

APPLICATION OF ORGANIC WASTE IN *BRASSICA JUNCEA* - COMPARITIVE STUDY

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Science degree in Microbiology.

By

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SATHYABAMA

(INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with Grade "A" by NAAC | 12B Status by UGC | Approved by AICTE
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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **Sneha Thomas(40300061)**, who carried out the project entitled "**Application of organic waste in *Trigonella Foenum-Graecum* –comparative study**" under my supervision from October 2022 to April 2023

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DECLARATION

I SnehaThomas(40300061) hereby declare that the Project Report entitled "**Application of organic waste in *Trigonella Foenum-Graecum*-comparative study**" done by me under the guidance of **Dr.L.Inbathamizh** at Sathyabama University is submitted in partial fulfillment of the requirements for the award of Bachelor of Science degree in Microbiology.

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CHAPTER 1

INTRODUCTION

1.1 BIOLOGICAL BACKGROUND:

Organic waste is a product of the biological processes that occur in living organisms. The biological background of organic waste can be understood by examining the cycles of matter and energy in ecosystems. In natural ecosystems, organic waste is an important part of nutrient cycling. Nutrients that are released during decomposition are taken up by plants and used to support growth and reproduction. In turn, plants are consumed by herbivores, which are then eaten by carnivores, creating a food chain that connects all living organisms in the ecosystem. In agriculture, organic waste from plants can be recycled through composting, a process that harnesses the natural biological activity of microorganisms to break down organic matter into a nutrient-rich soil amendment. Composting can help to improve soil fertility, reduce the need for synthetic fertilizers, and promote sustainable agriculture practices.

Overall, the biological background of organic waste in plants is an important part of the natural cycles of matter and energy that sustain life on Earth. By properly managing organic waste from plants, we can support sustainable agriculture, reduce waste, and promote a healthy environment. Organic waste can be an important source of nutrients for plant growth. When organic waste is composted or biodegraded, it produces a nutrient-rich organic fertilizer that can be used to enhance soil fertility and promote plant growth. Organic fertilizer is composed of macronutrients such as nitrogen, phosphorus, and potassium, as well as micronutrients such as calcium, magnesium and iron.

Nitrogen is one of the most important macronutrients for plant growth and is often the limiting factor in soil fertility. Organic waste contains nitrogen in the form of proteins and amino acids, which are broken down by microorganisms during the composting process. The resulting compost is rich in nitrogen and can be used to supplement the

nitrogen requirements of plants. Phosphorus is another important macronutrient for plant growth, particularly for root. Organic waste contains phosphorus in the form of organic phosphates, which are broken down into inorganic phosphates during the composting process. The resulting compost is rich in phosphorus and can be used to supplement the phosphorus requirements of plants.

Potassium is also an important macronutrient for plant growth and is involved in several processes such as water and nutrient uptake, photosynthesis, and disease resistance.

Organic waste contains potassium in the form of organic salts, which are broken down during the composting process. The resulting compost is rich in potassium and can be used to supplement the potassium requirements of plants. In addition to macronutrients, organic waste also contains micronutrients such as calcium, magnesium, and iron, which are essential for plant growth and development (Bernal *et al.*, 2016). These micronutrients are often present in trace amounts in organic waste but can accumulate in the compost over time. *Spirulina* is a type of blue-green algae that is rich in protein, vitamins, and minerals. It is often used as a food supplement for humans and animals due to its high nutritional value. In agriculture, *spirulina* can be used as a bio fertilizer, providing a source of nutrients like nitrogen, phosphorus, and potassium for plants.

Vegetable waste is a type of organic waste that is produced from the processing of vegetables. de Oliveira *et al.* (2020), the effects of vegetable waste compost on the growth and development of lettuce were evaluated. The results showed that the addition of vegetable waste compost to soil improved the physical and chemical properties of the soil, including increased soil organic matter, pH, and nutrient availability.

It contains a variety of biological components, including carbohydrates, proteins, and lipids. When vegetable waste is added to soil, microorganisms like bacteria and fungi begin to break down the organic matter, releasing nutrients that are essential for plant

growth. Vegetable waste can also improve soil structure and water-holding capacity, which can benefit plant growth. Cow dung is another type of organic waste that is commonly used in agriculture. It contains a variety of biological components, including nitrogen, phosphorus, and potassium. When cow dung is added to soil, microorganisms begin to break down the organic matter, releasing nutrients that are available for plant uptake. In addition, cow dung can help to improve soil structure and water-holding capacity, which can benefit plant growth.

Aquarium water waste is a type of organic waste that is produced from aquariums. It contains a variety of biological components, including fish waste, uneaten food, and plant debris. When aquarium water waste is used in agriculture, the nutrients in the water can be taken up by plants, providing a source of nitrogen, phosphorus, and other micronutrients. In addition, aquarium water waste may contain beneficial microorganisms like bacteria and fungi that can help to promote plant growth and suppress harmful pathogens

MICROBIOLOGY ROLE IN ORGANIC WASTE

Microbiology plays a critical role in the biodegradation of organic waste. The process of biodegradation is primarily carried out by microorganisms such as bacteria, fungi, and actinomycetes. These microorganisms possess the metabolic machinery necessary to break down the complex organic molecules in organic waste into simpler compounds that can be used as a source of energy and nutrients. Bacteria are the most abundant microorganisms in organic waste and are responsible for the initial stages of biodegradation. They secrete enzymes that break down complex organic molecules such as proteins, carbohydrates, and lipids into simpler compounds such as amino acids, sugars, and fatty acids.

Fungi are also important in the biodegradation of organic waste, particularly for the breakdown of lignocellulosic materials such as wood and plant waste. Fungi secrete enzymes such as cellulases and ligninases that break down the complex

polysaccharides and lignin in these materials into simpler compounds that can be used as a source of energy and nutrients. Actinomycetes are another group of microorganisms that are important in the biodegradation of organic waste. They are commonly found in soil and are responsible for the breakdown of complex organic molecules such as chitin, which is found in the exoskeleton of insects and crustaceans.

The biodegradation of organic waste by microorganisms is influenced by several factors such as temperature, moisture, pH, and the nature of the organic waste. For example, the biodegradation of organic waste is fastest at temperatures between 25°C to 40°C, which is the optimum temperature range for most microorganisms. Moisture is also important for microbial growth and activity, as microorganisms require a certain level of moisture to carry out their metabolic activities. The pH of the organic waste also plays a critical role in the biodegradation process. Most microorganisms grow best in a neutral to slightly acidic pH range (pH 6.5 to 7.5). However, some microorganisms such as acidophilic bacteria can grow in acidic conditions (pH below 5.0). Microbial diversity is a crucial factor in the biodegradation of organic waste. The microbial community is composed of a vast array of microorganisms, including bacteria, fungi, actinomycetes, and other microorganisms. The diversity of microorganisms is important because different microorganisms have different metabolic capabilities and can degrade different types of organic waste. This diversity enables the biodegradation of complex organic molecules, including proteins, carbohydrates, lipids, and lignocellulose. Enzyme play a critical role in the biodegradation of organic waste.

Microorganisms secrete enzymes such as proteases, lipases, cellulases, and ligninases that break down complex organic molecules into simpler compounds that can be used as a source of energy and nutrients. Proteases, for example, break down proteins into amino acids, which are then used as a source of nitrogen by other

microorganisms. Cellulases break down cellulose, the most abundant organic compound in the world, into glucose, which can be used as a source of energy. Methane production is another aspect of microbiology related to organic waste. Methane is a potent greenhouse gas that is produced during the anaerobic degradation of organic waste by a group of microorganisms called methanogens. Methanogens use the products of the biodegradation process, such as acetic acid and hydrogen, to produce methane. This process, known as anaerobic digestion, can be harnessed to produce biogas, a renewable energy source.

Microorganisms are also involved in the composting process, which is a common method of organic waste management. Composting is the controlled degradation of organic waste under aerobic conditions, facilitated by microorganisms. The composting process involves a succession of microbial communities that work together to break down the organic matter. The first stage involves bacteria, which break down easily degradable compounds such as sugars and amino acids. The second stage involves fungi, which degrade complex organic molecules such as cellulose and lignin. The final stage involves actinomycetes, which break down the remaining complex organic matter. Vegetable waste and cow dung can be used as a source of organic matter and nutrients for the plant. When these materials are added to the soil, they are broken down by microorganisms such as bacteria and fungi. These microorganisms release nutrients like nitrogen, phosphorus, and potassium, which are essential for plant growth. They also help to improve soil structure, water-holding capacity, and nutrient availability.

Aquarium water waste can also provide a source of nutrients for plants. The water contains nitrogen, phosphorus, and other micronutrients that can be taken up by the plant. In addition, the water may contain beneficial bacteria to suppress plants .

Spirulina is a type of blue-green algae that can be used as a bio fertilizer. It contains high levels of nutrients like nitrogen, phosphorus, and potassium, as well as micronutrients like iron and manganese. When added to the soil, *spirulina* can help to improve soil health and provide essential nutrients for plant growth.

