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EFFECT OF MICROBIAL INOCULANT ON COMPOSTING OF VEGETABLE WASTE

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Abstract: Every year, India creates more than 42 million metric tonnes of solid trash. The nation's garbage management system is under a substantial degree of stress as a direct result of the nation's growing urbanisation. Additionally, every year in India, 18% of the fruit and vegetable harvest is wasted owing to rotting. Composting is the most effective method for recycling organic waste currently available. Another sort of compost is called vermicompost, and it is distinguished from ordinary compost by the use of earthworms in the decomposition process. It's probable that microbial inoculants will play a big part in this. Microbial inoculation, a complicated agricultural practise that has an effect on the surrounding environment, is an innovative strategy for raising crop yields while simultaneously minimising the quantity of inorganic fertiliser that is necessary. Inoculants composed of microorganisms are regularly sprayed to soil in order to increase agricultural productivity and even people's overall health. We are all aware that the composting process is an ongoing one that requires a large amount of time. Therefore, as a result of this, it was what first got them interested in employing vermicomposting and microbial inoculants in order to improve the characteristics of the compost and receive the greatest possible advantages. As a result, the idea of integrating all three tactics into compost came into existence. We need to come up with a strategy to utilise the trash from vegetable markets in agricultural practises so that we can improve the general quality of the soil and boost the growth of plants. This experiment is meant for farmers who grow certain types of land, such as fields of cabbage, onions, or bananas. In addition, the experiment helps to highlight the distinction between compost that is generally generated from mixed vegetable waste and compost that is formed from waste that has been separated.

***Index Terms* – Compost, Vermicompost, Microbial Inoculant, Microbes, Bin Composting, Additives.**

I. INTRODUCTION.

Solid Waste Management refers to the management of solid waste, and it presents a serious issue for developing nations like India. In 2020, India's population is projected to reach 138 crores, and that number is expected to grow by another 3.5% year till then. The rate of trash output per capita is expanding at a rate of 1.3% per year[1], hence the yearly rise in rubbish production is around 5%. The world's agricultural and food sectors will confront serious challenges in the 21st century. Among these additional issues, food safety and proper waste management stand out as particularly pressing. The amount of food that ends up in landfills and incineration plants is rising[2]. Waste from India's vegetable markets is a major source of frustration since it is often dumped with other garbage at landfills and dumps. This nuisance is experienced via the release of greenhouse gases into the atmosphere, the creation of leachate, and the creation of odor nuisance. Vegetable waste management and reuse has risen to the forefront as a major environmental issue. India's population and economy have grown rapidly in recent decades, leading to a commensurate increase in the amount of garbage produced, most of it consisting of unwanted vegetables. The improving quality of life in India is the primary driver of this increase. India produces around 150 million tonnes of fruits and vegetables annually. About half of this amount, or 50 million metric tonnes, is waste, which is becoming a problem at municipal landfills and adding considerably to pollution problems in the environment. Therefore, regardless of the method used, control of these organic fractions is crucial for environmental protection and the valorization of by-products generated throughout the process. Since composting provides more economic and environmental advantages than other main waste management systems and eventually results in a more stable product, it is gaining popularity as a means of disposing of organic waste. The final product may be used to do things like make soil more fertile and keep it that way. When used routinely as a soil conditioner, compost generated from vegetable waste increases both the soil's organic matter content and its carbon-to-nitrogen (C/N) ratio compared to unamended soil[3]. Composting relies on a dynamic and quick succession of populations of aerobic bacteria in order to

accomplish the biological oxidation of organic materials. As an exothermic process, composting explains this. Composting is an efficient way to manage vast volumes of these organic wastes that need to be processed.

Composting is a great way to recycle organic waste. Composting is a time-consuming process since the materials need time to decompose and develop fully. Compost characteristics and utility may be improved by vermicomposting and the addition of microbial inoculants, respectively. As a result, we need to come up with a strategy for recycling the garbage produced by vegetable markets and putting it to use in agro - ecosystems, where it may improve soil quality and encourage plant growth. It is the purpose of this study to perfect all three composting methods and evaluate their relative efficacy. One-crop farmers, such those who grow cabbage, onions, or bananas, are the primary target audience for this study. The experiment also aids in differentiating between typical compost created from trash coupled with vegetable matter and compost formed from rubbish that has been isolated.

