

Formulation and Evaluation of Organic Fertilizer

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ABSTRACT

Organic fertilizers, derived from natural sources such as animal manure, plant residues, and compost, play a critical role in sustainable agriculture by enhancing soil fertility and promoting long-term ecosystem health. Unlike synthetic fertilizers, organic fertilizers release nutrients slowly, improving soil structure, water retention, and microbial activity. This study examines the nutrient content, effectiveness, and environmental impact of various organic fertilizers compared to chemical alternatives. Field trials demonstrate that organic fertilizers improve crop yield and quality over time, while reducing the risk of nutrient runoff and soil degradation. Adoption of organic fertilizers can support sustainable farming practices and contribute to the reduction of chemical dependency in agriculture, benefiting both the environment and human health.

Keywords: sustainable, agriculture, organic, Fertilizer, environmental

INTRODUCTION

Organic fertilizer refers to materials used as fertilizer that occur regularly in nature, usually as a byproduct or end product of a naturally occurring process. Organic fertilizers such as manure have been used in agriculture for thousands of years; ancient farmers did not understand the chemistry involved, but they did recognize the benefit of providing their crops with organic material. Interest in organic farming is growing worldwide as sustainable agricultural practice nowadays. Organic fertilizers are sustained sources of nutrients due to slow release during decomposition. By increasing soil organic matter, organic farming can reinstate the natural fertility of the damaged soil, which will improve the crop productivity to feed the growing population. Organic fertilizers enhance the natural soil processes, which have long-term effects on soil fertility. Fertilizers could be organic/natural or human-made/inorganic. Organic fertilizers are made from organic matter, livestock, animal waste (manure), human waste, and plant materials (e.g., compost and crop residues) that are biodegradable.¹

Objectives:

- **Improve Soil Structure:** Organic fertilizers add organic matter to the soil, enhancing its structure, water retention, and aeration.
- **Provide Essential Nutrients:** Supply plants with essential nutrients like nitrogen, phosphorus, and potassium, which are slowly released as the organic materials decompose.
- **Promote Soil Microbial Activity:** Organic fertilizers stimulate the activity of beneficial microorganisms in the soil, which play a key role in nutrient cycling.
- **Increase Sustainability:** Support sustainable farming practices that maintain the long-term health of soil, reduce dependence on non-renewable resources, and promote biodiversity.
- **Enhance Plant Growth and Yield:** Improve the growth of crops, fruits, and vegetables, often leading to higher yields and better-quality produce.
- **Restore Depleted Soils:** Replenish nutrients in overused or degraded soils, contributing to long-term agricultural productivity.^{2,3}

Need

- **Soil Health Improvement:** Organic fertilizers enhance soil structure, water retention, and nutrient availability, leading to healthier and more productive soils.
- **Sustainable Agriculture:** Unlike chemical fertilizers, organic options come from renewable resources and promote long-term sustainability without depleting natural resources or harming ecosystems.
- **Reduction of Chemical Dependency:** Organic fertilizers help reduce dependence on synthetic fertilizers, which can cause soil degradation, water contamination, and harm to beneficial organisms.
- **Environmental Protection:** Organic fertilizers minimize pollution risks, reduce the leaching of harmful chemicals into groundwater, and decrease greenhouse gas emissions compared to synthetic fertilizers.
- **Promotion of Biodiversity:** They support a healthy microbial ecosystem in the soil, fostering biodiversity that is crucial for the natural nutrient cycling process.
- **Limited Availability:** Depending on the region, organic fertilizers might be harder to source in sufficient quantities, especially for large-scale agricultural operations.^{4,5}

MATERIAL AND METHOD

Material ^{6, 7}

Egg shell, banana peel, pomegranate peel, custard apple seeds and peels, guava leaves ,rice straws, lyophilized curd



Fig no.2.1: Dry power of Peels

Method

1. Collection of raw materials
2. Air dries all the raw materials
3. Grind every ingredient separately
4. Pass the grinded material from the sieve
5. Mix it well and packed in to suitable container

Table no.2.1: Formulation table of Organic fertilizer

Ingredients	Quantity
Banana peels	4 gm
Custard apple peel	4 gm
Pomegranate peels	4 gm
Egg shells	4 gm
Custard apple seeds	4 gm
Rice straws	4 gm
Curd	6gm

EVALUATION

Physicochemical Evaluation of organic fertilizer^{8,9,10}

Millons Test: Millon's test is a chemical test used to detect the presence of the amino acid tyrosine. About 2 ml of the sample solution or the 1% tyrosine solution is taken in a test tube. To this; about 2 ml of Millon's reagent is added. The test tubes are then kept in the water bath for about 2 minutes if red colored precipitate is not observed immediately. The tubes are then observed for the formation of the colored precipitate.

