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Effect of Vermiwash and Vermicompost on the Growth of Fenugreek (*Trigonella* Sp.)

Leena Shakya[1], Archana Singh[2], Astha Maurya[3], Priya Kushwaha[4], Tanishka[5], Tamanna Goyal[6], Sunil Kumar Dhiman[7]

[1,2]Assistant Professor, Department of Botany, Kirori Mal College, University of Delhi, Delhi. 110007
[3,4,5,6] Student, B.Sc.(H) Botany, IIyear, Department of Botany, Kirori Mal College, University of Delhi, Delhi. 110007
[7] Associate Professor, Department of Botany, Kirori Mal College, University of Delhi, Delhi. 110007

ABSTRACT: Vermicomposting is a useful and completely environmentally friendly technology that changes biodegradable waste into nutrient rich organic matter. This technology can also be used for obtaining vermiwash, nutrient rich bio liquid. It is a liquid extract, which is both useful and environmentally friendly. Vermicompost enriches the soil with nutrients and beneficial microorganisms, while vermiwash can provide a nutrient boost directly to the plant. The present study was done to assess the effect of different concentration of vermiwash and vermicompost on growth of Fenugreek through vermiponics and pot method respectively. The 25% vermiwash showed increase in shoot length as compared to control whereas 50% of vermiwash was found to be phytotoxic to the growth of Fenugreek plant as compared to control. Similar trend was observed in pot method using different concentrations of vermicompost. 25% vermicompost was found to increase the shoot length as compared to 50% and 75% vermicompost. Both vermicompost and vermiwash can be valuable addition to fenugreek cultivation. It is essential to use these products (vermiwash and vermicompost) in moderation i.e. 25% for maximizing the growth during cultivation.

KEY WORDS: earthworm, fenugreek, optimum growth, phytotoxicity, shoot length, vermiponics, vermicomposting, vermiwash.

INTRODUCTION

Vermicompost is a nutrient-rich organic fertilizer produced by composting organic materials with the help of earthworms. When applied as a soil amendment or added to potting mix, vermicompost can enhance soil structure, water retention, and nutrient availability. The organic matter in vermicompost helps retain moisture in the soil, preventing it from drying out quickly, which can be especially beneficial in arid or dry regions. Vermiwash is a liquid extract produced during the vermicomposting process. It contains nutrients, enzymes, and beneficial microorganisms that can enhance plant growth. It contains several enzyme, plant growth hormones, vitamins along with micro and macronutrients (Nadana et al., 2020, Shield and Earl, 1982). These increase the resistance power of crops against various diseases and enhance the growth and productivity of crops (Anand et al., 1995; Pathak and Ram, 2004; Suthar et al., 2005; Umamaheshwari et al., 2003; Yadav et al., 2005, Chattopadhyay, 2015). Vermiwash also has some organic acids and mucus of earthworms and microbes apart from soluble plant nutrients (ShivSubramanian and Ganesh Kumar, 2004). As a by-product of vermicompost, it could be used as fertilizer by directly adding it into soil and as a liquid spray to plant body to prevent fungal, bacterial pathogen, and pests (Gudeta et al.,2021).

Hydroponics is a method of growing plants without soil, using a nutrient-rich water solution to deliver essential nutrients directly to the plant roots. These days vermiponics is a technology that is being adopted by modern farmers on their fields. In vermiponics, different concentrations of vermiwash is used to provide nutrients to the growing plants in a condition that is devoid of soil as a medium or simply modified hydroponics.

Fenugreek is an annual herbaceous plant botanically known as *Trigonella foenum-graecum* and commonly called 'Methi'. It is an annual plant that thrives in regions with a Mediterranean climate (Ahmad et al., 1999). It prefers well-drained soil and lots of sunlight. The leaves are trifoliate and the plant produces white or yellowish flowers with typical leguminous characteristics. The seeds are small, brown and roughly angular in shape (Srinivasan, 2006; Basu, 2006). They have a distinctive aroma and a slightly bitter taste. Fenugreek is typically grown from seeds and usually takes about 90 to 120 days to reach maturity. The leaves are harvested when the plant is about 6-8 inches tall to be consumed as vegetable and the seeds are ready to be harvested in 3-4 months. It is mostly cultivated as a leafy vegetable, condiment and as a medicinal plant. Leaves contain 86.1% moisture, 4.4% protein, 0.9%

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fat, 1.5% minerals, 1.1% fiber and 6% carbohydrates (Wani and Kumar, 2018). Leaves also contain calcium, zinc iron, phosphorous, riboflavin, carotene, thiamine, niacin and vitamin C (Rao, 2003; Muralidhar et al., 1999). Fresh leaves of Fenugreek contain ascorbic acid (220.97 mg per 100 g of leaves) and β-carotene (about 19 mg/100 g) (Yadav and Sehgal, 1997; Thomas et al., 2011). Seeds are rich source of diosgenin which is mainly used for the preparation of contraceptive pills (Mehrafarin et al., 2010). It is used as a substitute for Medicinal Yam (Anandhi et al., 2019).

