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Original Research Paper

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UTILIZATION OF PILOT SCALE BIOGAS SLURRY BY PRODUCING BIOMANURE FOR *SOLANUM LYCOPERSICUM*

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ABSTRACT The Consistent Demand For Fossil Fuels On A Rapid Scale Has Negative Impact On The Environment And Public Health. Therefore Renewable Energy Has Potential Alternative And Reduced Side Effects. Around A Decade, Anaerobic Digestion Treatments Are Used For Biomass Processing. Biogas And Bio Fertilizers Are The Resources Developed By Anaerobic Digestion. In This Study, Renewable Organic Carbon Wastes Are Secreted And Introduced To A Pilot Scale Digester. The Slurry, Water And Solid Waste In Ratio 3:5:2 Was Maintained Throughout The System. The Experimental Design Was Maintained For 30 Days. A Total Of 4 Litres Of Biogas Was Generated During This Period. The Biometric Evaluations Were Done For 90 Days On *Solanum Lycopersicum,* After Application Of Liquid Bio Fertilizers Formulated From Biogas Effluent.

KEYWORDS : Anaerobic Digestion, Biomanure, Biofertilizer, *Solanum lycopersicum.*

Introduction

Biogas produced from organic wastes by continuous action of methanogenic bacteria through anaerobic decomposition [1].Liquid bio-fertilizers are liquid formulation containing not only the desired microorganisms and their nutrients but also special cell protectants or chemicals that promote formation of resting spores or cysts for longer shelf life and tolerance to adverse conditions [2]. Indiscriminate use of synthetic fertilizers has led to the pollution and contamination of soil, and has polluted water basins, destroyed micro-organisms and friendly insects, making the crop more prone to diseases and reduced soil fertility [3]. This research is intended to evaluate the effect of different chemical pre-treatments on potato peel waste, in conditions for mesophilic digestion.

Methane and acid-producing bacteria act in a symbiotical way. Acid producing bacteria create an atmosphere with ideal parameters for methane producing bacteria. On the other hand, methane-producing microorganisms use the intermediates of the acid producing bacteria. Without consuming them, toxic conditions for the acid-producing microorganisms would develop inside the digestor and finally methanogen remains. In real time fermentation processes the metabolic actions of various bacteria acts in a design. No single bacterium is able to produce fermentation products alone as it requires others too [4]. It is of paramount importance today to focus on the sustained economic use of existing limited resources and on identifying new technologies and renewable resources, for example, biomass, for future energy supply [5][6]. The resultant slurry is separated to make bio fertilizer and bio manure. Biometric evaluations were focussed on *Solanum lycopersicum*. In the present study, biogas is produced from segregated waste, the slurry collected is upgraded with a potential agro industrial waste degrading isolate *Pseudomonas aeruginosa* MTCC 9236 and further organic fertilizers are applied to *Solanum lycopersicum* plants.

Materials and Methods

A separate container for coconut shells, egg shells, peels and chicken mutton bones. These will be crushed separately by mixer grinders. Different containers were used to collect the wet waste, stale cooked food, waste milk products. The vegetables refuse like peels, rotten potatoes and coriander leaves were collected.

1.1 Pretreatment

In this stage the waste materials are treated with water or other chemicals which aid in the digestion of these wastes. Mixed waste crushed in homogenizers at 23,500 rpm for 5 seconds to breakdown large particles into smaller ones. The substrate materials are fed to the digester tanks where water and other materials are added to allow the digestion of wastes.

1.2 Anaerobic Digestion

The wastes are digested by *Methanobacterium* isolated from domestic Biogas Plant. The maintenance of pH, temperature and other factors influencing the digestion of the wastes were optimized accordingly. The slurry was collected from a bio gas domestic unit in Irijalakuda, Thrissur District, Kerala. The slurry was introduced in ratio 2 liters mixed with 1 kg of grinded kitchen waste with 3 liters of water. The digester had a capacity of 10 liters. The slurry was also analyzed for presence of Methanogens by microscopy and cultural characteristics. Important aspect is smoother running of plant by avoiding the choking of the plant. This chocking occurs due to thick biological waste that not reaches to the microorganisms to digest. The easy answer to this problem was to convert solid wastes into liquid slurry.

1.3 Anaerobic Digester and Fermentation

The 10 liter digester can is supplied with PVC pipe, T valve, gas valve, and tyre tube. The grinded slurry in above proportion is stored inside the digester and sealed. The bacteria will be produced within 1-2 weeks. The process will produce methane only at strictly anaerobic condition since the gases methane, hydrogen and carbon monoxide (CO) can be combusted or oxidized with oxygen. All type of gases produced gets stored inside the tyre tube. In order to avoid the excess storage of carbon dioxide the NaOH is supplemented in water at a ratio of 1:50 in a measuring cylinder and attached to tyre tube gas connector. The digestor is painted with black colour since light will allow the algae to grow. If algae grow then oxygen will be produced and bacteria respire aerobically and methane cannot be generated. It also maintains biogas temperature for mesophilic degradation (25 to 37)◦C. The design of biogas plant is completed. Biogas comprises primarily methane (CH_4) and carbon dioxide (CO_2) and may have small amounts of hydrogen sulphide (H_2S), moisture and siloxanes. The fermentation was carried out using the *Methanogens* multiplied in the digester.