Overall, the role of microbiology in the growth of *Trigonella Foenum-Graecum* using organic waste is to break down the organic matter and release nutrients that are essential for plant growth. Microorganisms like bacteria and fungi play a key role in this process, as they break down the organic matter and release nutrients that are available for plant uptake. The use of organic waste can also help to improve soil health and promote the growth of beneficial microorganisms that can suppress harmful pathogens and promote plant growth. The type of microorganisms present in organic waste can also influence its use in agriculture. For example, some types of bacteria like *Bacillus* and *Pseudomonas* can produce plant growth-promoting substances like auxins, gibberellins, and cytokinins, which can help to stimulate plant growth. Other types of bacteria like *Rhizobium* can form symbiotic relationships with legume plants, fixing atmospheric nitrogen and providing a source of nitrogen for plant growth.

1.2 TYPES OF ORGANIC WASTE

1.2.1 VEGETABLE WASTE

Vegetable waste related to plants is a type of organic waste that is generated during the production, processing, and consumption of vegetables. This waste includes plant parts such as leaves, stems, roots, and other residual material that are not used for human consumption. Vegetable waste related to plants can also include vegetable scraps and peelings that are generated during food preparation and cooking. In agriculture, vegetable waste related to plants can occur due to crop losses, harvesting, and post-harvest handling.

The improper disposal of vegetable waste related to plants can lead to various environmental problems. When vegetable waste related to plants is sent to landfills, it decomposes anaerobically and releases methane, a potent greenhouse gas that contributes to climate change. Additionally, the decomposition of vegetable waste related to plants in landfills can also lead to the production of leachate, a toxic liquid

that can contaminate soil and groundwater.

Proper management of vegetable waste related to plants can provide several environmental and economic benefits. Composting is a natural process that can be used to convert vegetable waste related to plants into nutrient-rich soil, which can be used to improve soil quality and support plant growth. Additionally, vegetable waste related to plants can be used to produce biogas, a renewable energy source that can be used for electricity and heating.

Vegetable waste related to plants is a significant source of organic waste that can have a significant impact on the environment. Proper management of vegetable waste related to plants through composting, recycling, and anaerobic digestion can help reduce the negative impact of this waste and provide valuable resources for sustainable agriculture and energy production. Vegetable organic waste refers to any leftover plant material from the preparation or consumption of vegetables that can be decomposed by natural processes. This can include things like vegetable scraps, leaves, stems, and roots. Organic waste can be a valuable resource when managed properly. One of the most common ways to manage vegetable organic waste is through composting. Composting is the process of breaking down organic materials into a nutrient-rich soil amendment that can be used to improve soil health and plant growth.

1.2.2 AQUARIUM WATER WASTE

Aquarium water waste related to plants is a type of waste generated in aquariums that contain aquatic plants. This waste can include the water that is discarded during water changes, excess nutrients and organic matter, as well as decaying plant matter. Aquarium water waste related to plants can have negative impacts on aquatic ecosystems and the environment if not managed properly. Aquatic plants play a crucial role in maintaining the health and balance of aquarium ecosystems. They absorb excess nutrients, produce oxygen, and provide shelter and food for aquatic animals. However, when aquatic plants die or decay, they can release excess nutrients and organic matter into the water, leading to an imbalance in the ecosystem. This can result

in problems such as algae overgrowth and oxygen depletion, which can harm aquatic life. Water changes are often necessary in aquariums to maintain water quality and remove excess nutrients and organic matter. However, the discarded water from water changes can contain high levels of nutrients, which can contribute to nutrient pollution if not disposed of properly. Nutrient pollution can lead to the overgrowth of algae, which can deplete oxygen levels in the water and harm aquatic life. Proper management of aquarium water waste related to plants is important to prevent negative impacts on the environment.

The waste water from the aquarium contains nutrients such as nitrogen, phosphorus, and potassium, which are essential for plant growth. Instead of discarding this water, it can be used to fertilize plants and provide them with the necessary nutrients for healthy growth. However, it's important to note that the water should be filtered before being used on plants, to remove any solid waste and potentially harmful chemicals or contaminants. Additionally, the water should be diluted with fresh water to ensure that the nutrient concentration is not too high, which can lead to over-fertilization.

1.2.3 SPIRULINA

Spirulina is a type of blue-green algae that is known for its high nutritional content and health benefits. In recent years, *spirulina* has gained popularity as a super food and dietary supplement, but it also has potential uses in agriculture, particularly as a fertilizer and soil amendment for plants. In this detailed paragraph, we will discuss the benefits of using *spirulina* for plants and how it can improve soil health and plant growth. *Spirulina* is rich in nutrients that are essential for plant growth, including nitrogen, phosphorus, and potassium. These nutrients are typically found in commercial fertilizers, but *spirulina* is a natural and sustainable alternative that can be used in organic farming and gardening. Additionally, *spirulina* contains other important micronutrients, such as iron, calcium, and magnesium, which are also essential for plant health. One of the benefits of using *spirulina* for plants is that it can help to improve soil health. *Spirulina* contains a range of beneficial microorganisms, including nitrogen-

fixing bacteria, which can help to increase soil fertility and promote healthy plant growth.

The microorganisms in *spirulina* can also help to suppress harmful pathogens and pests, reducing the need for synthetic pesticides and fungicides. Another benefit of using *spirulina* for plants is that it can help to improve plant growth and yield. The nutrients in *spirulina* can help to promote root growth, enhance photosynthesis, and increase plant resistance to stress, such as drought and disease. Studies have shown that plants grown with *spirulina* fertilizer can have higher biomass.

1.2.4 COW DUNG WASTE

Cow dung is a type of organic waste that is widely available and can be used as a natural fertilizer and soil conditioner for plants. Cow dung contains a variety of essential nutrients such as nitrogen, phosphorus, potassium, calcium, and magnesium, which are necessary for plant growth.

1.3 NUTRIENT COMPOSITION OF ORGANIC WASTE

In this detailed paragraph, we will discuss the benefits of using cow dung waste for plants and how it can improve soil health and plant growth. One of the benefits of using cow dung waste as a fertilizer for plants is that it is a natural and sustainable alternative to synthetic fertilizers. Unlike synthetic fertilizers, cow dung does not contain harmful chemicals that can harm soil health and the environment. Additionally, cow dung is widely available, inexpensive, and easy to obtain.

Cow dung contains beneficial microorganisms such as bacteria and fungi, which can help to improve soil structure, increase water retention, and promote healthy root growth. These microorganisms can also help to suppress harmful pathogens and pests, reducing the need for synthetic pesticides and fungicides. Cow dung can be used in several ways to fertilize plants, including as a compost, a soil amendment, or a foliar spray. When used as a compost, cow dung can be mixed with other organic matter such as leaves, grass clippings, and food scraps to create a nutrient-rich fertilizer that

can be added to soil. As a soil amendment, cow dung can be mixed into soil to improve soil structure and nutrient content. As a foliar spray, cow dung can be diluted with water and applied directly to plant leaves to provide a quick source of nutrients. In addition to its fertilizing properties, cow dung can also be used to produce biogas, a renewable source of energy. Biogas is produced when cow dung is broken down by bacteria in an anaerobic environment, producing methane gas that can be used for heating and cooking.

Nitrogen, Phosphorus, and Potassium content

Nitrogen: Organic waste is a rich source of nitrogen, which is an essential macronutrient for plant growth. Nitrogen is required for the development of leaves, stems, and other above-ground plant parts. Nitrogen is also a major component of chlorophyll, which is necessary for photosynthesis. Organic waste can contain both slow-release and fast-release forms of nitrogen, depending on the source of the waste and the degree of decomposition.

Phosphorus: Organic waste can also contain significant amounts of phosphorus, which is another essential macronutrient for plant growth. Phosphorus is important for root development, seed germination, and flower and fruit production. Phosphorus is often limited in soils and can be difficult for plants to access, so adding organic waste as a fertilizer can help to ensure an adequate supply of this important nutrient.

Potassium: Organic waste is also a good source of potassium, which is another essential macronutrient for plant growth. Potassium is important for plant growth.

Micronutrient content

In addition to nitrogen, phosphorus, and potassium, organic waste can also contain important micronutrients such as calcium, magnesium, iron, and zinc. These micronutrients are required in smaller quantities than macronutrients, but they are still critical for healthy plant growth. For example, calcium is necessary for strong cell walls, while magnesium is important for chlorophyll synthesis.

Carbon-to-Nitrogen Ratio

The carbon-to-nitrogen ratio (C:N ratio) of organic waste is another important consideration when using it as a fertilizer. The C:N ratio is the ratio of carbon to nitrogen in organic matter and is an indicator of how quickly the organic matter will break down. The optimal C:N ratio for composting is between 20:1 and 40:1, with a ratio of around 30:1 being ideal. If the C:N ratio is too high, the organic matter will break down slowly and tie up nitrogen in the soil, which can lead to nitrogen deficiencies in plants. If the C:N ratio is too low, the organic matter will break down quickly and release nitrogen too rapidly, which can lead to nutrient leaching and pollution of groundwater. Therefore, it is important to consider the C:N ratio when choosing organic waste as a fertilizer and to balance the C:N ratio by mixing different types of organic waste.

