International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

The Impact of Organic Compost with Inorganic Fortification on the Proximate and Antioxidant Properties of the Fenugreek Plant

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Abstract: ***Fenugreek has been used for a variety of purposes throughout history. Abscesses, arthritis, bronchitis, ulcers, wounds, and digestive issues were all treated with it medicinally. Fenugreek leaves contain 86.1% water, 4.4% protein, 0.9% fat, 1.5% minerals, 1.1% fibre, and 6% carbohydrates. It also contains some minerals and vitamins like calcium, iron, phosphorous, carotene, thiamine, riboflavin, niacin, and vitamin C. The fenugreek, or Trigonellafoenum-graecum L., is a seasonal herb that is indigenous to the countries of the eastern mediterranean and is commonly grown in India, Egypt, and Morocco. It is also known as methi in some regions. This study was conducted to evaluate the effect of different type of compost (T1-Control, T2-Sweet lime compost 2 Ton/ha, T3-Sweet lime compost 4Ton/ha, T4-Sweet lime compost with Zinc and Iron 2 Ton/ha, T5-Sweet lime compost with Zinc and Iron 4Ton/ha, T6-Pineapple compost 2 Ton/ha, T7-Pineapple compost 4Ton/ha, T8-Pineapple compost with Zinc and Iron 2 Ton/ha), T9-Pineapple compost with Zinc and Iron 4Ton/ha) on fenugreek. The experiment was conducted at the Research Farm, Department of Horticulture, Banaras Hindu University, Varanasi, during the Rabi seasons of 2019 and 2020, respectively. The experiment was laid out in Randomized Block Design with three replications. The whole field was first divided into three blocks, and each block was further divided into nine plots. An analysis of variance for all the treatments in Randomized Block Design (RBD) was carried out. For testing the hypothesis, the ANOVA table was used. Maximum results for all parameters of fenugreek were recorded with the application of fortified pineapple waste compost.***

Keywords: Compost, Inorganic Fertilizer, Fenugreek

1. Introduction

India is privileged to have a variety of agro-climatic zones with distinct seasons that support the growth of a wide range of vegetables. As a consequence, farmers have experienced greater economic benefits due to greater productivity in a shorter period of time (Govt. of India, 2015–16). After China, India is the world's second-largest producer of vegetables, producing 14% of all vegetables on an area of 9.575 million hectares with a productivity of 17.7 million tons per ha. (Sahni, 2017). Green leafy vegetables are necessary for a healthy diet. Their texture and firmness are due to their composition, which is made up of cellulose, hemicellulose, and pectin. The body receives the appropriate amount of vitamins, minerals, dietary fiber, and other nutrients from them. (Asaolu*et al*.2012). They are very important protective foods and are helpful for preserving health and treating a variety of illnesses. (Mohammed and Sharif, 2011).

They contain a variety of minerals, including Ca, Fe, Cu, P, Zn, Cl, and Na, which are crucial for metabolism and growth. These counteract the acidity of other foods by having an alkaline effect. (Arasaretnam et al. 2017). The fenugreek, or Trigonellafoenum-graecum L., is a seasonal herb that is indigenous to the countries of the Eastern Mediterranean and is commonly grown in India, Egypt, and Morocco. It is also known as methi in some regions. Fenugreek seed is generally used in cooking for its strong flavour and fragrance. (Helambe *et al*.2012). In the Indo-Pak subcontinent as well as other eastern nations, the seeds and leaves of fenugreek plants are widely consumed as a spice in food preparations and as an ingredient in traditional medicine (Syeda*et al*.2008). Fenugreek has been used for a variety of purposes throughout history. Abscesses, arthritis, bronchitis, ulcers, wounds, and digestive issues were all treated with it medicinally. Fenugreek leaves contain 86.1% water, 4.4% protein, 0.9% fat, 1.5% minerals, 1.1% fibre, and 6% carbohydrates. It also contains some minerals and vitamins like calcium, iron, phosphorous, carotene, thiamine, riboflavin, niacin, and vitamin C. (Helambe et al.2012). It is a cold-season plant that can tolerate very low temperatures. Within 120 to 150 days, the crop is ready for harvest. It can grow successfully in both tropical and temperate climates and has a wide range of adaptability. Although it can be grown on a wide range of soils, clay loamis generally best for it. For better production and growth, the soil's pH should be between 6 and 7.

2. Materials and Method

The experiment was carried out at the Research Farm, Department of Horticulture, Banaras Hindu University, Varanasi, in the Rabi seasons of 2019 and 2020, respectively. The experiment was laid out in Randomized Block Design with three replications. Three blocks were first created out of the entire field, and then each block was further divided into nine plots.