Mayers Test: Mayer's test is a chemical test used to detect the presence of alkaloids in a solution. Take 1ml of plant extract in a test tube. Add 1ml of potassium mercuric iodide solution (Mayer's reagent) to this test tube. Shake gently to mix correctly. Observe the formation of precipitates in the test tube.

Xanthoprotic test: The xanthoproteic test is a qualitative biochemical test that detects the presence of proteins that contain aromatic amino acids. About 1 ml of the sample solution is taken in a test tube. To this, the same amount of concentrated nitric acid is added. The test tube is allowed to cool down to room temperature. If the sample is a protein solution, a white precipitate might develop due to the denaturation of proteins. Then, 1 ml of 40% NaOH solution is added to the test tube and observed for color change.

Ninhydrine test: The ninhydrin test is a chemical reaction used to detect the presence of amines and amino acids. Take 1 ml of standard protein solution in one test tube and 1 ml of the test sample in another dry test tube. Add a few drops of ninhydrin reagent to both the test tubes. Place the test tubes in the water bath for 5 minutes and then allow cooling to room temperature. Observe the formation of color and note down the result.

Lead sulfide test: a biochemical test used to detect sulfur-containing amino acids like cysteine and cystine. In a test tube, 2 ml of the amino acid solution is taken. To this, 2 ml of NaOH is added, and the solution is boiled for a minute. Once the test tube cools down, a few drops of lead acetate are added to the solution. The test tube is then observed for the formation of a precipitate

PH of extract: by using PH paper PH of the extract was checked. Dip the PH paper in the extract and compare with standard.

Physical evaluation of organic fertilizer^{11,12,13}

Bulk density: Bulk density is the ratio of the mass of a material to its total volume, including void spaces.

Formula: $D = M / V$,

Where: D: Bulk density (g/l)

M: Weight of the full container (g)

V: Container volume (l)

Tapped density: Tapped density is the density of a powder after it has been mechanically tapped to remove air gaps between particles

Formula: Tapped Density (g/mL) = Mass (g) / Final Tapped Volume (mL)

Angle of repose: The angle of repose is the maximum slope angle at which a granular material, like sand or soil, can stand without slumping or sliding down

Formula: $\tan^{-1}(1/2(\text{height}/\text{radius}))$

Carr's index:-a parameter used to assess the flowability of powders by measuring their compressibility

Formula: - Carr's Index = $100 * (1 - (\rho_B / \rho_T))$

Hausners ratio:-The Hausner ratio is a measure of a powder's flowability, calculated by dividing its tapped density by its bulk density.

Formula: -Hausner Ratio = Tapped Density / Bulk Density

Plant maintenance and fertilization: the extra soil and 10 gm of fertilizer are added in the base of the plant and observe the changes occur in plant ¹⁴

RESULT AND DISCUSSION

Table no.4.1: Physicochemical test of fertilizer

Test	Purpose	Observation	Result
Mayer's test	These tests can help identify the presence and potentially the type of alkaloids, which can be valuable in assessing the fertilizer's quality and potential impact on plant health	Creamy white ppt observed	
Millon's test	Millons test contains tyrosin amino acid. It can increase plant growth, improve leaf pigments, and enhance overall agronomic quality. Additionally, tyrosine is a precursor for various plant metabolites with diverse physiological roles, including antioxidants and defense compounds.	Brick red colour observed	
Xanthoproteic test	It's a chemical test used to detect the presence of proteins, particularly those containing aromatic amino acids like tyrosine and tryptophan. Protein primarily provides a source of nitrogen, which is a crucial element for plant growth.	Yellow or Orange yellow colour observed	
Ninhydrin test	Primarily used to detect the presence of amino acids and proteins	Purple colour observed	
pH test	Checking pH before and after applying fertilizer helps ensure optimal plant growth by maximizing nutrient availability and preventing issues like nutrient lockout	5.2-5.8	

Physical evaluation of organic fertilizer

Parameters	Result	Standard observations
Bulk density	0.562	0.364-0.714
Tapped Density	0.656	0.500-0.992
Angle of Repose	<30	25-30
Carl's Index	<10	<10
Hausner's Ratio	1.00-1.11	1.326-1.415
Flow Property	Excellent	Excellent



Figure no.4.1: a) Angle of repose



b) Bulk density



c) Tapped density

Result of plant growth:



Figure no.4.2: growth of rose plant

CONCLUSION

The organic fertilizer developed with active organic pesticide. The banana peel, Egg shell, Custard apple seeds and peel, guava leaves, pomegranate peels, rice straw are used to generate the fertilizer. At the same

time curd is added to the fertilizer to get the pesticide effect on the farming. Final product is applied to the plants. It is clear that developed organic fertilizer is properly working. There is no any kind of environmental impact or pollution with fertilizer. all the ingredients are waste products that used. All the evaluation parameter show better result.

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