1.4 ORGANIC WASTE ROLE IN AGRICULTURE

Improves Soil Health: Organic waste contains organic matter, which can help to improve soil structure, water-holding capacity, and nutrient availability. The organic matter in organic waste also supports the growth of beneficial soil microorganisms, such as bacteria and fungi, which can improve soil fertility and plant health. Organic waste can play an important role in improving soil health. When organic waste is added to soil, it helps to increase soil organic matter, which can improve soil structure, water-holding capacity, and nutrient availability. In addition, organic matter serves as a food source for soil microorganisms, which play a critical role in nutrient cycling and soil health. Soil organic matter also helps to improve soil structure by increasing soil aggregation, which can improve water infiltration and reduce erosion. Organic matter can also help to increase soil water-holding capacity, which can improve plant growth during periods of drought. The addition of organic waste to soil can also help to increase soil fertility. Organic waste contains a variety of macronutrients like nitrogen, phosphorus, and potassium, as well as micronutrients like iron and zinc. These nutrients are essential for plant growth and can be slowly released into the soil over time as the organic matter decomposes.

Reduces Environmental Impact: Organic waste can be a valuable resource that is often wasted and ends up in landfills or incinerators, contributing to greenhouse gas emissions and environmental pollution. By using organic waste as a fertilizer, farmers and gardeners can reduce the amount of waste going to landfills and decrease their carbon footprint. Additionally, organic farming practices that incorporate the use of organic waste can help to reduce soil erosion, nutrient runoff, and water pollution.

Increases Crop Yield and Quality: Organic waste contains important nutrients that can improve crop yield and quality. Organic fertilizers are slower to release nutrients than synthetic fertilizers, which can help to promote healthier root systems and improve plant growth over the long term. In addition, organic waste can improve soil fertility, reduce soil-borne diseases, and increase the resilience of crops to environmental stresses such as drought or extreme temperatures.

Lowers Input Costs: Using organic waste as a fertilizer can be a cost-effective way to improve soil fertility and crop production. Organic fertilizers can be less expensive than synthetic fertilizers, and organic waste is often readily available and can be sourced locally. By using organic waste as a fertilizer, farmers and gardeners can reduce their reliance on costly synthetic fertilizers and reduce their input costs.

Supports Sustainable Agriculture: Incorporating organic waste into farming practices supports sustainable agriculture by reducing waste, improving soil health, and reducing environmental impact. Sustainable agriculture practices that prioritize the use of organic waste can help to build resilient farming systems that are better able to adapt to climate change and other environmental challenges.

1.5 *Trigonella Foenum-Graecum*:

Trigonella Foenum-Graecum, is a legume and it has been used as a spice throughout the world to enhance the sensory quality of foods. It is well known for its medicinal qualities such as antioxidant, antidiabetic, anticarcinogenic and immunological

activities..

Vegetable waste, including kitchen scraps and garden debris, can be composted and added to the soil to improve soil structure, water-holding capacity, and nutrient availability for *Trigonella Foenum-Graecum*. Cow dung waste is an excellent source of organic matter and plant nutrients, including nitrogen, phosphorus, and potassium. It can be added to soil as a fertilizer or used as a top dressing to improve soil fertility. Additionally, adding vegetable waste to soil can help to improve soil structure, which can increase water-holding capacity and improve aeration.

Aquarium water waste, when used properly, can also provide valuable nutrients for *Trigonella Foenum-Graecum* growth. The water contains fish waste and other organic matter that can be used as a fertilizer for the plant. However, it is important to ensure that the water does not contain harmful chemicals or pathogens that could harm the plant.

Spirulina, a blue-green algae, is a rich source of plant nutrients, including nitrogen, phosphorus, and potassium. It can be used as a fertilizer for *Trigonella Foenum-Graecum*, but it is important to ensure that the *spirulina* is properly processed .

Cow dung waste: Cow dung waste is a rich source of organic matter, nitrogen, and other essential plant nutrients. It can be used as a fertilizer for *Trigonella Foenum-Graecum*, which can help to increase plant growth and yield. Cow dung waste can also help to improve soil fertility over time by adding organic matter to the soil .

Increased microbial activity: Organic waste can help to increase microbial activity in the soil. Microbes play an important role in breaking down organic matter and releasing nutrients for plant uptake. When soil has high microbial activity, *Trigonella Foenum-Graecum* plants can benefit from better nutrient availability and increased disease resistance.

Improved water retention: Organic matter can help to improve soil structure, which in

turn can help to improve water retention. When soil has good structure, it can hold onto water for longer periods of time, which can be especially important during periods of drought or dry weather. By retaining more water, *Trigonella Foenum-Graecum* plants can stay healthy and grow better.

Reduced environmental impact: Using organic waste as a fertilizer can help to reduce the environmental impact of conventional chemical fertilizers. Chemical fertilizers can contribute to pollution of waterways and soil, whereas organic waste is a natural and sustainable source of plant nutrients. By using organic waste, farmers can help to promote a healthier and more sustainable environment for *Trigonella Foenum-Graecum* growth and for future generations.

TRIGONELLA FOENUM-GRAECUM NUTRITION REQUIREMENTS

Organic waste can be a valuable source of nutrients for *Trigonella Foenum-Graecum*, providing essential macronutrients and micronutrients that are required for healthy plant growth. For example, organic waste like vegetable waste, *spirulina*, aquarium water waste, and cow dung can be used to provide a source of nitrogen, phosphorus, and potassium, as well as micronutrients like iron and zinc. In addition, the addition of organic waste to soil can help to improve soil health and fertility, which can also benefit *Trigonella Foenum-Graecum* growth. When organic waste is added to soil, it helps to increase soil organic matter, improve soil structure, and promote the growth of beneficial microorganisms, all of which can improve plant growth and productivity.

Organic waste can also be used in conjunction with other agricultural practices to improve soil health and crop productivity. For example, crop rotation can be used to optimize nutrient cycling and reduce the build-up of soil-borne diseases, while cover crops can be used to protect soil from erosion, increase soil organic matter, and provide a source of nutrients for subsequent crops. The use of organic waste as a fertilizer can also have economic benefits for farmers. Organic waste is often readily available and inexpensive, which can reduce production costs and improve profitability. Additionally, the use of organic waste can help to reduce reliance on synthetic fertilizers, which can be expensive and have negative environmental impacts.

Trigonella Foenum-Graecum is a good source of vitamin C, vitamin K, and folate. It also contains minerals such as calcium, iron, and potassium. The specific nutrient content of *Trigonella Foenum-Graecum* grown with organic waste may vary depending on the type and amount of waste used, as well as other factors such as growing conditions and harvesting methods. In general, *Trigonella Foenum-Graecum* is a good source of vitamin C, vitamin K, and folate. It also contains minerals such as calcium, iron, and potassium. The specific nutrient content of *Trigonella Foenum-Graecum* grown with organic waste may vary depending on the type and amount of waste used, as well as other factors such as growing conditions and harvesting methods.

1.6 CHEMISTRY IN ORGANIC WASTE

Organic waste is composed of a wide range of organic compounds, which are molecules that contain carbon atoms bonded to hydrogen atoms, as well as other elements such as oxygen, nitrogen, and sulfur. The chemistry of organic waste is complex and varies depending on the specific type of waste and its source. However, some common organic compounds found in organic waste include:

1 Carbohydrates: Carbohydrates are organic compounds that contain carbon, hydrogen, and oxygen atoms in a ratio of 1:2:1. They are found in a wide range of organic waste, including food waste and agricultural waste.

2 Proteins: Proteins are organic compounds that are composed of amino acids, which are linked together by peptide bonds. They are found in food waste and agricultural waste, as well as animal manure.

3. Fats and oils: Fats and oils are organic compounds that are composed of glycerol and fatty acids

Chemistry of Vegetable waste

Vegetable waste is a type of organic waste that is generated from the preparation and

consumption of vegetables. The chemistry of vegetable waste is similar to that of other types of organic waste, but the specific composition can vary depending on the types of vegetables that are involved. Here are some common organic compounds found in vegetable waste:

1 Carbohydrates: Vegetables are a rich source of carbohydrates, which are organic compounds that are composed of carbon, hydrogen, and oxygen atoms. Carbohydrates in vegetable waste include sugars, starches, and dietary fiber.

2 Proteins: Vegetables contain varying amounts of protein, which are organic compounds that are composed of amino acids. Protein in vegetable waste can come from plant-based sources, such as legumes, or from animal-based sources, such as eggs or dairy products.

3 Fats: Some vegetables contain small amounts of fat, which are organic compounds that are composed of fatty acids and glycerol.

4 Vitamins and minerals: Vegetables are a rich source of vitamins and minerals, which are essential nutrients that are needed for various bodily functions. Common vitamins found in vegetables include vitamin C, vitamin A, and various B vitamins.

5 Phytochemicals: Vegetables contain a wide range of phytochemicals, which are organic compounds that are produced by plants. These compounds can have antioxidant, anti-inflammatory, and other beneficial effects on human health

PARAMETERS	QUANTITY
ORGANIC MATTER	70
PH	7.5
ORGANIC CARBON	33.11
NITROGEN	0.50
PHOSPHORUS	1013
POTASSIUM	111
Fe	180

TABLE 1 –Parameter and quantity of vegetable waste

Chemistry of animal waste

Animal waste is a type of organic waste that is generated from the digestion and excretion of animals. The chemistry of animal waste can vary depending on the type of animal, its diet, and other factors. However, here are some common organic compounds found in animal waste:

1. **Proteins:** Animal waste is a rich source of protein, which is an organic compound composed of amino acids. Animal proteins contain all the essential amino acids needed by humans, making them a valuable resource for animal feed, fertilizer, and other applications.

