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Full Length Research Article

Experimental Study of Fenugreek Microgreen on Use of Selected Fruit Peel Waste as Biofertilizers: Promoting Sustainable Agriculture

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Abstract

This study evaluates the impact of pomegranate, orange, and sweet lime peel powder waste management on the growth of fenugreek microgreens. The selected fruit peels were collected, sun-dried, and finely ground into fine powder. Variation I is pomegranate peel powder, Variation II is orange peel powder, Variation III is sweet lime peel powder which was prepared from one gram of fruit peel powder diluted with 100 ml of water and Variation IV is a mixture of all three fruit peel powders each containing 0.3 grams diluted with 100 ml of water. Fenugreek seeds are collected from the seed centre. 25 grams of the seeds were soaked in 100 ml of water and germinated for 4 days. The soaked seeds are sown in the soil bed and cultivated for 7 days in the field. The diluted peel powder extract was poured on a daily basis into the fenugreek microgreens field and monitored. Fenugreek microgreens are grown under four variations and compared with the control. The evaluation was done in terms of measuring soaking time, germination time, the weight of the seeds after soaking, water absorbed after soaking, length of the fenugreek microgreens including stem and root, and the number of leaves. This research reveals that fruit peel powder compositions may enhance plant growth and yield by reducing the demand for environmentally friendly chemical fertilizers. It is suggested that farms include fruit waste to increase crop production and maintain a sustainable environment.

***Key words*:** Pomegranate peel, Orange peel, Sweet lime peel, Fenugreek, Organic agriculture

The Food and Agriculture Organisation (FAO) estimates that at least 1.3 billion metric tonnes of food produced globally each year is lost or wasted [8]. Around the world, 45% of the food waste produced is made up of fruits and vegetables [5]. Fruits contain 10-20% peel, discarded as waste during fruit processing. Fruits waste are a good source of phytochemical [6] and are rich in nutrients, and functional properties. It is also considered a source of prebiotics and antioxidant [10]. India frequently has a lot of peels from tropical fruits such as bananas, papayas, pineapples, mangoes, oranges, and pomegranates. These can be utilized as organic fertilizers for plants [1]. Reducing food loss and waste is an essential strategy for enhancing our food system's effectiveness, safety, quality, and sustainability [2]. Pomegranate peel generally discarded as waste is a rich source of bioactive compounds [3]. Numerous studies have demonstrated that fruit wastes are rich in nutrients, including dietary fibre, vitamins, and minerals, as well as phytochemicals, antioxidants, food components like pectin, natural colours, and antifungal and antibacterial substances [9]. Pomegranate peels are rich in micronutrients including B, Fe, Zn, Cu, and Mn as well as K, N, Ca, P, Mg, and Na. Molasses, pectin, and limonene are all present in large quantities in orange peel [4].

MATERIALS AND METHODS

Collection of samples

Fruit peels namely pomegranate peel, orange peel, and sweet lime peel were collected from the local fruit juice vendors. The collected fruit peels were checked for quality and were dried in the sunlight for 6-10 days at 30°Cand powdered in a pulverize. The powdered fruit peels are sieved through a siever with at 2mm in size to obtain a fine powder.

Formulation of different fruit peels as Biofertilizer

The fruit peel powder is weighed and diluted for the formulation as fruit peel biofertilizer. Based on the literature available one gram of fruit peel powder was selected to become a biofertilizer. The four variations of fruit peel powder were prepared and compared with the control. Fenugreek microgreens grown without using any fertilizer are considered as control. Variation I is pomegranate peel powder, Variation II is orange peel powder, Variation III is sweet lime peel powder one gram of fruit peel powder is diluted with 100 ml of water and Variation IV is a mixture of three fruit peel powders each containing 0.3 grams diluted with 100 ml of water which was prepared and poured on daily basis into the fenugreek microgreens field and monitored.

Cultivation of fenugreek microgreens

25 grams of fenugreek seeds were sown in five different regions and watered every day with fruit peel powder extract. In the control group, only water is used and for other variations prepared fruit peel powder extract was poured into the field on daily basis for 7 days. For Variation I-pomegranate peel powder, variation II- orange peel powder, variation III- sweet lime peel powder, and for variation IV mixed of all three-fruit peel powders was used. Soaking time, the weight of the seeds after soaking, the quantity of remaining water after soaking, the germination period, the height of the germinated seeds, the average height of the root, stem, total height of the microgreens and total yield of the microgreens of different variations were observed and recorded.

RESULTS AND DISCUSSION

The following tables and figures show the results of the different growth parameters in fenugreek seeds sown after 7 days. The data presented in (Table 1, Fig 1) represented the germination period of the fenugreek microgreens under four variations and a control group. The quantity of the seeds before soaking, the weight of the seed after soaking, the quantity of remaining water after soaking, and the height of the germination were observed. (Table 2, Fig 2) represented the average height of the fenugreek microgreens of four variations and a control group.