Fenugreek is a staple spice in Indian cuisine. Both its seeds and leaves are used in cooking. The seeds are often roasted and ground to make a spice blend or used whole in various dishes. The leaves are used fresh or dried as a flavoring agent in curries, pickles, and other dishes (Ahmad et al., 2016; Srinivasan, 2006). It has a long history of use in traditional Indian medicine or Ayurveda. It is believed to have various health benefits, including aiding digestion, reducing inflammation, and regulating blood sugar levels. It is also used to promote lactation in nursing mothers (Betty, 2008). It is used for treating skin conditions, wounds, and as a natural remedy for hair care (Moradi kor et al., 2013). The aromatic qualities of fenugreek make it valuable in the cosmetics and perfume industries. Sometimes seeds are used as a component in livestock feed, particularly for poultry, due to their nutritive properties (Ahmad et al., 2016). Fenugreek oil is used for cooking, massage, and as an ingredient in cosmetics and hair products. Fenugreek (*Trigonella foenum-graecum*) is an economically important plant in India with diverse uses ranging from culinary and medicinal to industrial applications. Its versatility and wide range of applications contribute to its significance in both traditional and modern contexts. India is one of the largest producers of fenugreek in the world (Rasheed et al., 2015). It is cultivated in various states across India, including Rajasthan, Gujarat, Uttar Pradesh, Madhya Pradesh, and Punjab. It is grown as a cash crop and is an integral part of Indian cuisine and traditional medicine (Anandhi et al., 2019).

In recent years, there has been an increasing interest in organic fenugreek cultivation and sustainable farming practices in India, aligning with global trends towards healthier and environmentally friendly food production.

The present study was performed to assess the effect of different concentration of vermiwash and vermicompost on growth of fenugreek through vermiponics and pot method.

MATERIALS AND METHODS

Plant culture and experimental treatments

The experiment was carried out in hydroponics facility at Kirori Mal College, with 5 replications of each treatment in hydroponics in addition to triplicates in the earthen in Botanical Garden. The experiments were conducted to examine the effects of the different concentrations of vermiwash (25% and 50%) and vermicompost (25%, 50% and 75%), in a controlled condition (temperature: 25–30^{0}C, relative humidity: 70–60%) under natural light on the growth of fenugreek (*Trigonella foenum-graecum)* plant, so as to find out the desirable concentrations of the bio compost (both in solid and liquid forms) that could be applied to the plants for the best growth.

Collection of plant seeds and plant growth medium (vermicompost and vermiwash)

Both vermicompost and vermiwash were collected from the vermicomposting unit of the Kirori Mal College, where due procedure is being followed to prepare the vermicompost and vermiwash. The good quality of authentic seeds of fenugreek (*Trigonella foenum-graecum*) were procured from the seed division of IARI.

Experimental design

To standardize the concentration of vermiwash and vermicompost on the growth of plant fenugreek (*Trigonella foenum-graecum*), the organic fertilizer was collected from the vermiculture bags. Vermiwash was diluted at different concentrations (0, 25 and 50%) by mixing it with RO water for vermiponics and vermicompost was mixed with loamy soil in different concentrations (0, 25, 50 and 75%) for pot experiments (Table. 1).

Pot experiment: Earthen pots having the 9 cm in diameter and a height of 16 cm were used for the experiments. They had the capacity to have 5 kg of soil in them. 10 seeds were sown in each pot to ensure the emergence of the seedlings, which were reduced to five in each pot.

Hydroponic experiment: Vermiwash was used in different concentrations during the growth of plant in order to supply nutrient requirements. To ensure, the uniformity of the experiment, the electrical conductivity, TDS and pH of water was measured regularly and appropriate corrections were made whenever any deviation was observed.