Throughout the experiment, the treatments were distributed at random within each block. Multiple plowings were used to prepare the experimental field. Two types of compost made from two distinct fruit wastes (pineapple and sweet lime) were used as treatments, along with two doses of zinc sulfide ($ZnSO_4$) and iron sulfide (FeSo4) sulfide. In all, there were nine treatments. Fenugreek seeds were purchased from a licensed agricultural store in Varanasi, Uttar Pradesh.10 plants were randomly selected from each net plot for the purpose of recording biochemical observations, leaving the remaining plants in the border rows. The "F" (variance ratio) table was used to assess the treatment's significance. The critical difference was compared to the significant mean differences at the 5% probability level (Gomez and Gomez, 1984). An analysis of variance for all the treatments in the randomized block design (RBD) was carried out. For testing the hypothesis, the ANOVA table was used.

3. Antioxidant and proximate composition analysis

3.1Carotenoids, Lycopene, Chlorophyll-

The content of carotenoids, lycopene, and chlorophyll in spinach was determined using the method described by (Jana Branišа1 *et al.*2014) on a fresh weight basis.

Ascorbic acid-Ascorbic acid in spinach was determined by the method described by (Bhuvaneswari S. *et al.*2015, http: //www.isca. in/IJBS/Archive/v4/i7/9. ISCA-IRJBS-2015-081. pdf)

3.2 Crude fiber

The estimation of crude fibre from plants is based on treating the moisture and fat-free material first with 1.25 percent H2SO4 and then with 1.25 percent alkali. The solution is filtered, and the residue is transferred to a weighed dish. It is dried in an oven at 100 degrees Celsius and then ignited to produce ash. The decrease in weight because of ignition is equal to crude fiber.

3.3 Total ash

In a previously weighed nickel dish, accurately placed 5–10 grams of oven-dried fine powder of the sample, then placed the sample in a muffle furnace at dull red heat (550 ^{o}C) for 30 minutes. Grinded the resulting mass with a pestle and place it again in the muffle furnace. Repeated this process till no more charred particles remained in the dish, then placed the crucible in a desiccator, cooled it up to room temperature, and weighed it.

Calculations: $\text{Total ash (\% by weight)} = \frac{(W_2-W)}{(W_1-W)} \times 100$

W= weight of the empty crucible (in g.)
W_1= Weight of the crucible with food material taken for the test (in g.)
W_2= Weight of the crucible with total ash (in g.)

3.4 Moisture

Vegetables were chopped finely and weighed accurately 10-50gm a flat bottomed dish and kept it in an oven at 100-110 $^{0\,c}$ overnight. Cooled the dish in a desiccator and weighed it to a constant weight. Moisture is calculated by the following formula:

$$\text{\% of moisture content} = \frac{W_2}{W1} \times 100$$

W1= Weight of the material taken for the test
W2= Weight of the material after heating.

3.5 Fat

After carefully weighing the sample, which weighed approximately 4–10 g, I transferred it to an extraction thimble. For around 6 hours on a sand bath, I kept the thimble in a Soxhlet extractor with an electric heater.

The extraction was said to be complete when a drop of petrol or ether taken from the drippings of the extractor did not produce any greasy stains on a filter paper. Removed the thimble and heated it so that the extractor filled up about two-thirds with gasoline, leaving only a small quantity of the fuel in the flask. Then I stopped heating and removed the flask from the apparatus. Filtered the residual gasoline that had fat in solution using Whatmann No.40 and collected the filtrate in the already weighed small beaker or glass dish. I washed the flask as well as the filter paper many times with redistilled petrol until a drop of the filtrate did not leave a greasy spot on the filter paper. Evaporated the gasoline in the dish very carefully and calculated the weight of the residue to be constant weight. The amount of crude fat or ether extract would be calculated by increasing the weight of the dish.

$$\text{Percentage of crude fat} = \frac{\text{Weight of Ether soluble material}}{\text{Weight of the sample}} \times 100$$

3.6 Protein

Protein content was determined by the Kjeldahl method.

3.7 Energy (Physiological Calorific Value)

The physiological calorific value (Kcal/100g) of the sample was given by method (Mudambi and Rao, 1989) and calculated by summing up the products of multiplication of per cent protein, fat and carbohydrates present in the sample by 4, 9 and 4 respectively i. e. Physiological calorific value (Kcal/100g) (4 Protein %6) + (9x Fat %) + (4 Carbohydrate %)

4. Results and Discussions

4.1 Proximate composition of spinach

Table 1: Effect of organic compost on proximate composition in fenugreek as influenced by fruits waste compost