Composting vegetable waste in a bin to create high-quality compost that includes nutrients in a form plants can utilise is the focus of the present effort. I've seen the research is focused on speeding up the composting process with the use of accelerating elements like commercial vermicompost, microbial inoculant, and natural accelerating ingredients like banana peel, onion peel, and sawdust as a bulking agent.

II. METHODOLOGY

The methodology used for tuning the vegetable waste into a good quality compost is discussed here. This subtopic also describes the procedure adopted for carrying out the study of accelerating ingredients in composting technique and preparation of the compost. the methodology includes various phases of work, that is collection of raw vegetable waste from vendors, procurement of accelerators and bulking agent, setting up of bin composters, collection of samples, determining various characteristics of samples and recording the results of the laboratory test.

2.1 Collection of materials.

To perform biological degradation during composting to get a good quality composed following materials were used.

1. Vegetable waste.

All the vegetable waste required for the study was collected from various vegetable vendors in local market of Amravati. the collected Waste was then shredded for reducing the volume of waste.

Fig 2.1.1.1 Vegetable waste from Vendors.

2. Sawdust

Sawdust is formed of small particles of food and it provides the free airflow, moisture regulation, and maintains the carbon to nitrogen (C: N) ratio[4]. An adequate aeration during composting is necessary for proper composting as to generate a good quality and matured compost. Low aeration rate might lead to anaerobic conditions, while a high aeration rate might result in excessive cooling, that's preventing thermophilic conditions. due to many pores and low moisture content, bulking agent support the creation of inter and intra particle voids[5].

Fig 2.1.2.1 Sawdust

3. Onion peels

Onion skin and peels have antioxidant characteristics and include numerous important components including sulphur, potassium, phosphorus, zinc, iron, vitamins. the onion peels contain roughly 54% of volatile solids with 1.5% dry weight of lignin. onions are one of the key vegetables used in India and onion fields are the most common trash discarded in practically

every kitchen. In the study onion peels were chosen as they are widely obtainable, can act as moisture adjuster due to their low moisture content and have high levels of cellulose which can be an excellent carbon source[6].

Fig 2.1.3.1 Onion Peels

4. Banana peels

Banana peels provides several benefits as they are a major source of soluble and insoluble fibre, antioxidants. Moreover, the skin of a banana contains various minerals and metals including potassium, phosphorus, calcium, magnesium and manganese. banana peels represent roughly 18 to 33% of entire fruit bulk and are considered as a waste product. at present, these peels are not being used for any other applications and are usually disposed as solid trash at considerable expenditure. Potassium is the most essential element that is used as fertiliser. it is crucial for improving general plant vigour, build up, and resistance to pest and disease which is necessary to assist fruit grow[7].

Fig 2.1.4.1 Banana Peels

5. Cabbage Leaves

Cabbage leaves still decompose rapidly in a compost pile, though it is better to break up or cut up complete heads to accelerate the decomposition of the dense portion. Even red cabbages are considered green for composting purposes, thus they are a rich source of nitrogen for your compost pile. Add them to browns if you have a large quantity to dispose of to maintain C : N ratio.

Fig 2.1.5.1 Cabbage Leaves.

6. Vermicompost

Vermicompost from trust basket claims that it can be used in agriculture (organic farming), greenhouses, orchards, lawns, garden plants, and containers. Vermicompost consists solely of earthworm casts. These worm castings provide nutrients that are water-soluble and readily absorbable by plants. It provides nearly all of the required macro- and micronutrients for plant growth. It improves soil aeration, beneficial microorganism-rich soil devoid of weed seeds, pesticides, and hazardous pathogens. No additives such as charcoal, coco peat, or soil are present to increase the weight or volume. Vermicompost from trustbasket enhances soil structure and texture, attracts earthworms with deep burrow, increases the capacity to store water, free of weed seeds, hazardous chemicals, and infection, lack any ingredients that would raise its weight or volume, there is no offensive odour, increase the population of beneficial soil microorganisms[8].