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Table 1: Experimental design of the study

Hydroponic experiment	Pot experiment
Control: T0 - 100% RO water	**Control**: T0 - 100% soil
Vermiponics: T1 - 75% RO water + 25% Vermiwash T2 - 50% RO water + 50% Vermiwash	**Vermicompost**: T1 - 75% soil+ 25% vermicompost T2 - 50% soil+ 50% vermicompost T3 - 25% soil+ 75% vermicompost

Growth measurements:

The germinated plants were allowed to grow in two sets of growth conditions. In one set, RO water was used as control along with different concentrations of vermiwash (25% and 75%) in hydroponic unit and in the second set vermicompost along with soil with different concentrations of vermicompost (25%, 50%, 75%) was utilized. Seeds were germinated in nursery bed plastic trays with cocopeat as the medium. Later on, they were shifted to the hydroponic unit after 10th day of germination when the seedlings attained the height of 5-6 cm. The growth of the plant was assessed by measuring shoot length after 3 day. Initially the observations were recorded on every 3rd day and thereafter every 7th day till the time plants ceased their growth due to the high concentrations of fertilizer. The observations are shown in Table 2 and 3.

Table 2. Effect of vermiwash on shoot length of Fenugreek plant in vermiponic experiment

Treatments / S.No	Date	T0 (Control) (cm)	T1 (25% vermiwash) (cm)	T2 (50% vermiwash) (cm)
1.	31-05-2023	9.4	9.5	8.6
2.	03-06-2023	10.2	10.6	8.7
3.	06-06-2023	11	10.8	9.1
4.	13-06-2023	11.5	12.3	10.6
5.	20-06-2023	11.7	12.4	10.7

Table 3. Effect of vermicompost on shoot length of fenugreek plant in pot experiment.

Treatments / S.No	Date	T0 (Control) (cm)	T1 (25% vermicompost) (cm)	T2 (50% vermicompost) (cm)	T3 (75% vermicompost) (cm)
1.	31-05-2023	6.30	6.40	5.40	5.70
2.	03-06-2023	6.75	7.60	6.60	6.50
3.	06-06-2023	7.70	7.90	7.10	7.10
4.	13-06-2023	9.40	9.50	8.10	8.40
5.	20-06-2023	10.12	10.35	8.70	8.50

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RESULTS AND DISCUSSION

Vermiwash that drains out from the vermicompost bags carries a lot of nutrients along with it. This concentrated vermiwash is diluted before its use in hydroponics for growing fenugreek. The effect of different concentrations of vermiwash on shoot length of fenugreek plant has been shown in Table 2. and plotted in Figure 1. It was observed that seedlings grown in 25% vermiwash concentration displayed positive response towards its growth and the length of shoot is maximum under this treatment. The shoot length of fenugreek in hydroponics was found to be highest in (T1 treatment) i.e., 25% vermiwash concentration from the day 1 of observation i.e., 10th day of transplantation (9.5 cm) and it remained highest till the last day of observation i.e. 30th day (12.4 cm). Conversely, 50% vermiwash concentration (T2 treatment) in hydroponic system proved to be toxic and didn't support the growth of the plant after 30th day. The T2 treatment initially exhibited increase in shoot length but as the time passed the growth of plant reduced and after 30 days, the plants died due to high toxic dose of the vermiwash. Vermiwash diluted with 1:4 ratios resulted in maximum shoot length followed by control (0% vermiwash). T2 treatment having 50% dilution showed poor growth and proved fatal for the plant. Undiluted naturally produced vermiwash displayed the lowest growth as reported by Chattopadhyay, (2015), which is primarily due to highly concentrated nature, having lots of nutrients proving toxic to plants. There could be a chance of release of more amounts of micronutrients, i.e., Fe, Cu, Zn and Mn in undiluted vermiwash and vermicompost. Though micronutrients are helpful in plat growth, greater amounts could be toxic at the same time.

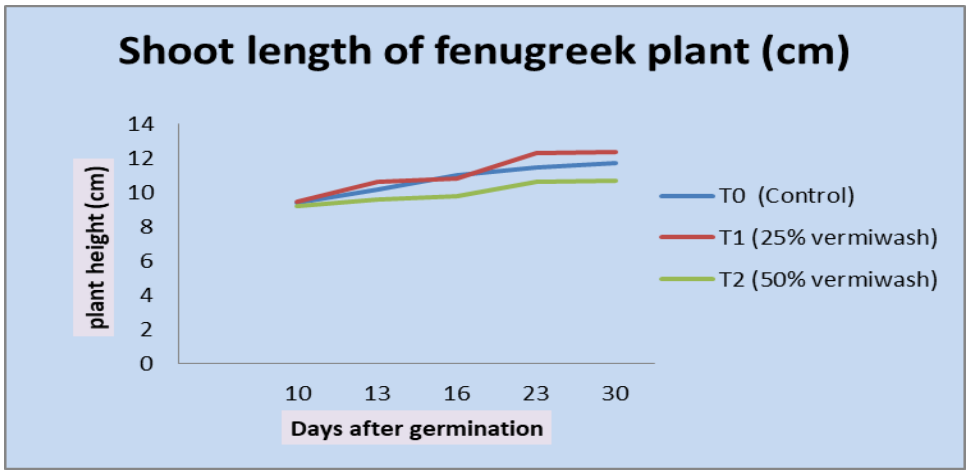

Figure 1. Effect of vermiwash on shoot length of fenugreek plant in hydroponic experiment