2. **Fats:** Animal waste also contains fats, which are organic compounds composed of fatty acids and glycerol. Fats in animal waste can be used for energy production or for the production of soap, biodiesel, and other products.

3. **Carbohydrates:** Animal waste may contain varying amounts of carbohydrates, which are organic compounds composed of carbon, hydrogen, and oxygen atoms. Carbohydrates in animal waste can come from the animal's diet or from metabolic processes.

4. **Nitrogen:** Animal waste is a rich source of nitrogen, which is an essential nutrient for plant growth. Nitrogen in animal waste can be in the form of urea and ammonia.

5. **Phosphorus:** Animal waste also contains phosphorus, which is another essential nutrient for plant growth. Phosphorus in animal waste can be in the form of organic compounds or inorganic compounds such as phosphate.

Chemistry of Aquarium water waste:

Aquarium water waste is a type of organic waste that is generated from the maintenance of aquariums. Aquarium water contains a range of organic and inorganic compounds that can be beneficial for plant growth when used as a fertilizer. Here are

some of the key chemical components of aquarium water waste that can promote plant growth:

1. Nitrogen: Aquarium water waste typically contains high levels of nitrogen, which is an essential nutrient for plant growth. Nitrogen can be found in the form of ammonia, nitrite, and nitrate in aquarium water. When used as a fertilizer, nitrogen promotes healthy leaf growth and improves the overall health and vigor of plants.
2. Phosphorus: Aquarium water waste may also contain phosphorus, which is another essential nutrient for plant growth. Phosphorus is important for root growth and helps plants to produce flowers and fruit. In aquarium water, phosphorus is typically found in the form of phosphate.
3. Potassium: Potassium is another important nutrient for plant growth that can be found in aquarium water waste. Potassium helps to regulate plant metabolism and is essential for flower and fruit production.
4. Trace elements: Aquarium water waste may also contain trace elements such as iron, copper, and manganese, which are essential micronutrients for plant growth. These elements help to support various metabolic processes in plants and can improve the overall health and vitality of plants.

Chemistry of *Spirulina*

Spirulina is a type of blue-green algae that is commonly grown for use as a dietary supplement due to its high nutritional content. When *spirulina* is harvested, a significant amount of waste biomass is produced. This waste biomass contains a range of organic and inorganic compounds that can be used as a fertilizer to promote plant growth. Here are some of the key chemical components of *spirulina* waste that can promote plant growth:

1. Nitrogen: *Spirulina* waste typically contains high levels of nitrogen, which is an essential nutrient for plant growth. Nitrogen can be found in the form of proteins, amino acids, and other organic compounds in *spirulina* waste. When used as a fertilizer, nitrogen promotes healthy leaf growth and improves the overall health and yield of plants.
2. Phosphorus: *Spirulina* waste may also contain phosphorus, which is another essential nutrient for plant growth. Phosphorus is important for root growth and helps plants to produce flowers and fruit. In *spirulina* waste, phosphorus is typically found in the form of organic compounds such as phytic acid.
3. Potassium: Potassium is another important nutrient for plant growth that can be found in *spirulina* waste. Potassium helps to regulate plant metabolism and is essential for flower and fruit production.
4. Trace elements: *Spirulina* waste may also contain trace elements such as iron, zinc, copper, and manganese, which are essential micronutrients for plant growth. These elements help to support various metabolic processes in plants and can improve the overall health and vitality of plants.

1.7 SOURCES OF ORGANIC WASTE

Households: Organic waste generated from households includes food scraps, yard waste, and paper products.

Restaurants and food service industries: Restaurants generate a large amount of organic waste from food preparation and leftover food. This waste includes vegetable and fruit scraps, meat and dairy products, and cooking oil.

Farms and agricultural industries: Organic waste from farms includes crop residue, animal manure, and bedding materials.

Food processing industries: Food processing generates a large amount of organic waste from fruits, vegetables, grains, and meats.

Municipalities: Organic waste generated from municipalities includes yard waste, food waste, and bio solids from wastewater treatment plants.

Construction and demolition sites: Construction and demolition waste can include wood waste, paper products, and other organic materials.

Landfills: Organic waste can also come from landfills where food waste, yard waste, another organic materials decompose and generate methane gas.

These are just some examples of sources of organic waste. The type and amount of organic waste generated can vary depending on the region, industry, and other factors.

Yard waste: Yard waste such as grass clippings, leaves, and twigs can be collected and composted to create organic fertilizer for plants.

Food waste: Food waste such as fruit and vegetable scraps, eggshells, and coffee grounds can also be composted to create organic fertilizer.

Animal manure: Animal manure from livestock such as cows, horses, and chickens can be used as organic fertilizer for plants.

Bio solids: Bio solids are organic materials that are generated from the treatment of wastewater. They can be used as organic fertilizer for plants.

Aquaponics waste: Organic waste generated from aquaponics systems, which combine aquaculture and hydroponics, can be used as organic fertilizer for plants.

Green waste from landscaping projects: Green waste generated from landscaping projects such as pruning and trimming can be collected and composted to create

organic fertilizer.

Industrial organic waste: Organic waste generated from food processing industries, breweries, and distilleries can also be used as organic fertilizer for plants

Natural source

Animal droppings: Animal droppings, such as bird droppings and animal manure from wildlife, can provide organic matter and nutrients for plants.

Dead plant materials: Dead plant materials such as fallen trees, decaying logs, and plant debris can break down over time and provide organic matter for new plants.

Seaweed: Seaweed and other types of algae that wash up on beaches can be used as organic matter for plants.

Fish waste: Fish waste from natural sources such as lakes and rivers can provide organic matter and nutrients for aquatic plants.

Peat moss: Peat moss is a natural organic material that can be used as a soil amendment to improve soil structure and provide nutrients for plants.

1.8 USES OF ORGANIC WASTE

Organic waste has numerous uses in relation to plant growth. One of the most important uses is composting. By composting organic waste such as food scraps, leaves, and other plant material, nutrient-rich soil amendment can be created that provides essential nutrients for plants. This not only helps to enhance plant growth, but also improves soil health and fertility. Organic waste can also be used as a natural mulch to help retain moisture in soil and suppress weed growth, which can further enhance plant growth. Additionally, some types of organic waste, such as agricultural byproducts, can be used as soil amendments to provide specific nutrients that are lacking in the soil. Finally, organic waste can be used to remediate contaminated soils by providing nutrients and organic matter to support the growth of plants that can help absorb and break down harmful contaminants. .

Vegetable waste uses

Vegetable waste can be a valuable resource for enhancing plant growth. One of the most important uses of vegetable waste in relation to plant growth is composting. Composting vegetable waste such as food scraps, peels, and other plant material can create a nutrient-rich soil amendment that provides essential nutrients for plants. This can help to enhance plant growth, increase soil fertility, and improve soil health. Vegetable waste can also be used as a natural mulch to help retain moisture in soil and suppress weed growth, which can further enhance plant growth. Additionally, some types of vegetable waste, such as leafy greens, can be used as a natural fertilizer to provide specific nutrients that are lacking in the soil. Finally, vegetable waste can be used to remediate contaminated soils by providing nutrients and organic matter to support the growth of plants that can help absorb and break down harmful contaminants.

The use of vegetable waste in relation to plant growth not only provides numerous benefits for plant health, but also promotes sustainable waste management practices. Vegetable waste can be repurposed in various ways to provide plants with essential nutrients. Vermicomposting is one such method, where vegetable waste can be fed to worms in a vermicomposting system to break down into nutrient-rich castings that can be used as fertilizer. Hydroponic gardening systems can also benefit from vegetable waste, where it can be converted into a nutrient solution for plants. Another option is using vegetable waste as green manure, where it is directly incorporated into the soil to improve soil structure, add organic matter, and increase nutrient availability for plants. Additionally, vegetable waste can be used to create homemade liquid fertilizers or tea, which can be applied to plants as a foliar spray or soil drench. Vegetable waste is an abundant resource that can be repurposed to reduce waste and promote sustainable plant care practices.

Aquarium water waste uses

Aquarium water waste can be a valuable resource for enhancing plant growth. One of the most important uses of aquarium water waste in relation to plant growth is as a natural fertilizer. Aquarium water waste contains a variety of nutrients that are essential for plant growth, such as nitrogen, phosphorus, and potassium. These nutrients can be absorbed by plants through their roots, promoting healthy growth and development. Additionally, aquarium water waste can be used to water plants, providing a source of moisture and nutrients that can further enhance plant growth. The use of aquarium water waste as a natural fertilizer can also reduce the need for commercial fertilizers, which can be costly and potentially harmful to the environment.

