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Significance of Eco Garbage Enzyme in Organic Farming for Improve Plant Growth and Fruit Quality on Guava (*Psidium guajava*) cv. Allahabad Safeda

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A B S T R A C T

Eco-enzyme is an organic compound in the form of a complex solution resulting from the fermentation process of kitchen waste materials in the form of fruit peels and vegetable waste**.** Alternative market waste processing, especially organic vegetables and fruit skin waste that is done is making an eco-friendly biopesticide called ecogarbage enzyme. The present investigations on **"**Significance of Eco Garbage Enzyme in Organic Farming for Improve Plant Growth and Fruit Quality on Guava (*Psidium guajava*) cv. Allahabad Safeda**"** was conducted at the farm, Village- Sarawan Bodla, Tehsil- Malout, Distt- Sri Muktsar Sahib, Punjab during 2021-2022. Experiments were laid out in randomized block design (RBD) with five treatments viz. T_1- Control, T_2-2.5 CC/L, T_3-Cu_1 5 CC/L, T_4- 7.5 CC/L and T_5- 10 CC/L. Eco garbage enzyme gives a real influence on root length, stem girth, plant canopy, fruit weight, fruit size, TSS, Ascorbic Acid and Acidity of guava plant with the best concentrations of ecogarbage enzyme is 10cc/ L (1 ml). Eco enzyme is a fermented liquid from organic waste fruits, vegetables, and other organic waste which is very useful for agriculture, health, and households**.** Waste ingredients such as vegetable waste or fruit peels can be processed into a multipurpose eco-enzyme liquid. Making eco-enzyme is very simple and can be done by anyone. Ecogarbage enzyme will be applied as a bio pesticide to be used on guava plant. This study aims to process organic waste market as eco garbage enzyme and to know its influence on the growth and fruit quality of guava plant. The method used in this research is descriptive quantitative. This research produces eco garbage enzyme which is the result of semi aerobic fermentation that can be applied as an environmentally friendly bio pesticide.

Introduction

Guava (*Psidium guajava* L.) is one of the most popular fruits grown in tropical, sub-tropical regions of India, which belongs to the family Myrtaceae. It is the fifth most important fruit in area after mango, banana, citrus and apple and fifth most important fruit in production after banana, mango, citrus and papaya. This fruit is a native of tropical America and extensively grown in South Asian countries. It is successfully grown all over the country but leading guava growing states are Uttar Pradesh, Bihar. Rewa, Neemuch, Ratlam, Khandwa and Mandsaur (Anonymous, 2018). In India, guava shares 4.5 % in

area and 11.4 % in production and the total area and production of guava are about 0.26 million hectare and 39,97,000 MT, respectively (Anonymous, 2018).

Guava fruit contains water (80-82%), protein (0.71%), fat (0.5%), carbohydrate (11-13%) and acids (2.4%). Among fruits, it ranks third in vitamin-C content after Barbados cherry and Aonla. Guava fruits are rich in dietary fibers and vitamin C and have moderate levels of folic acid (Rajkumar *et al.*, 2017). It also contains substantial quantities of carbohydrates, sugars and pectin. Owing to excellent taste and flavor, high nutritional value and wide availability at moderate price the fruit is often called as "Poor man's apple" (Suman *et al.,* 2016).

Waste is a material that is wasted from all the results of human activities or natural processes that are not utilized. Based on the form, the waste is classified into three parts one of which is solid waste which is often called the garbage. Garbage can be positive and negative economic value, which is a positive economic value of waste if it can be utilized into something useful and has a high value. Garbage can be sorted / processed based on the nature and the material phase of the waste.

Based on the material phase can be divided into three categories namely solid phase, liquid, and gas. According to Slamet (2002), sorting by nature is divided into two types: organic and inorganic waste. In addition, the garbage can also is sorted based on the classification of household waste, commercial waste, building waste, and public facility waste.

The waste management / segregation planning is made of a law that is expected to be able to handle the garbage problem in order to be managed. Looking a turban especially Denpasarcity, handling of garbage management is very urgent considering the daily garbage reaching 850 ton / day (Ris, 2016). The government hopes that the handling of waste management based on Law No. 18 of 2008 can be implemented. In addition, Law No.32 of 2009 on Environmental Protection and Management can also be used for basic waste management. Garbage management is also inseparable from Bali Provincial Regulation No.5 of 2011on waste management which mentions waste management is an effort to handle garbage in changing the characteristics, composition, and amount of waste.

This is supported by the research of Jana *et al.*, (2006) shows the observations made in the market of market waste piles Badung which has the largest percentage of organic waste reached 71.51%, its makes a discovery in managing organic waste to be used as compost. Alternative market waste processing, especially organic vegetables and fruit skin waste that is done is making an eco-friendly biopesticide called ecogarbage enzyme.