Fig 2.1.6.1 Trustbasket Vermicompost

7. Microbial Inoculant.

Inoculum is an enzyme and microbial combination that is offered by prions biotech. The inoculum, which is short for "bioaugmentation technology product" is a novel idea in the system for managing solid waste. The Indian biotechnology firm is responsible for the development of its active components (prions biotech). This formulation contains microorganisms that have been encapsulated as well as enzymes that decompose organic debris and an odor-removing material that has also been produced by microorganisms. Benefits: formula that is extremely concentrated. The greatest possible reduction in oil and micronutrients. The greatest possible decrease in the amount of aliphatic and aromatic hydrocarbons helps to eliminate sludge. Effective in a diverse array of contexts and circumstances. Reduced levels of total organic carbon, nitrogen, potassium, and potash in accordance with norms. Perform your duties in both an aerobic and an anaerobic state. Never quits working. Mitigates odor issue, Safe environment friendly, Produces bio-stabilized organic manure that is devoid of disease-causing organisms, noxious odours, and weed seeds. Inoculum's mode of action is significantly superior to that of existing competitive products such as enzymes, bacterial, fungal, and actinomycete strains. Multi-enzymes will be helpful in the speedier cleavage of organic molecules, and further degradation will be handled by endospore-forming bacilli, fungal, algal, and actinomycetes strains as long as the appropriate nutrient supplements and moisture levels are present. Inoculum should be dosed at 10–20 grams per kilogram of trash. Make a compact pile in one of the bins, and then sprinkle inoculum over the top of the garbage. To ensure that everything is properly prepared, rotate the heap once every week. In just four to six weeks, the compost will be ready to use[9].

Fig 2.1.7.1 Prions Biotech Inoculum

2.2 Experimental Setup for Bin Composter.

Five bin composters were utilised for this study. One bin composter was utilised for standard composting without additions or bulking agents. In contrast, the other five composters contained both additives and bulking agents. The compost container is manufactured of polypropylene, has a cylindrical shape, weighs 1.8 kilogram, and measures 40 x 36 x 42 centimetres.

The drum features a lid that aids in preventing odours, flies, and rodents. The composter has a capacity of 25 litres. In addition, it includes a tray with microscopic holes. The aim of the holes is to allow leachate to seep to the bottom of the container. The net was installed on the tray's base to prevent the dirt and vegetable debris from escaping. The tap can be used to drain the leachate.

Fig 2.2.1 Bin Composter

2.3 Experimental Process.

In order to carry out the experiment, the trash from the raw vegetable market was gathered, shredded, and then put through the composting process. The method of composting that was used in this research was the bin composting method, which was chosen since it speeds up the composting process. The composter was filled with alternate layers of vegetable waste with vermicompost and sawdust. the microbial inoculants were sprinkled on the top most layer along with the sawdust. bin composter no 1 was made using vermicompost (including worms) having Vegetable waste 6 kg and sawdust 9 kg, Bin composter no 2 was made using traditional method Using same proportion of waste. Composter no 3, 4, 5 were made using readily available vermicompost and microbial inoculant Also using natural accelerating agent such as Main ingredient (cabbage leaves, banana peels, and onion peels) respectively. After the compost had time to mature and was prepared for use, it underwent additional testing to determine its chemical and physical properties, and the results of that testing were analysed. The matured compost can be investigated for physical, chemical, and biological parameters to check its maturity and stability. All the chemical analysis were performed on the samples in its natural state.