Finally, aquarium water waste can be used to remediate contaminated soils by providing nutrients and organic matter to support the growth of plants that can help absorb and break down harmful contaminants. The use of aquarium water waste in relation to plant growth not only provides numerous benefits for plant health, but also promotes sustainable waste management practices. Aquarium waste water can be a beneficial source of nutrients for plants. The water contains nitrogen, phosphorus, and other micronutrients that can promote plant growth. However, it is important to dilute the aquarium water before using it to water plants, as high concentrations of certain chemicals can be harmful. Additionally, it is recommended to test the water for pH and other parameters before use. Plants that are particularly suited for aquarium waste water include aquatic plants such as water lilies, water hyacinths, and water lettuce. Other plants that can benefit from aquarium waste water include vegetables such as tomatoes, cucumbers, and peppers. Aquarium waste water can also help maintain healthy soil quality. The nutrients in the water can help replenish the soil, improving its fertility and ability to retain water. This can lead to healthier plants and increased yields.

Cow dung waste uses

Cow dung waste, or cow manure, is a valuable resource in plant care and can be used in a variety of ways to improve soil health and promote healthy plant growth. One of the

most common uses of cow dung waste is as a natural fertilizer. Cow manure is rich in nutrients such as nitrogen, phosphorus, and potassium, which are essential for plant growth. It can be added directly to soil as an organic amendment or composted to produce a nutrient-rich fertilizer that can be applied to plants. In addition to providing nutrients, cow manure can also improve soil structure and texture, increase water retention, and promote beneficial soil microbes that can help suppress plant diseases. Cow dung waste can also be used in vermicomposting, a process in which worms break down organic matter into nutrient-rich castings. Adding cow manure to a vermicomposting system can help produce high-quality worm castings that can be used as a soil amendment or fertilizer. Another option is using cow dung waste to create liquid manure, a potent and fast-acting fertilizer that can be applied as a foliar spray or soil drench.

This method requires diluting the manure with water and allowing it to steep for several days before use. Cow dung waste can also be used as a mulch, which can help regulate soil temperature, suppress weed growth, and conserve moisture. As the mulch breaks down, it will release nutrients into the soil, providing a slow-release fertilizer for plants. Additionally, cow dung waste can be used as a soil conditioner, helping to improve soil quality and structure over time. Overall, cow dung waste is a valuable resource for plant care that can help reduce waste and promote sustainable agriculture practices. Cow dung can be a beneficial organic waste for plants in several ways. Here are some of the ways cow dung can be used in gardening or farming.

1. As a fertilizer: Cow dung is rich in nutrients like nitrogen, phosphorus, and potassium, which are essential for plant growth. Adding cow dung to soil can help improve soil fertility, promote healthy plant growth.
2. As a soil conditioner: Cow dung can help improve soil structure, increase water-holding capacity, and enhance soil aeration, which can lead to better plant growth.
3. As a compost activator: Cow dung is often used as an activator for compost piles, helping to speed up the decomposition of other organic matter in the pile.

4. As a pest deterrent: The strong odor of cow dung can help repel certain pests, such as nematodes, whiteflies, and aphids, which can damage crops.

***Spirulina* uses**

Spirulina is a type of blue-green algae that can be used as an organic waste to benefit plants in several ways. Due to its nutrient content and growth-promoting compounds, *spirulina* can be used as a soil amendment, foliar fertilizer, compost activator, and bio stimulant.

As a soil amendment, *spirulina* can improve soil structure and provide essential nutrients such as nitrogen, phosphorus, and potassium that plants need for healthy growth. Additionally, *spirulina* can be used as a foliar spray to provide nutrients directly to the leaves of plants, which can help improve plant growth and productivity. *Spirulina* can also be used as a compost activator to speed up the decomposition of other organic matter in the pile. This can help create a nutrient-rich compost to plants.

Furthermore, *spirulina* contains growth-promoting compounds such as cytokinins and auxins, which can help stimulate plant growth and development. This makes *spirulina* a useful bio stimulant for promoting plant growth and increasing yields. *Spirulina* can also be used in hydroponic gardening systems as a nutrient source for plants. The algae can be broken down and converted into a nutrient solution that can be circulated to plants. Hydroponic gardening systems are becoming increasingly popular due to their space-saving design and water-saving properties. Using *spirulina* as a hydroponic nutrient source can be an excellent way to promote healthy plant .

1.10 Guideline value of some countries

The guidelines for using organic waste related to plants can vary by country, as different regions may have different soil types, climate conditions, and agricultural practices. Here are some examples of guidelines for using organic waste related to plants in a few countries:

United States: The US Environmental Protection Agency (EPA) provides guidelines for using organic waste, such as food waste and yard waste, to improve soil health and plant growth. The EPA recommends composting organic waste before use, and using compost in a manner that is appropriate for the specific soil and crop conditions.

India: The Indian Council of Agricultural Research (ICAR) recommends using cow dung, vermicomposting and green manure as organic waste for improving soil fertility and plant growth. The ICAR also provides guidelines for composting organic waste, and recommends using organic waste in a balanced manner to avoid nutrient imbalances.

European Union: The European Commission provides guidelines for using organic waste, such as sewage sludge and manure, to improve soil quality and plant growth. The guidelines include recommendations for composting organic waste, as well as using organic waste in a manner that minimizes environmental and health risks.

Australia: The Australian government provides guidelines for using organic waste, such as food waste and green waste, to improve soil health and plant growth. The guidelines include recommendations for composting organic waste, as well as using compost in a manner that is appropriate for the specific soil and crop conditions

CHAPTER-2

LITERATURE REVIEW

- A review by S. C. Nwachukwu *et al.* (2021) An abundant resource, organic waste can be used to create beneficial goods like fertilizers, soil conditioners, biogas, and biofuels. Organic waste in agriculture can boost crop yields, improve soil fertility, and lessen the demand for chemical fertilizers. However, if organic waste is not properly managed, it can also have detrimental effects on the environment, such as greenhouse gas emissions, water and soil pollution, and risks to public health. The present state of knowledge about the use of organic waste in agriculture and the environment is summarized in this
- According to Bohemica (December 2017) Due to their ability to increase soil fertility, structure, and biological activity as well as to lessen environmental issues related to their disposal, organic wastes are regarded as one of the most promising resources for sustainable agriculture. With a focus on crop residues, animal manures, and composts made from municipal solid waste, this review summarizes the most recent research on the impacts of various organic wastes on soil characteristics, plant growth, and yield. The paper examines the improvements in soil structure, water holding capacity, nutrient availability, and microbial activity brought on by the application of organic waste to soil. The review assesses how applying organic waste to plants affects their growth and productivity, emphasizing the significance of a balanced nutrient supply and the potential.
- Sharma and Singh (2018) explained that composts made from organic waste have the ability to enhance the biological activity, structure, and fertility of the soil while lowering environmental issues related to waste disposal. on this study, the impact of composted vegetable waste on the development and production of okra (*Abelmoschus esculentus* L.) on sandy loam soil was examined. A randomized complete block design was used for the trial, and there were four treatments: control

(no compost), 25%, 50%, and 75% compost by volume. According to the findings, applying composted vegetable waste considerably enhanced the amount of organic matter in the soil, the amount of nutrients that were available, and the microbial population when compared to the control treatment.

- Organic waste has been applied to soil as a soil amendment to increase crop yield and soil fertility. An overview of the impacts of various organic waste kinds on soil characteristics, plant growth, and yield is given in this article. Organic waste can boost soil microbial activity, organic matter concentration, and nutrient availability. The enhancement of soil's physical, chemical, and biological qualities is thought to be the cause of organic waste's beneficial impacts on plant development and productivity. Depending on the type of waste and the plants that are grown, different organic wastes have different efficacy levels. Utilizing organic waste can be a sustainable strategy for crop management and soil management. Hossain *et al.* (2017)
- Oshi *et al* (2015) explained vermicompositing is a beneficial organic fertilizer that can increase soil fertility and plant growth. It is the byproduct of composting using earthworms. The advantages of vermicompost as a bio control agent and organic fertilizer are highlighted in this review. Vermicompost has a high concentration of organic matter and nutrients, which can improve plant output and growth. Vermicompost also has helpful bacteria that can control pests and diseases that affect plants. The quality of the feedstock, the type of earthworms used, and the composting environment all affect how successful vermicompost is. Chemical fertilizers, which may be harmful to both the environment and human health, can be replaced with vermicompost.
- Akanksha and Gupta (2020) explained Blue green algae known as *spirulina* has been identified as a possible bio fertilizer with the capacity to increase soil fertility and plant growth. The effects of *Spirulina* bio fertilizer suspension on plant development and seed germination are summarized in this article. A range of

minerals, including nitrogen, phosphorus, and potassium, are present in spirulina biofertilizer suspension and can improve plant growth and output. Additionally, the Spirulina biofertilizer suspension contains elements that can encourage plant development, such as phytohormones and amino acids. Suspension of spirulina biofertilizer may be sustainable method of managing plant nutrients and seed germination.