Eco garbage enzyme is the utilization of fruit and vegetable leather waste mixed with brown sugar and water which is then fermented. According Saravan, *et al.,* (2013) mentioned the effectiveness of eco garbage is very effective to manage waste in composting to minimize pest disturbance. In addition, according to research results Bo *et al.*, (2007) mentions vegetable waste is very effective in the formation of volatile fatty acids (VFA) and nutrients such as nitrogen content that is useful for plants.

Bio-enzyme was first developed by Dr. Rosukon Poompanvong. Bio-enzyme is also referred as Eco-enzyme, Garbage enzyme, Terrazyme etc. Bio-enzyme works similar to enzyme as they degrade a large amount of waste within a small span of time. Synthetically, bio-enzymes are a mixture of composite substances like proteins, salt etc. which are products of naturally occurring bacteria or yeast which are used to make bio-enzyme.

The combination of jaggery/brown sugar/molasses, citrus fruits, vegetable peels and water is involved in the fermentation process. Fermentation can be described to be a chemical change which is brought about by employing microorganisms. An example of such a chemical transformation using microorganisms is pharmaceutical production,

animal feed stuff, food additives etc. On the contrary, it can also be carried out under aerobic conditions (in the presence of oxygen). Molasses assist in fermentation process as it acts as a complexing agent and also as a carbon source for unaffected treatment of organochlorides. Throughout the fermentation process, non-pathogenic i.e., a good bacterium breaks down larger pieces (organic waste, soil) into smaller particles. It also generates products such as ozone, nitrates and carbonates etc. Foliar Fertilization of nutrients is advantageous in terms of low application rate, uniform distribution of fertilizer materials and quick response to applied nutrients (Mishra *et al.*, 2017).

Ozone gas reduces the amount of carbon dioxide in the atmosphere and heavy metals that confines heat in clouds thereby lowering emission of greenhouse gases and hence helps in the reduction of global warming. Nitrate is an instinctive nutritious hormone for plants and carbonate has proven to be beneficial for aquatic life. We dwell in a consumerist society wherein, most of the products are accessible with the click, but a closer look at their constituents and process of manufacture will reveal how injurious they are to the surroundings. Contaminated surrounding contribute obnoxiously to the 3Ds of destruction of sustainable lifestyle i.e., disease, disturbance and distress. The diversity of flora and fauna on planet earth is destructively affected when we stream chemicals into the environment; we are slowly destroying off their habitat. This will eventually result in their extinction of many species in the long run. In the times of a pandemic crisis such as COVID-19, which is spreading through symptomatic and asymptomatic carriers, it is essential to regularly disinfect all inanimate surfaces around us to contain community transmission. All home cleaning products contain toxic and aggressive chemicals, these cleaners are extremely hazardous to our health and the environmental implications of them are destructive. The use of these chemical products may resolve our household difficulties quickly with ease and but it causes a grave problem for our nature. On the other hand, use of bio-enzymes, resolves many such problems associated with hazardous chemicals. Natural enzyme is a multifunctional instinctive cleaner which unusually decontaminates the environment. It is used as a fertilizer, herbicide, as a household cleaner and also for de-clogging the sewers. Thus, employing kitchen waste to generate bio-enzyme saves money and our surroundings to a great extent. Resorting to greener ways to do so is by creating a laboratory at home and synthesizing an environment friendly bioenzymes.

Materials and Methods

The experiment was conducted in the research farm of Mr. Lakhwinder Singh, Village- SarawanBodla, Tehsil- Malout, Dist- Sri Muktsar Sahib. The present investigations were made on eight year old Guava trees growing in the Orchard. Thirty nine trees which were uniform in size & vigour and given cultural practices as per package of practices recommended by Punjab Agricultural University, Ludhiana were selected for the present study. All the treatment was applied as a last week September. During the course of studies, recommended cultural practices were followed in the experimental materials.

Observations were recorded on growth parameters like Plant height (cm), Leaf area (cm^2) and Fruit quality parameters like Total soluble solids (TSS), Acidity (Titrable acidity), Ascorbic acid (mg/100g) and Total sugars (%).