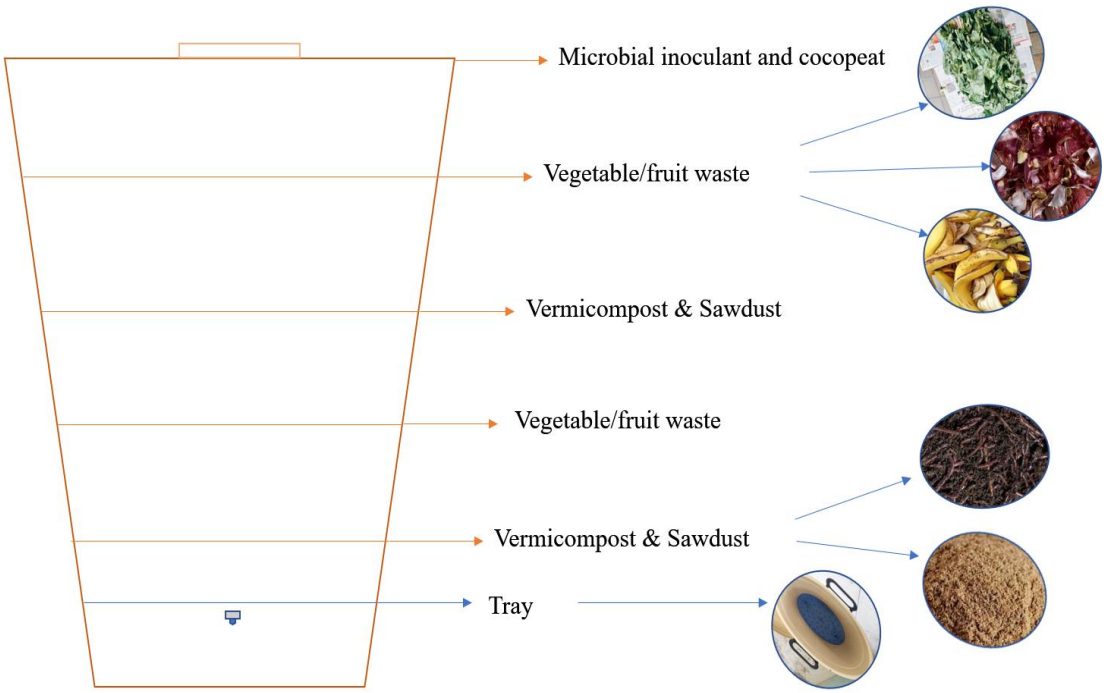


Fig 2.3.1 Schematic diagram of bin composter after completion of setup.

III. RESULTS AND DISCUSSION.

The trend towards more efficient methods of compost production and handling requires a complete understanding of the process, the materials involved, and the physical and chemical parameters of the compost such as pH, moisture content, total carbon, total nitrogen, total phosphorus, total potassium, NPK ratio and C: N ratio. these parameters influence the process and product in various ways from aeration effectiveness to compost soil interaction thus it is extremely important to analyse these parameters to know the compost in better way.

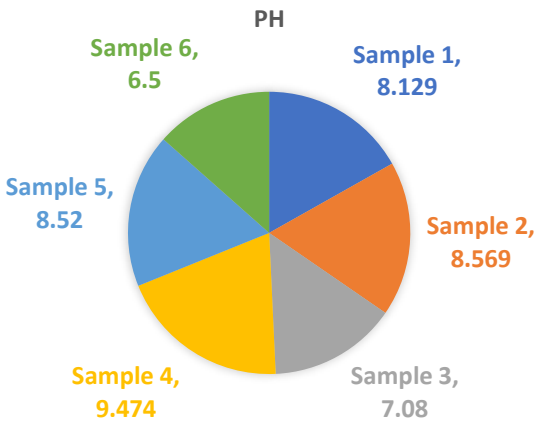
3.1 Analysis of compost samples.

Various tests were performed on the compost samples which are pH, moisture content, total carbon, total nitrogen, total phosphorus, total potassium, NPK ratio, C: N ratio. The characteristics of the compost samples are presented in the table.

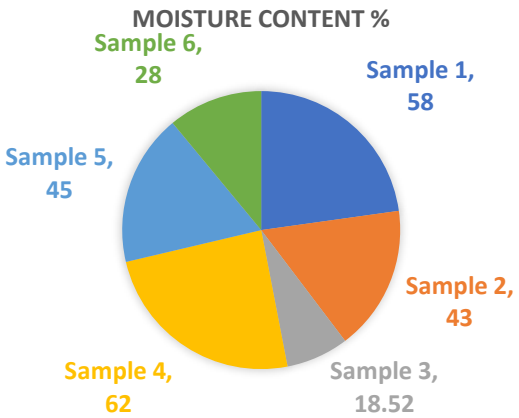
Table 3.1.1 Test results for Samples (1-6)