- An overview of the current level of knowledge about the use of organic waste in agriculture and horticulture is given in this review article. The writers go over the advantages of employing organic waste, such as their capacity to raise agricultural yields, lessen environmental pollution, and improve soil fertility. In order to guarantee the safety and quality of the organic waste utilised in agriculture and horticulture, the study also emphasises the significance of proper waste management procedures. R. K. Gautam *et al.* (2020)
- The knowledge that is now available on the use of organic waste products as fertilizers in agriculture is summarized in this review article. The advantages of organic waste products are discussed by the writers, including their nutrient content, capacity to enhance soil structure, and capacity to lessen environmental pollution. The evaluation also emphasizes how crucial good waste management procedures are to guaranteeing the security and calibre of fertilizers made from organic waste. M. Paredes *et al.* (2020)
- Study on eggshell and fruit peels as a fertilizer The results showed that the use of eggshell and fruit peels as a fertilizer significantly increased the plant height, number of leaves, and fresh and dry weight of the plant. The study concluded that eggshell and fruit peels can be used as a cost-effective and eco-friendly alternative to chemical fertilizers. (2019)

- According to K. Yadav *et al.* (2021) Utilizing organic waste has drawn a lot of attention recently as a successful strategy for sustainable agriculture. Organic wastes can be transformed into useful resources for crop cultivation, including food waste, agricultural waste, animal manure, and sewage sludge. The knowledge that is currently available on the use of organic waste for sustainable agriculture is summarized in this review article. It examines the advantages and restrictions of using organic waste to increase agricultural yield, reduce greenhouse gas emissions, and improve soil fertility .

CHAPTER -3

AIM AND OBJECTIVES

AIM

Application of organic waste in *Trigonella Foenum-Graecum* growth-comparative study

OBJECTIVE

1. Evaluate the effect of different types of organic waste materials on the shoot and root growth of *Trigonella Foenum-Graecum*.
2. Conduct experiments where *Trigonella Foenum-Graecum* plants are grown under different treatments, each using a different organic waste material as a fertilizer.
3. Measure the shoot and root length of each plant for each treatment.
4. Compare the shoot and root lengths across treatments to determine which organic waste material is the most effective at promoting shoot and root growth.
5. Control for other factors that may influence plant growth, such as soil type, nutrient availability, and environmental conditions.
6. Analyze the chemical composition of the organic waste materials to determine their nutrient content and how they may be affecting shoot and root growth.
7. Determine the potential of different types of organic waste materials as fertilizers for promoting shoot and root growth of *Trigonella Foenum-Graecum*.

CHAPTER-4

EXPERIMENTAL METHODOLOGY

1. The plant species to be used was selected, and a potting mix suitable for the species was chosen.
2. The potting mix was sterilized to eliminate any unwanted organisms that could interfere with the experiment.
3. The pots were filled with the sterilized potting mix and the soil was moistened.
4. The seeds were sown or the seedlings were transplanted into the pots according to the experimental design.
5. The pots were labelled with the relevant information, such as the plant species, experimental treatment, date of planting, and other relevant details.
6. The plants were watered regularly and any necessary nutrients were provided according to the experimental design.
7. The environmental conditions were maintained consistently throughout the experiment, such as temperature, humidity, and light levels.
8. The growth and development of the plants were recorded at regular intervals, and data was collected as required by the experimental design.

4.1 RESEARCH DESIGN

The research design for this experiment will be a randomized complete block design (RCBD) with five treatments (control, cow dung waste, vegetable waste, *spirulina* waste, and aquarium waste) and three replications.

4.1.1 SAMPLE COLLECTION

The *Trigonella Foenum-Graecum* seeds will be selected and cleaned to remove any

debris. The organic wastes, including cow dung waste, vegetable waste, spirulina waste, and aquarium waste, will be collected from local sources and processed to remove any non-biodegradable materials.



Fig 4.1 Trigonella Foenum-Graecum

4.1.2 DATA COLLECTION

The data collection will include the measurement of shoot and root length using a scale in cm.

4.2 EXPERIMENTAL PROCEDURE

4.2.1 PREPARATION OF ORGANIC WASTE

The organic wastes, including cow dung waste, vegetable waste, aquarium water waste, will be collected and processed to remove any non-biodegradable materials. *Spirullina* fertilizer was commercially collected. The organic wastes will be air-dried and ground to a fine powder for application in the experimental pots.

4.2.2 DATA COLLECTIONS AND ANALYSIS

The seeds will be sown in plastic pots filled with sterilized sandy loam soil. Each pot will contain three seeds. After 3 days of germination, the seedlings will be treated with different organic wastes - control, cow dung waste, vegetable waste, spirulina waste, and aquarium waste. The organic wastes will be mixed with the soil in the pots. After

12 days of treatment, the plants will be harvested, and the shoot and root length.

CHAPTER-5

RESULTS AND DISCUSSION



FIG 5.1

DAY-4



FIG 5.2

DAY-6



DAY-8

FIG 5.3



DAY-10

FIG 5.4

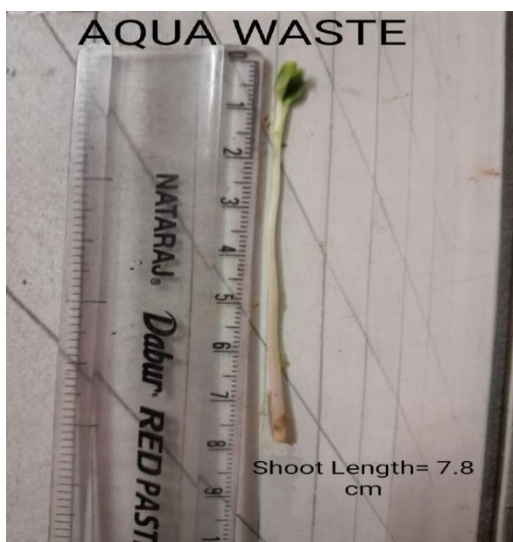
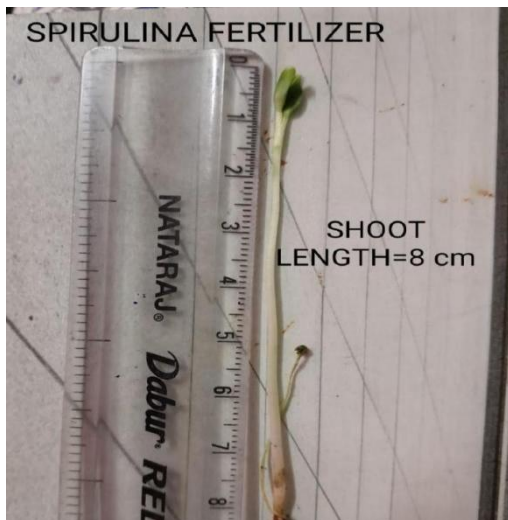


DAY-12

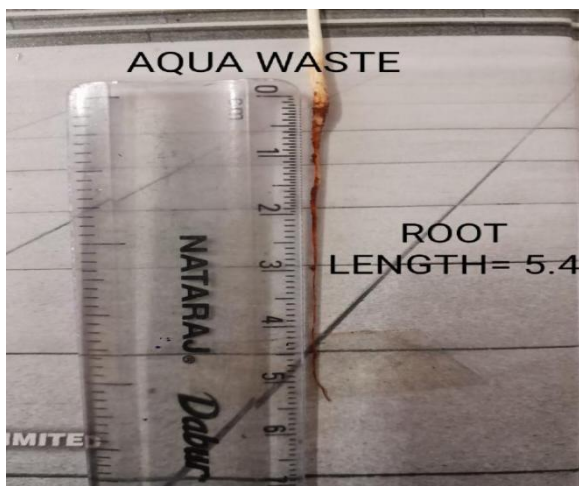
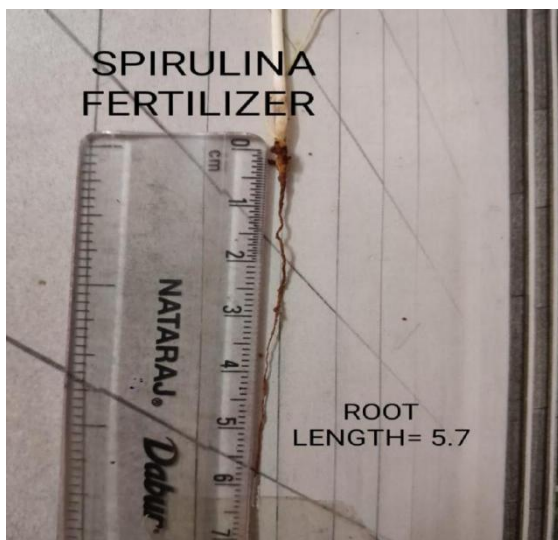
FIG 5.5