1.4 Biogas Purification

Biogas is usually contaminated with Carbon dioxide, hydrogen sulphide and water vapour. These can be removed by NaOH column setup for CO_2. Iron oxide column setup for H_2S and SiO_2, silica beds to remove water vapors. CH_4 alone can be preserved in the tube tyre.

1.5 Biogas Quality Analysis

Flame test was conducted every 7 day interval of CH_4 formation by flaming the gas coming out of ball valve. This was performed for qualitative analysis. The gas evolved is analyzed by *water displacement reaction* and measured in terms of liters. Here the gas coming out of the ball valve is placed inside the measuring cylinder containing water to the graduated level. The upright cylinder displaces the water inside once CH_4 starts flowing inside. The set up is maintained in tray containing ¾ of water level. This confirmed quantitative analysis. The biogas was measured in terms of liquid displacement reaction and the readings tabulated based on graduations marked on the measuring cylinder.

1.6 Development of Fertilizer

The discharge collected after anaerobic fermentation is filtered using a sieve. The solid granules are separated and dried in air. The liquid effluent is treated with bio control agent *Cellulosimicrobium* and incubated for 14 days. The bio fertilizer tested with control slurry in *Solanum lycopersicum*. The biometric valuations were taken every 30 days for 3 months.

Solid granules where subjected to heat at (65 – 70)◦ C. Air dry the granules with windrows. Spent wash prepared by mixing the slurry collected with *Pseudomonas aeruginosa* MTCC 9236. Spent wash is sprayed on each windrow at specific intervals. The windrows are then turned. Bio manure undergoes a composting period of 10 days. Finally compost mixed with press mud and released to fields for sowing.

1.7 Biometric analysis

The parameters tested for liquid biofertilizers and solid manures were plant height, number of leaves, number of fruits and yield per plant. Statistical analysis was done using XL-STAT, 2016.

Results and Discussion

The *Solanum lycopersicum* yield for liquid fertilizer produced was 22.23 Kg from seven treatments of five replications of Biogas spent and Absolute Control Plant generated 18.89 Kg in 90 Days with seven treatments of five replications. Biomanure developed also yielded 19.90 Kg of fruits from four treatments of five replications.

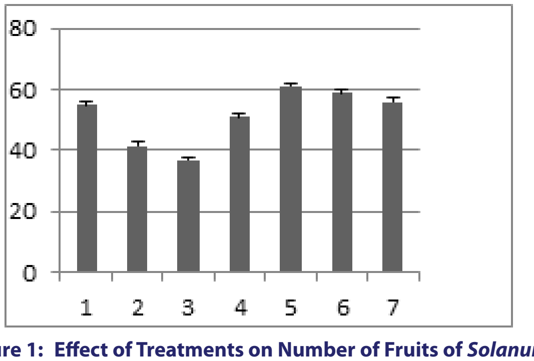

Figure 1: Effect of Treatments on Number of Fruits of *Solanum lycopersicum.*

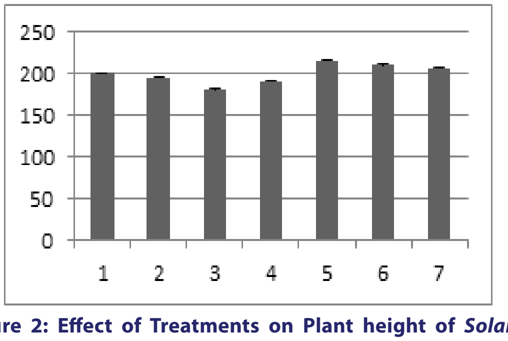

Figure 2: Effect of Treatments on Plant height of *Solanum lycopersicum.*

From the biometric parameters in Figure 1, Figure 2 and Figure 3, it is evident that Treatment 5 containing Liquid Biofertilizer and Soil tested fertilizer in 75:25 ratio shows maximum yield of *Solanum lycopersicum*. Followed by Treatment 6 containing soil tested fertilizer and bio manure in same ratio, Treatment 7 with combination of bio fertilizer and bio manure in 50:50 ratio and Treatment 1 and Treatment 2 containing liquid fertilizer and manure independently. There was no significant difference between Treatment 3 and Treatment 4 containing plants under stress conditions and plants with soil tested fertilizer. This was statistically on par with Packet of Packaging Recommendations containing Farm Yard Manure + Biocontrol + 75% of Nitrogen.

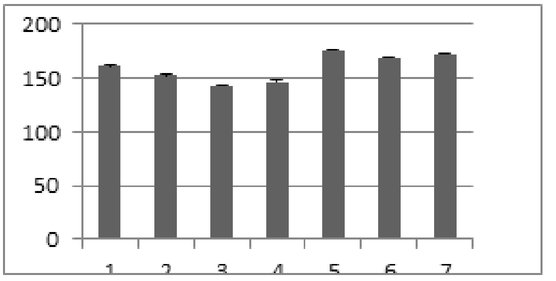

Figure 3: Effect of Treatments on Number of Leaves of *Solanum lycopersicum.*

The application of biogas slurry along with VAM and recommended dose of N, P and K improved the benefit: cost ratio of *Solanum lycopersicum* during summer and rainy seasons [22]. Here a single treatment formulation with biogas slurry as carrier for liquid biocontrol fertilizer increased the yield parameter of *Solanum lycopersicum* statistically.

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