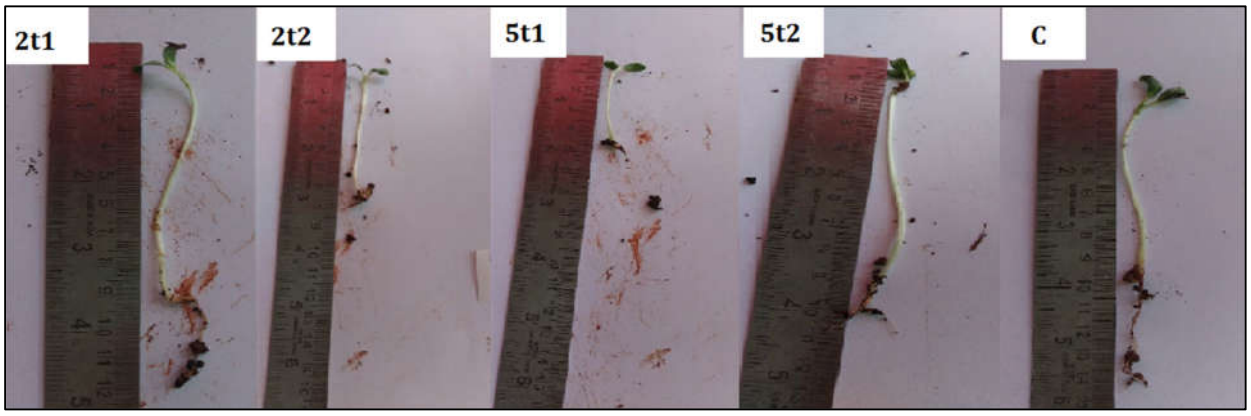


Figure. 7: Variation in plantlet length of Fenugreek plants at the time of harvest in different treatments

In Hindu culture, cows are revered, with cow urine highlighted in ancient texts as "Amrita," or the beverage of immortality, for its growth-promoting qualities. Treated Cluster bean and Fenugreek seeds with different concentrations of cow urine and medicinal plant extracts, soaked for various times. Seeds soaked in a 1:9 concentration for 12 hours showed maximum growth, suggesting this mixture as an effective natural plant growth enhancer (Barot et al., 2003). While Kolli and Ratnakumari (2024), observed the significant effect of used tea powder on the growth and productivity of coriander and Rumex plants.

In reference to overall above context, we have observed 5t2 set gives a best result. On the same scenario the 2t1 and 2t2 sets show moderate results. While the poor result is achieved in 5t1 when compared with control. Thus, growing seeds in supernatant of 1:1 ratio of tea powder and soil for 96 hours and then sowing it into 1:1 ratio of the soil and tea powder shows poor development.

Domestic vegetable and fruit waste, used as extracts and decoctions at varying dilutions, was tested for its effects on seed germination, leaf emergence, growth, and biomass. Compared to distilled water, all concentrations promoted seed germination, plant growth, and biomass, with higher dilutions (1:5 to 1:8) showing the greatest impact on tomato plant growth. This suggests that domestic waste can serve as an eco-friendly alternative to synthetic growth nutrients (Mishra and Koshy 2016).

On the other hand, growing seeds in supernatant of 1:1 ratio of tea powder and soil for 24 hours and then in normal water for 72 hours and then sowing it into 1:1 ratio of the soil and tea powder gives significant result. While sets 2t1 and 2t2 shows similar results. Thus, the procedure used to grow seedlings in 5t2 set is more favorable and advantageous for significant growth of plant.

CONCLUSION

As conclusion, noteworthy seed germination was observed in the 5t2 set, while the application of used tea powder in 1:1 proportion in soil showed significant growth in plantlet. The combination of used tea powder and soil constitutes utilization of organic waste in environmentally friendly manner for the fenugreek plant growth.

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