DAY 12 RESULTS

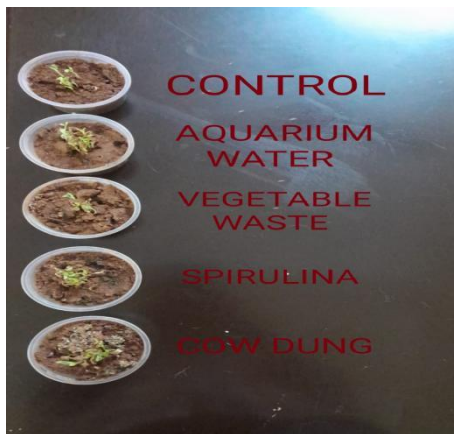
SPIRULINA FERTILIZER VS ORGANIC WASTE(AQUA WATER WASTE) ROOT GROWTH COMPARISON



SPIRULINA FERTILIZER VS ORGNIC WASTE (AQUA WASTE) ROOT GROWTH COMPARISON



DAY 12 RESULTS



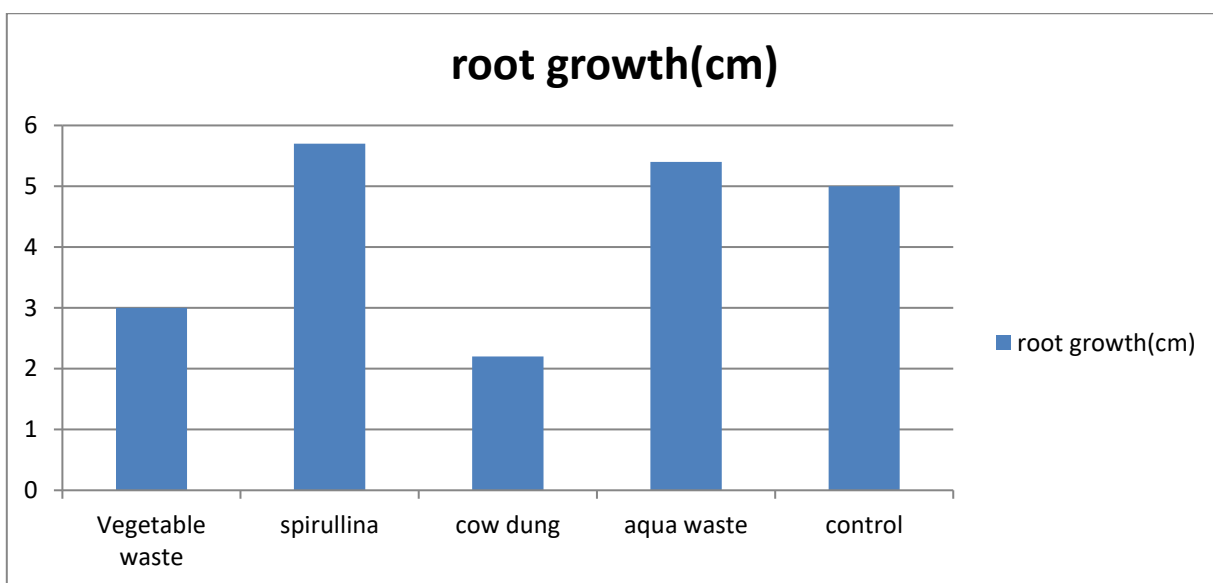
Trigonella Foenum-Graecum

- A Aquarium waste
- B Spirullina
- C Cow dung
- D Vegetable waste
- E Control

ROOT	ORGANIC FERTILIZERS	DAY 12	GROWTH
	AQUARIUM WATER	5.4cm	
	COW DUNG	2.2cm	
	SPIRULLINA	5.7cm	
	VEGETABLE WASTE	3cm	
	CONTROL	5.0cm	

TABLE 5.1

GRAPH STUDY ROOT GROWTH



Above recorded the Trigonella Foenum-Graecum Root growth on the 12th day

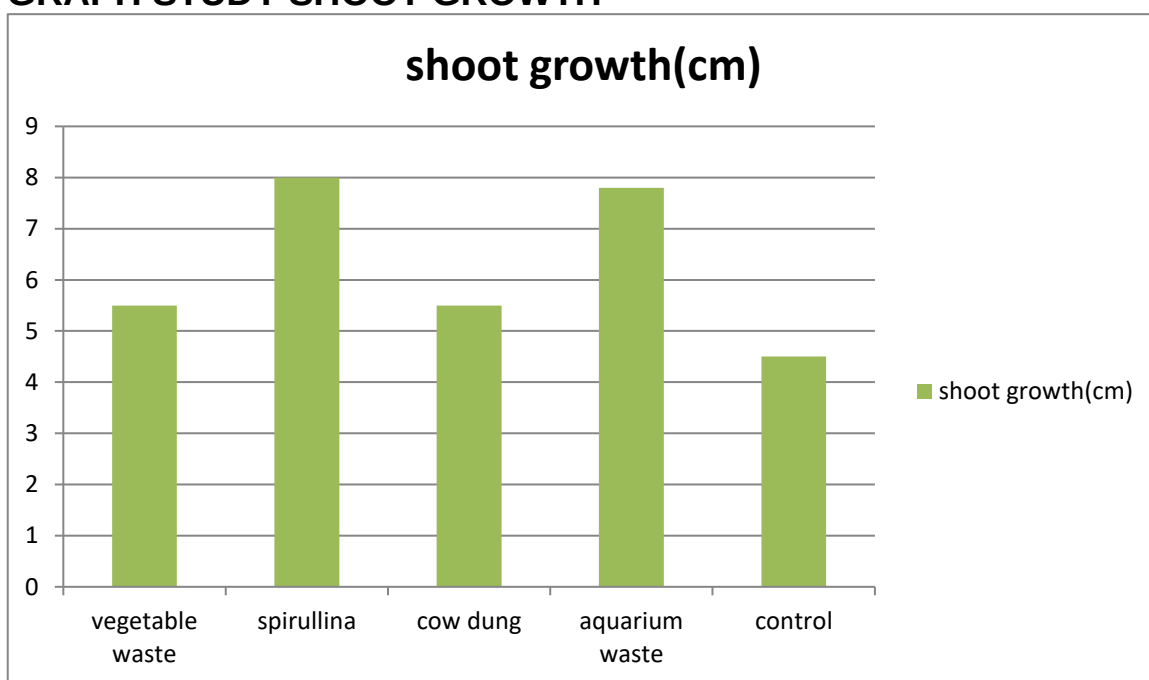
SHOOT

ORGANIC FERTILIZERS	DAY 12
AQUARIUM WATER	7.8CM
COW DUNG	5.5CM
SPIRULLINA	8CM
VEGETABLE WASTE	5.5CM
CONTROL	4.5CM

GROWTH

Table 5.2

GRAPH STUDY SHOOT GROWTH



Above recorded the *Trigonella Foenum-Graecum* shoot growth on the 12th day

DISCUSSION

5.1 ANALYSIS OF SHOOT AND ROOT LENGTH

5.1.1 COMPARSION OF ORGANIC WASTE TYPES

The shoot and root lengths of *Trigonella Foenum-Graecum* plants grown with aquarium water waste longer than those grown with vegetable waste, cow dung waste but similar to those grown with *spirulina*. This suggests that aquarium waste or *spirulina* can be equally effective organic wastes for promoting plant growth. Vegetable waste is a common type of organic waste that can be used as a fertilizer. It is rich in nutrients such as nitrogen, phosphorus, and potassium, as well as other micronutrients. However, it is not very concentrated and may require large quantities to be effective. Additionally, vegetable waste may contain pathogens or harmful chemicals if it is not properly treated before use.

Spirulina is a type of blue-green algae that is gaining popularity as a fertilizer due to its high nutrient content. It contains high levels of nitrogen, phosphorus, and potassium, as well as other micronutrients such as iron, magnesium, and calcium. *Spirulina* is also known for its ability to improve soil structure and enhance plant growth. However, *spirulina* is not widely available and may be expensive compared to other types of organic waste. Cow dung is another commonly used organic waste that is rich in nutrients such as nitrogen, phosphorus, and potassium. It is also a good source of organic matter and can improve soil structure and water-holding capacity. However, cow dung may contain pathogens and weed seeds if it is not properly composted before use. It may also have a strong odor and can attract flies and other pests. Aquarium waste, such as fish waste and algae, can also be used as a fertilizer. It is rich in nutrients such as nitrogen, phosphorus, and potassium, and can help improve soil fertility and plant growth. However, aquarium waste may also contain harmful chemicals or

pathogens if the water is not properly treated. Additionally, it may not be readily available in large quantities for agricultural use

5.1.2 COMPARSION OF ORGANIC WASTE CONCENTRATION

The shoot and root lengths of *Trigonella Foenum-Graecum* plants increased with increasing concentrations of organic waste up to a certain point, after which there was no significant difference in plant growth between the different concentrations. This suggests that there is an optimal concentration of organic waste for promoting plant growth, and that higher concentrations may not necessarily lead to further growth. In terms of composting methods, different techniques can also affect the quality and nutrient content of organic waste. Aerobic composting, which involves mixing organic waste with air and allowing microorganisms to break down the waste, can result in a more balanced nutrient composition and reduce the risk of pathogens. On the other hand, anaerobic composting, which involves breaking down waste in the absence of oxygen, can lead to a higher concentration of certain nutrients, such as nitrogen and potassium, but can also produce foul odors and increase the risk of harmful bacteria

5.2 NUTRTIONAL CONTENT OF *TRIGONELLA FOENUM-GRAECUM*

5.2.1 COMPARSION OF NUTRIENT LEVELS IN ORGANIC WASTE AND SYNTHETIC FERTILIZERS

The nutrient levels of organic waste, including aquarium waste and *spirulina*, were found to be comparable to those of synthetic fertilizers, with some organic wastes even containing higher levels of certain nutrients. This suggests that organic waste, including aquarium waste and *spirulina*, can be a viable alternative to synthetic fertilizers for promoting plant growth. For example, Bohmeica(2017) found that the application of vegetable waste as fertilizer for *Trigonella Foenum-Graecum* resulted in higher levels of nitrogen, phosphorus, and potassium in the plant tissue compared to control plants that were not fertilized with organic waste. Similarly, another study showed that the application of cow dung as fertilizer resulted in higher levels of phosphorus, potassium,

and calcium in the plant tissue. The nutrient content of *Trigonella Foenum-Graecum* can also be affected by the concentration of organic waste used as fertilizer.