Samples	% Carbon	Nitrogen	Phosphorous	Potassium	pH	C: N Ratio	Moisture Content
Sample 1	30.96	0.8	1.42	2.38	8.129	38.7	58
Sample 2	23.93	0.53	0.74	0.53	8.569	39.54	43
Sample 3	42.5	0.53	0.88	0.53	7.08	64.32	18.52
Sample 4	39.4	0.8	0.51	0.97	9.474	54.29	62
Sample 5	35.96	2.13	1.07	3.7	8.52	25.8	45
Sample 6	15.68	3.72	1.33	3.6	6.5	16.46	28

1. **Effect of additives on pH of the final compost.**
   In sample 1, 2, 3, and 5 the pH is within the recommended limits as the acceptable pH range for a compost including readily available vermicompost is 4.5 to 9.0. In sample 4 the pH value is 9.474, which is due to considered ratio of greens and browns. In sample 6 the pH value is 6.5, which is of the readily available vermicompost as it contains a smaller number of Browns.

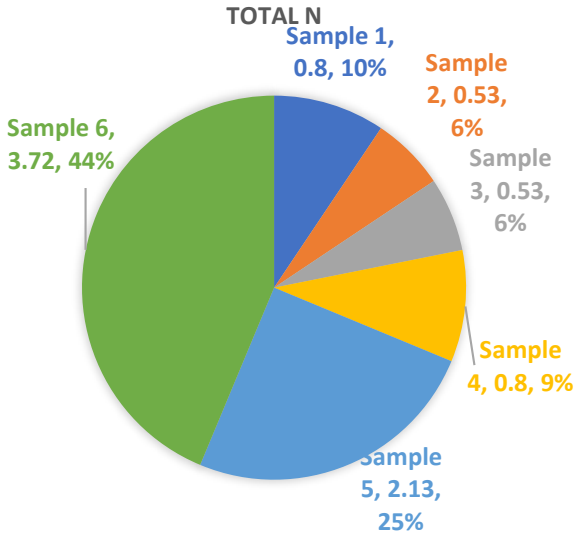


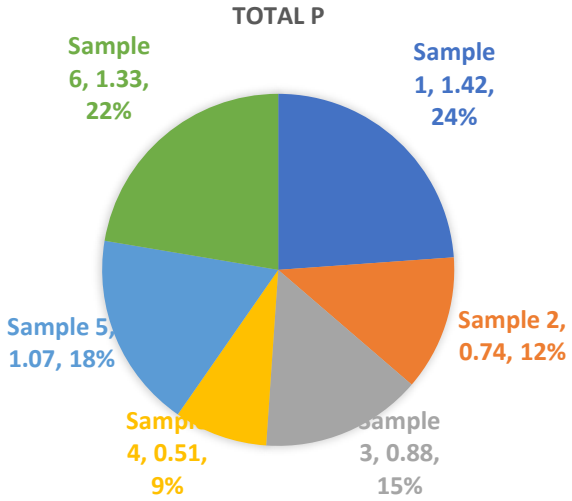
2. **Effect of additives on moisture content of the final compost.**
   As we can see that sawdust have successfully help in maintaining the moisture within standard limits. The moisture content of sample 1, 2, 4, and 5 is between 40 to 70%, which can be considered good due to its balanced Greens to browns Ratio.