Table 1 Germination of seeds

S. No	Variations of fruit peel powder	Quantity of seed before soaking (g)	Water (ml)	Soaking time (hrs)	Weight of the seed after soaking (g)	Quantity of remaining water after soaking (ml)	Germination period (Days)	Height of germination (cm) Mean ± S. D
1.	Control	25	100	20 hrs	84	51	4	3.35 ±0.1779
2.	Variation I	25	100	20 hrs	97	51	4	3.01 ± 0.1791
3.	Variation II	25	100	20 hrs	105	44	4	2.07 ± 0.2311
4.	Variation III	25	100	20 hrs	84	30	4	2.38 ± 0.1316
5.	Variation IV	25	100	20 hrs	109	23	4	2.63 ± 0.1059

1-Control, 2- Variation I Pomegranate peel powder, 3- Variation II- Orange peel powder, 4-Variation III Sweet lime peel powder, 5- Variation IV Mixed of all three fruit peels

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Fig 1 Germination of seeds

1-Control, 2- Variation I Pomegranate peel powder, 3- Variation II- Orange peel powder, 4-Variation III Sweet lime peel powder, 5- Variation IV Mixed of all three fruit peels

Fig 2 Height of the fenugreek microgreens

Germination period

The results of the study revealed that there was no significant difference in the number of days of germination between Variation I, II, III, and IV and the control group. This validates a finding from a comparable study by [7]. The weight of the seed after soaking and the amount of water still in the seed after soaking varied significantly. The weight of the seed after soaking is higher in Variation I, II, III, and IV compared to the control. In comparison to Variations II, III, and IV, Variation I have a larger germination height shown in (Fig 1, Table 2).

Table 2 Height of stem, root of fenugreek microgreens

S. No	Variations of fruit peel powder	Quantity of seed (g)	Height of stem (cm) Mean ± S. D	Height of root (cm) Mean ± S. D	Full height of fenugreek microgreens (cm) Mean ± S. D
1.	Control	25	7.19 ± 0.1969	7.95 ± 0.1433	14.96 ±0.2170
2.	Variation I	25	5.41 ± 0.1100	6.05 ± 0.1433	12.06 ± 0.1897
3.	Variation II	25	4.04 ± 0.1429	5.12 ± 0.1229	9.12 ± 0.2347
4.	Variation III	25	3.98 ± 0.1135	3.98 ± 0.1135	8.08 ± 0.1813
5.	Variation IV	25	6.13 ± 0.1337	6.48 ± 0.2347	12.86 ± 0.1505

1-Control, 2- Variation I Pomegranate peel powder, 3- Variation II- Orange peel powder, 4-Variation III Sweet lime peel powder, 5- Variation IV Mixed of all three fruit peels

Average height of the microgreens

On the 7th day after germination, Variation IV (Combination of Pomegranate, sweet lime, and orange peel powder) exhibited the highest mean plant height of 12.86 cm respectively and Variations I, II, and III shows the lowest mean height of 12.06 cm, 9.12 cm, and 8.08 cm. The mix of three fruit

peel powders showed significantly the highest mean plant height when compared to Variations I, II, and III shown in (Figure 2, Table 3).

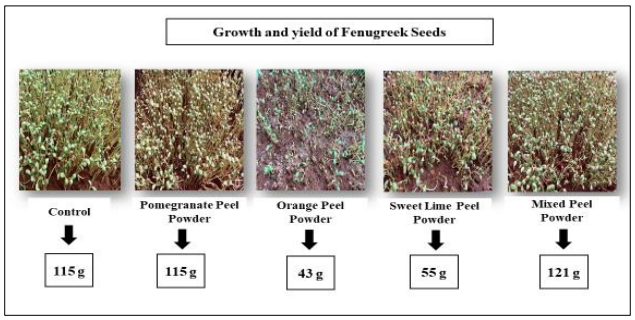

Fig 3 The yield of fenugreek per 25 g of the seeds on 7th day

Total yield of the plan

The weight of the total yield is taken without the root system on the 7th day of 25 grams of fenugreek seeds. Fenugreek grown as control with pomegranate peel powder showed the same amount of yield that is 115 g of fenugreek microgreens. Fenugreek is grown with orange peel powder and sweet lime peel powder the yielded 43 g and 55 g respectively. The highest yield of fenugreek microgreens was recorded in mixed peel powder which is about 121 g of yield. The result of the present study revealed that there is a significant difference between the fenugreek microgreens grown in pomegranate peel powder and mixed peel powder with the control shown in Figure 3.

CONCLUSION

Utilization of pomegranate, orange, and sweet lime peel waste as organic biofertilizer was compared with the growth of fenugreek microgreens aiming for sustainable agriculture. The study concluded that pomegranate, orange, and sweet lime peel waste contain appreciable amounts of nutrients to improve soil fertility and increase plant yields after discovering notable improvements in terms of growth and yield parameters, such as germination period and microgreens height in pomegranate peel and mixed peel powder. The general public and farmers are recommended to use fruit waste as organic biofertilizers. This study could be the roadmap to ensure effective agricultural output and significantly reduce the harmful effects of synthetic fertilizers which in turn help us to attain nutritional security and sustainability.

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