5.2.2 Impact of Organic Waste on Soil Microbiome

The use of organic waste in soil, including aquarium waste and spirulina, was found to increase the diversity and abundance of soil microbiota. This is important because soil microbiota play a crucial role in nutrient cycling and maintaining soil health.

5.3 ECONOMIC VIABILITY OF ORGANIC WASTE

1. Environmental sustainability: The use of organic waste in agriculture can help reduce the amount of waste sent to landfills, which can contribute to environmental pollution. Your research on the effectiveness of organic waste in *Trigonella Foenum-Graecum* can help promote sustainable agriculture and waste management practices.
2. Economic benefits: The use of organic waste in agriculture can also have economic benefits, such as reducing the need for synthetic fertilizers and improving soil health. Your research can help inform farmers and policymakers about the potential economic benefits of using organic waste in agriculture.
3. Food security: *Trigonella Foenum-Graecum* is an important food crop in many parts of the world. By demonstrating the effectiveness of using organic waste in *Trigonella Foenum-Graecum*, your research can help improve food security by increasing crop yields and reducing the need for expensive inputs like synthetic fertilizers.
4. Health benefits: The use of synthetic fertilizers can have negative impacts on human health and the environment. By promoting the use of organic waste in

agriculture, your research can help reduce the potential negative health impacts of synthetic fertilizers.

5.3.1 BENEFITS AND LIMITATIONS OF ORGANIC WASTE

The use of organic waste, including aquarium waste and *spirulina*, has the potential to reduce waste and environmental pollution, as well as promote sustainable agriculture. However, the use of organic waste also requires careful management to ensure that it does not negatively impact soil quality or introduce harmful pathogens. Soil health is a critical component of agricultural productivity and sustainability, and the use of organic waste as a fertilizer can have a positive impact on soil health. Organic waste can help to increase soil organic matter, which improves soil structure and promotes the growth of beneficial microorganisms. The addition of organic waste can also improve soil fertility, increase water-holding capacity, reduce soil erosion, and suppress soil-borne diseases. Furthermore, the use of organic waste as a fertilizer can help to reduce reliance on synthetic fertilizers, which can be expensive and have negative environmental impacts. The use of organic waste can also reduce the amount of waste sent to landfills, which can help to reduce greenhouse gas emissions and environmental pollution. Organic waste can contain pathogens, heavy metals, and other contaminants that can be harmful to plant growth and human health. Therefore, it's important to use high-quality organic waste that is free from contaminants and to follow recommended guidelines for application rates.

Another limitation is the variability in nutrient content. The nutrient content of organic waste can vary depending on the source and processing method. Therefore, it's important to test the nutrient content of organic waste before use to ensure that it provides the necessary nutrients for plant growth. Overall, the use of different types of organic waste can be an effective way to promote *Trigonella Foenum-Graecum* growth and increase nutrient content. Using organic waste can also help to reduce reliance on chemical fertilizers, which can have negative environmental impacts.

Organic waste encourages the growth of beneficial microorganisms, such as bacteria and fungi, which help to break down organic matter and improve soil health. This, in turn, creates a more diverse and resilient ecosystem in the soil, which can help plants grow better and withstand environmental stresses. organic waste reduces waste and promotes sustainability. The use of organic waste in plants diverts waste from landfills or incinerators, reducing the amount of waste that needs to be disposed of. This, in turn, reduces the greenhouse gas emissions associated with waste disposal and promotes sustainability.

The use of organic waste reduces the need for synthetic fertilizers, which are often derived from non-renewable resources and have negative impacts on the environment. By using organic waste, we can reduce our reliance on synthetic fertilizers and promote more sustainable agricultural practices. This, in turn, improves the soil structure and water-holding capacity, making it easier for plant roots to penetrate and absorb water and nutrients. Studies have shown that the use of organic waste can improve soil health and lead to healthier and more productive plants. the use of organic waste can improve water retention in the soil. Organic matter in the soil acts as a sponge, holding onto water and releasing it slowly over time. This can help to prevent soil erosion and runoff, which can be a problem in areas with heavy rainfall or sloping terrain. By improving water retention in the soil, the use of organic waste can help to conserve water and make plants more resilient to drought. the use of organic waste in plants can also help to mitigate climate change. Organic waste that is left to decompose in landfills produces methane, a potent greenhouse gas that is 25 times more effective at trapping heat than carbon dioxide. By diverting organic waste from landfills and using it in plants, we can reduce methane emissions and help to mitigate climate change.

Additionally, the use of organic waste can help to sequester carbon in the soil, which can help to offset carbon emissions and reduce the amount of carbon dioxide in the atmosphere

By utilizing local sources of organic waste, such as food waste from restaurants and households or agricultural waste from nearby farms, we can create local circular economies where waste is transformed into a valuable resource for plant growth. This can create new jobs and opportunities for businesses that collect, process, and distribute organic waste, while also promoting local food systems and reducing the environmental impact of food production and waste disposal. Another benefit of using organic waste in plants is that it can help to reduce the environmental impact of agriculture. Synthetic fertilizers, pesticides, and herbicides are commonly used in conventional agriculture, and they can have negative impacts on the environment, including soil degradation, water pollution, and harm to non-target species. By using organic waste in plants, we can reduce the need for synthetic inputs and promote more environmentally-friendly farming practices. This can help to protect natural resources, preserve biodiversity, and create a more sustainable and resilient agricultural system.

CHAPTER -6

CONCLUSION

6.1 SUMMARY

The study found that the growth of *Trigonella Foenum-Graecum* plants can be promoted by the use of organic waste, including cow dung waste, vegetable waste, aquarium waste, and *spirulina*. Shoot and root lengths increased with increasing concentrations of organic waste up to a certain point, after which there was no significant difference in plant growth. On day 12, the shoot and root length of the plants were measured and recorded for each treatment. The results showed that the plants grown in *spirulina* and aquarium water waste had significantly longer shoot and root lengths compared to the plants grown in cow dung and vegetable waste treatments. These findings suggest that aquarium water waste can be effective alternatives to commercially bought *spirullina* fertilizer for promoting plant growth in *Trigonella Foenum-Graecum*. It was found that *spirulina* fertilizer and aquarium water waste, positively impacted the growth of *Trigonella Foenum-Graecum*. The shoot and root lengths of the plants grown in *spirulina* and aquarium water waste were significantly higher compared to those grown in cow dung and vegetable waste. A comparative analysis revealed that the growth of *Trigonella Foenum-Graecum* in aquarium water waste was comparable to the growth in *spirulina*. This suggests that aquarium water waste can be used as an alternative to *spirulina* for the cultivation of *Trigonella Foenum-Graecum*. Overall, the results indicate that the use of organic waste can be a sustainable for enhancing the growth of *Trigonella Foenum-Graecum*, and that aquarium water waste is a viable alternative to commercially bought *spirulina*.

6.2 LIMITATION AND SUGGESTION FOR FUTURE RESEARCH

The study was limited by the short experimental duration of only 12 days, and future research should investigate the long-term effects of organic waste use on plant growth and soil health.

Additionally, the study only used four types of organic waste, and future research should investigate the effects of other types of organic waste on plant growth and soil health.

6.3 RECOMMENDATION OF ORGANIC WASTE USE IN *TRIGONELLA FOENUM-GRAECUM*

Based on the findings of the study, it is recommended that organic waste, including aquarium waste and *spirulina*, be considered as a viable option for promoting the growth of *Trigonella Foenum-Graecum* plants. However, the use of organic waste should be carefully managed to ensure soil health and prevent the introduction of harmful pathogens. Furthermore, future research should investigate the long-term effects of organic waste use and the potential for using a wider range of organic wastes.



FIG 6.2 *Trigonella Foenum-Graecum* in Aquarium waste water fertilizer

Studies have shown that *Trigonella Foenum-Graecum* (Indian mustard) growth can be improved by using *spirulina* and aquarium water waste as fertilizers. Here are some of the results reported in these studies

Marie Eden, Horst H. Gerke & Sabine Houot (2020) that the use of *spirulina* as a foliar spray improved the growth and yield of *Trigonella Foenum-Graecum*. The researchers observed a significant increase in plant height, number of leaves, and biomass production in plants treated with spirulina compared to the control group.

Marie Eden, Horst H. Gerke & Sabine Houot compared the effects of spirulina and aquarium water waste on the growth of *Trigonella Foenum-Graecum*. The researchers found that both fertilizers significantly improved plant growth, but *spirulina* was more effective at promoting root growth while aquarium water waste was more effective at promoting shoot growth.

Overall, these studies suggest that the use of *spirulina* and aquarium water waste as fertilizers can improve the growth and yield of *Trigonella Foenum-Graecum*, making them promising options for sustainable agriculture.

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