Vermicompost is an organic remedy that improves the physical and chemical properties of soils along with the providing nutrient to the plants. It is therefore used to increase crop yields. The effect of different concentrations of vermicompost on shoot length of fenugreek plant in pot experiment has been shown in Table-3. The pots having 25% vermicompost was found to be more suitable for growth and showed best results. The maximum shoot length of fenugreek was observed in T1 treatment i.e., in 25% vermicompost, similar in trend with the hydroponic experiment. The shoot length was recorded maximum in 25% vermicompost (T1 treatment) i.e., 6.4 cm as compared to 50% and 75% vermicompost (T2 and T3 treatments respectively) i.e., 5.4 cm and 5.7 cm respectively (Figure 2). Moreover, the results obtained through this study showed that vermicompost is an alternative to chemical fertilizers to increase the plant growth. The study confirmed that 25% of vermiwash and vermicompost is the optimum concentration for fenugreek growth in hydroponics and pots.

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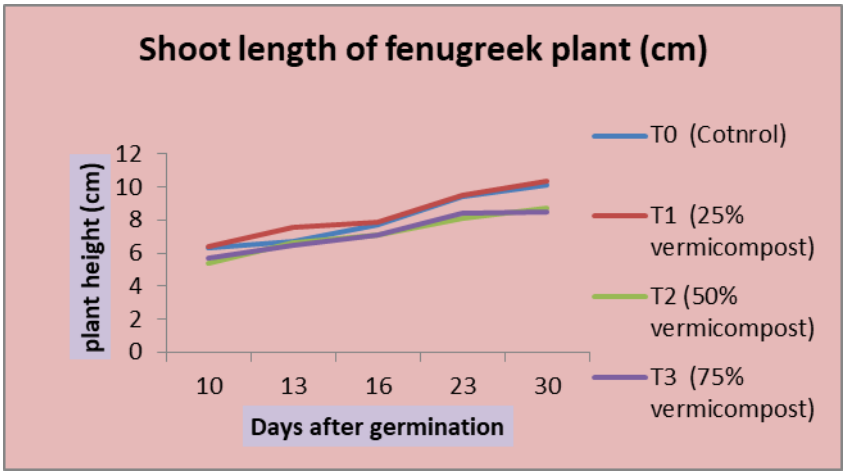

Figure 2. Effect of vermicompost on shoot length of Fenugreek plant in pot experiment.

The experiments conducted by Plíva (2006) to check the applicability of the certified methodology for the determination of vermiwash phytotoxicity assay was also inferred that vermiwash concentrations above 25% are phytotoxic and pose a significant risk to plants. Thus, when using vermiwash as a fertilizer for plants there is a necessity to dilute.

Overall, when used correctly, vermicompost and vermiwash can be valuable inputs for improving soil fertility and crop productivity (Sherman, 2011). However, it is essential to conduct on-site trials and optimize their use to local conditions and crop types to maximize their benefits. Additionally, farmers should also consider other sustainable agricultural practices to achieve long-term soil health and crop yield improvements. Vermicompost and vermiwash are generally safe and beneficial for fenugreek (*Trigonella foenum-graecum*) and other plants when used correctly. The key is to use them in moderation and follow recommended guidelines for application. Overuse or improper application can potentially lead to nutrient imbalances, which might affect plant health (Usmani et al., 2020). Additionally, it is a good practice to monitor the plants for any signs of stress or nutrient-related issues and must adjust the fertilization practices accordingly.

CONCLUSION

Vermicompost enriches the soil with nutrients and beneficial microorganisms, while vermiwash can provide a nutrient boost directly to the plant. The present study revealed that both vermicompost and vermiwash can be valuable fertilizers to fenugreek cultivation when used in moderation i.e 25% or lesser shows best results during cultivation. The use of 25% (or less than it) of vermiwash and vermicompost is recommended for maximizing the growth of fenugreek during cultivation in hydroponics or pot respectively.

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