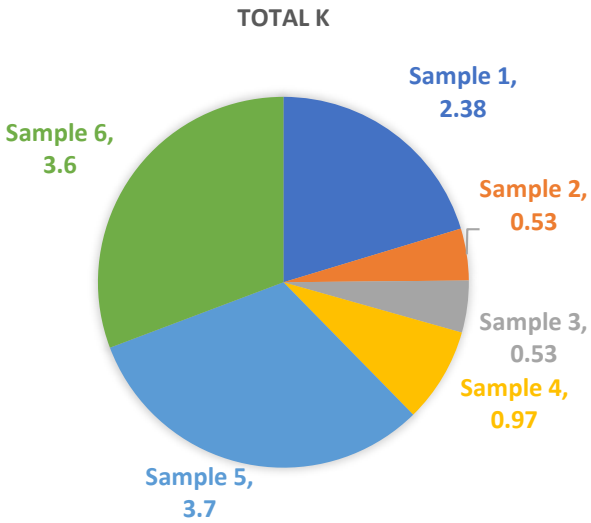


3. **Effect of additives on NPK of the final compost**
   As we can see from sample 1 and sample 2, the compost parameters of sample 1 are increased because of the addition of vermicompost roughly by 27%. The time necessary for sample 2 to develop was roughly 120 – 150 days. Whereas the period necessary for sample one to mature was roughly 60 to 75 days. Sample 3, sample 4, and sample 5 are made from segregated waste (cabbage leaves, banana peels, onion peels) which were composted for 45 days . Targeting their application for the farmers with certain sort of farm. In these samples, vermicompost and microbial inoculant were introduced. If we review the parameters of sample 2 and sample 3, the nitrogen concentration and potassium content are equal, but the period necessary for sample 2 to get that results were nearly double as compared to the time required for sample 3. The phosphate in sample 3 is relatively more than in sample 2. If we analyze the parameters of sample 2 and sample 4, the nitrogen and potassium concentration is high in sample 4. Also, the parameters of sample 5 with regard to sample 2 are substantially higher due to the variable ratio of green and browns. Lastly, the parameters of sample 6 is of the vermicompost itself which contains a very high nitrogen content as

well as potassium content, also phosphorous content. In accordance with the requirement of the crop, we can add a suitable number of greens and Browns to attain the desired result.

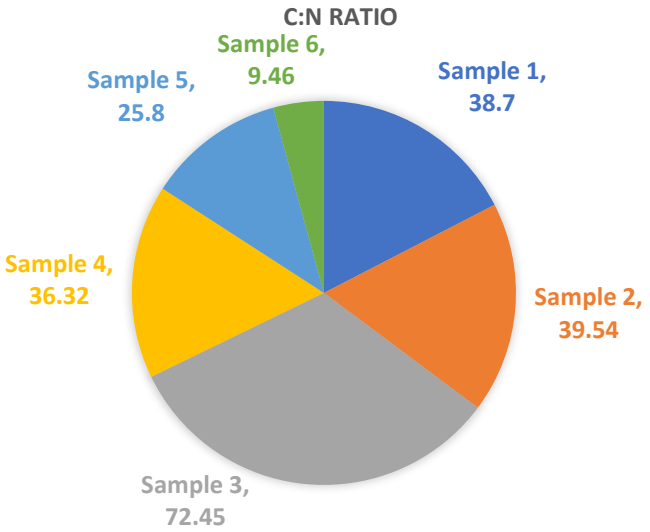






4. Effect of additives on C: N ratio of the final compost

The C: N Ratio for sample 1, 2, 4, and 5 is around 25 – 40, which can be considered good. The study has shown that we can get a balanced C: N Ratio if we have a balanced greens to brown materials in the compost. Sample 3 Has pH value 7.08 which is okay, the moisture content is 18.52 percent, which is very low, due to more quantity of carbon than nitrogen. as the carbon material (sawdust) retails all the moisture but due to the lack of greens the compost become dry. Similarly the C:N ratio is 64.32 which also indicates high carbon than nitrogen. due to the lack of moisture, the microorganisms are hard to survive and therefore it slows down the composting process. Sample 6 have pH value 6.5. we can add browns to neutralize it. High C/N ratios can lead to prolonged composting duration and low C/N ratios enhance nitrogen loss.



CONCLUSION.

The current research work was undertaken to analyse and compare the traditional solid compost and composts made using different additives and bulking agent for the treatment of vegetable waste which is a major issue in municipal solid waste management if just dumped into landfills. on the basis of the test results following conclusions can be drawn, vegetable waste is a major issue in municipal solid waste management due to its high moisture content it creates a lot of nuisance and forms leachate well just dumped into the landfills. but with the use of bin composting techniques it can be possible to compost the vegetable waste at the point of generation itself without any need to send this vegetable waste to landfills. does minimising the load on landfills.

The compost amendments need by the addition of sawdust, natural accelerating agents as main ingredients and readily available accelerating agents such as vermicompost and microbial inoculants help in improving the quality of the compost. combining this method with bin composting method has accelerated the process. The NPk ratios for sample 1,2,3,4 showed better results for application. Also the C : N ratio values for sample 1,2,4,5 were within permissible range. the time required for composting as compared to the traditional method was reduced by 27%.

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