The process of making eco garbage enzyme is conducted for 2 months starting from June until September with the first step is to process and sort the market waste, especially organic waste of vegetable and fruit waste. The preparation of ecogarbage enzyme is done by weighing the material from fruit and vegetable waste, brown sugar, and water with the ratio of vegetable and fruit waste 3 kg, brown sugar 1 kg, and water 10 L which is then stored in 5L plastic bottles. Fermentation refers to the activity of bacteria and fungi. These microbes break complex compounds, like sugars,

into simple substances, such as carbon dioxide and alcohol. During the fermentation process, methane gas, hydrogen, carbon dioxide, and organic acids either volatile or nonvolatile are yielded. The acids contain acetate acids, lactate acids, and butyrate acids. The volatile acids which are intermediates in the decomposition of higher compounds must not exceed a predetermined value, usually 2000 to 3000 ppm. If the volatile acids value is allowed to rise above 2000 ppm (as acetic) gas formation drops off, the quantity of acids increases rapidly, and all the fermentation cease. Even though some acids can be found as product, reference which explains details completely about any acid which is formed rarely and far from enlightening.

The main ingredients to make ecoenzyme are kitchen waste, brown sugar, and water according to ratio 3:1:10. Kitchen waste that ecoenzyme need come from fruits and vegetables. These kitchen waste are cut into small pieces, brown sugar is punched into powder, and mixed with water in a plastic container that can be tightly sealed. The bottle should be shook to make sure all the ingredients hydrated and soluble. Make sure to open the cap every two weeks to release the gas of carbondioxide and methane.

This study included experimental research with quantitative descriptive method due to the treatment of experimental group to perform preparation and identify root length, stem girth, plant canopy, fruit weight, fruit size, TSS, Ascorbic Acid and Acidity of guava plant. This research will be designed using single factor experiment that is because this research is only influenced by one factor that is concentration. The study was also designed from the preparation stage of ecogarbage enzyme materials, the manufacture of ecogarbage enzyme, testing on growing fruits.

Enzyme assay Amylase

Eco-Enzyme crude sample was serially diluted 10-1 to 10-4 and 0.1 mL sample was spread on each starch nutrient agar plates. After incubation for 1-2 days at 37 o C plate was flooded with Gram's iodine and observed for zone of hydrolysis.

Identification of metabolites

Tests were carried out to confirm the presence of flavonoids, alkaloids, quinones, cardenolides, and saponins.

Alkaline regent test

The 2 mL of sample was treated with few drops of 20% NaOH solution and observed for change in intense yellow colour to colourless solution on addition of dilute HCL.

Wanger's reagent

The 2 mL of Sample was treated with 3-5 drops of Wanger's reagent (1.27g of iodine and 2g of KI in 100 mL of water) and observed for formation of reddish/brown precipitate.

Keller test

5mL of sample was treated with 2 mL of glacial acetic acid in a test tube and few drops of 5% FeCl3 solution was added to it. This was carefully under layered with 1 mL concentrated H2 SO4, awaited to form brown ring at interface (which is due to deoxy sugars) characteristics of cardenolides.

Production of Eco-Enzyme

The citrus fruit peels (sweet lime, orange, and lemon) were collected washed thoroughly under running tap water and were chopped into small pieces. Then 500 g of brown sugar was added to 5lts of water and stirred until sugar dissolved completely, to it chopped 1.5kg fruit peels were added. The solution was incubated for 3 months in airtight plastic container. Initially the mixture was stirred daily using glass or wooden rod to release the gas formed by fermentation. Further in second month the solution was mixed once in two weeks followed by once in middle of third month.

Table.1 Effect of Foliar application of ecoenzyme on tree height and leaf area of guava tree.

Symbol	Concentration of ecogarbage enzyme	Tree height increase (cm)	Leaf area (cm^2)
T_1	0 cc/L	13.67	**37.74**
T_2	2.5 cc/ L	14.12	**38.51**
T_3	5 cc/L	16.55	**40.43**
T_4	7.5 cc/ L	17.08	**39.67**
T_5	10cc/L	18.95	**40.39**
S. Em. ±		1.41	**0.98**
$CD_{(0.05)}$		**4.11**	**2.87**

Table.2 Effect of Foliar application of ecoenzyme on TSS, Ascorbic Acid and Acidity of guava tree.

Symbol	Concentration of ecogarbage enzyme	TSS (^{0}Brix)	Ascorbic acid (mg/100g)	Acidity (titratable acidity)
T_1	**0 cc/L**	**8.40**	**156.72**	**0.52**
T_2	**2.5 cc/ L**	**8.57**	**169.14**	**0.57**
T_3	**5 cc/L**	**8.58**	**171.36**	**0.61**
T_4	**7.5 cc/ L**	**8.64**	**174.92**	**0.63**
T_5	**10cc/L**	**8.89**	**179.34**	**0.71**
S. Em. ±		**0.16**	**3.36**	**0.02**
$CD_{(0.05)}$		**0.46**	**9.80**	**0.07**

Quantification of Acetic acid

The 10 mL of sample was titrated against the titrant 1M NaOH. The few drops of phenolphthalein indicator was added and observed for the formation of pink colour.