Treatment	Energy, Kcal.	Protein (g/100g)	Fat (g/100g)	Moisture (g/100g)	Crude fibre (g/100g)
T1 (Control)	54.62	2.26	0.06	84.87	2.06
T2 (Sweet lime compost 2 Ton/ha)	53.30	2.45	0.14	85.18	2.29
T3 (Sweet lime compost 4Ton/ha)	53.48	2.76	0.53	85.95	2.13
T4 (Sweet lime compost with Zinc and Iron 2 Ton/ha)	57.57	3.22	0.27	84.62	2.36
T5 (Sweet lime compost with Zinc and Iron 4Ton/ha)	55.44	2.83	0.43	85.14	1.88
T6 (Pineapple compost 2 Ton/ha)	54.88	3.06	0.68	85.49	2.27
T7 (Pineapple compost 4Ton/ha)	53.57	2.62	0.34	85.38	2.36
T8 (Pineapple compost with Zinc and Iron 2 Ton/ha)	50.35	3.18	0.32	86.34	2.17
T9 (Pineapple compost with Zinc and Iron 4Ton/ha)	53.83	3.29	0.29	86.64	2.30
SEM±	0.090	0.019	0.010	0.042	0.037
C. D. at 5%	0.271	0.058	0.031	0.126	0.112

Significantly, the T4 sample showed the highest energy content (57.57), and the T8 sample showed the lowest energy content (50.35). Protein content of the fenugreek plant was highest (3.29) with T9 and lowest (2.26) with T1. T6 had the highest (0.68) and lowest (0.06) fat contents, respectively. The highest (86.64) moisture content was observed under T9, and the minimum (84.62) moisture content was recorded under T4. Significantly highest (1.77) ash content was observed in T2, followed by T7 (1.63); however, T2 was statistically at par with T7. A minimum (1.31) ash content was observed in T3. The highest (2.36) crude fiber content was observed under T4, and it was followed by T2, T6, T7, T8, and T9; however, T4 was statistically at par with T2 (2.29), T6 (2.27 g), T7 (2.36), and T9 (2.30). Lowest (2.06) crude fiber content was observed under T1. N. (Saada *et. al*.2009) concluded that the proximate content of fenugreek seeds is affected by the addition of the two types of organic compost. Conversely; the combination of manures (cow manure: goat manure, and chicken manure) with wheat husks is highly suggested as an organic compost product with significantly better performance on the chemical characteristics of the fenugreek plant.

4.2 Antioxidants availability in spinach

Table 2: Effect of organic compost on antioxidant composition in fenugreek as influenced by fruits waste compost

Treatment	Vitamin C (mg/100g)	Carotenoids (mg/100ml)	Lycopene (mg/100ml)	Total chlorophyll (mg/100ml)
T1 (Control)	248.54	33.95	0.45	121.59
T2 (Sweet lime compost 2 Ton/ha)	244.7	56.86	1.27	266.88
T3 (Sweet lime compost 4Ton/ha)	299.08	42.06	0.94	232.18
T4 (Sweet lime compost with Zinc and Iron 2 Ton/ha)	395.75	45.52	1.02	211.09
T5 (Sweet lime compost with Zinc and Iron 4Ton/ha)	583.05	44.41	1.26	212.16
T6 (Pineapple compost 2 Ton/ha)	462.45	46.38	0.82	211.23
T7 (Pineapple compost 4Ton/ha)	695.25	47.72	1.42	245.17
T8 (Pineapple compost with Zinc and Iron 2 Ton/ha)	286.73	60.61	2.89	390.05
T9 (Pineapple compost with Zinc and Iron 4Ton/ha)	268.86	71.02	1.95	180.57
SEM±	33.815	7.435	7.435	28.793
C. D. at 5%	101.3692	22.488	0.851	86.312

T7 had the highest (695.25) vitamin C content and T2 had the lowest (244.7) vitamin C content. It was perceived that significantly maximum (71.02) carotenoids content was observed in T9. It was followed by T8 and T2, however T9 was statistically at par with T8 and T2. Lowest (33.95) carotenoids content was observed under T1. Significantly highest (2.89) lycopene content was observed under T8. While the lowest lycopene content was observed under T1 (0.45). Total chlorophyll content was found to be significantly highest (390.05) with T8, and minimum (121.59) total chlorophyll content was found under T1. (Purbajanti *et al.*2019) concluded that 10 tons of cow dung per ha and 100 kg of NPK-16 fertilizer per ha were used to achieve the total chlorophyll content. A positive relationship between chlorophyll and nutrient content was observed in black gram by using coir waste and cow dung. (Baranisrinivasan, 2011) found that organic matter content correlated positively with the yield and vitamin C content of amaranth. (Adekayode *et. al*, 2011)

5. Conclusion

Highest protein and moisture content was recorded with fortified pineapple waste compost (4 tons/ha), whereas energy and crude fiber content was recorded with fortified sweet lime compost (2 tons/ha). Without fortified sweet lime and pineapple waste, compost recorded the highest ash and fat content. However, all treatments of fruit waste organic compost with fortification and without fortification were good for the overall proximate composition of fenugreek.

The highest antioxidant content in fenugreek was found in fortified pineapple waste compost at 2 and 4 tons per acre. Maximum results for all parameters of fenugreek were achieved with the application of fortified pineapple waste compost.

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