Antimicrobial activity

The nutrient agar plates were spread with different microbial suspension (*E.coli*, Pseudomonas ssp., Bacillus spp.) and 1 mL of sample was inoculated using well diffusion method. These plates were incubated for 48 hrs at 32^O C and observed for zone of inhibition.

Effect on plantlet growth

Two containers of soil were taken and labelled as with and without Eco-enzyme, each container added 25 seeds of wheat and 5 mL diluted Ecoenzyme and container kept for plantlet growth.

Applications of Eco-enzyme

Enhanced Plant Growth in Guava plant by Eco enzyme because due to the presence of all-natural raw material present in the production it doesn't cause any hazardous or ill effect to environment while the chemical agents get accumulated in the nature and degrade the land over there and also may affect the water bodies over there. It also does not have any toxic effects over to human while few chemical agents do have ill effects. Due to the presence of natural microbes it activates the soil biology and helps in enhancement of plant growth and yield which has vice versa effect by chemical agents. Also, it has efficient commercial cleaning properties, it repels pest like mosquito. It also cheaper in rate, harmless and natural product. As the Eco-Enzyme produced is in acidic nature it has to be diluted before the use for different purposes because the acidic nature may spoil the texture of things on which it is used. Further the plants also require the diluted form as many plants needs slight alkaline or

neutral pH, also if soil is too much alkaline acidic nature may use to retain the natural pH of soil that is required. The produced Eco-enzyme is a multi-usage product of kitchen waste which has ecological significant and is eco-friendly.

Results and Discussion

Eco garbage enzyme is fermented semi-aerobic for 2 months and produces a light brown solution. The ecogarbage enzyme solution was then tested to determine the macro and micro nutrient content. Based on the results of the highest macro element content test of potassium macro element (K)of 203 mg / L and phosphorus (P) of 21.79 mg / L. Potassium content (K) will be shown in the growth of many leaves and not perforated. In addition to the potassium macro element, in the eco garbage enzyme solution of phosphor (P) which can be shown in a good root system on the growth of guava plants. A macro nitrogen element (N) with a small content in the solution of the eco garbage enzyme will affect the high growth of the guava plant.

Growth Parameters

The data pertaining to the tree height of different treatment combinations have been presented in Table-1.It is evident from the Table that different treatments strikingly resulted in difference in average tree height of plant. Maximum tree height increase (18.95 cm) was recorded in treatment T_5 10 CC/L which was statistically at par with height increase 17.08 cm in treatment T_4 7.5 CC/L and 16.55 cm in treatment T_3*i.e*5 CC/L. The minimum tree height (13.67 cm) was recorded in treatment T_1 (control).

The relevant data of leaf area different treatment combinations have been presented in table represented in Table-1.It is clearly evident from the data that different treatments show significant difference in leaf area. From Table it is clearly showed that the maximum leaf area was recorded 40.39 cm^2 in treatment T_5 10 CC/L which was statistically at par with 39.67 cm^2 in treatment T_4 7.5 CC/L and 40.43 cm^2in treatment T_3*i.e*5 CC/L. The minimum leaf area (37.74 cm^2) was recorded in treatment T_1 (control).

Fruit Quality Parameters

From Table-2 it is clearly showed that the maximum fruit TSS 8.89 (^{0}Brix) was recorded in treatment T_5 10 CC/L which was statistically at par TSS (8.64^{0}Brix) in treatment T_4 7.5 CC/L. The minimum TSS (8.40^{0}Brix) was recorded in treatment T_1 (control). The relevant data ascorbic acid of different treatment combinations have been presented in Table-2. From Table it is clearly showed that the maximum fruit titratable acidity (0.71) was recorded in treatment T_5 10 CC/L which was statistically at par 0.63in treatment $T_4$7.5 CC/L. The minimum fruit titratable acidity (0.52) was recorded in treatment (control).

On the basis of results obtained from various treatments, it can be concluded that the application of treatment T_5 10 CC/L gave best results in quality and yield parameters which was at par with treatment T_3*i.e*5 CC/L and T_4 7.5 CC/L. It is used as natural fertilizer and biopesticide so it increases growth of plant and quality of guava. The ingredients to make ecoenzyme are kitchen wastes. Brown sugar is carbohydrate source which consists of carbon, oxygen, and hydrogen when it decomposed. Meanwhile, protein from vegetables will be decomposed to yield nitrogen which is utilized to fertile the soil and improve soil quality increase sugars and ascorbic acid in fruit. Organic materials can be benefited for supporting the growth of microorganisms and other soil organisms.

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