Feasibility of Compostable Bags for disposal of Solid Waste in Urban Households

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Abstract— *An alternative of conventional plastic bag for biodegradable waste to compostable bags is the focus of the present paper. For a long time, ordinary plastic bags and sometimes biodegradable plastic bags are being used for household waste disposal. As a result, the garbage landfill sites are flooded with plastic bags which seem to be never degradable kind of material. Several researches have highlighted the hazards of plastic bags on land, human health, flora and fauna and environment in general. Feasibility of compostable bags is a ray of hope to protect the land, human health and the environment from the menace of plastic bags.*

Keywords— Biodegradable waste; Biodegradable plastic carry bags; Composting; Compostable carry bags.

I. INTRODUCTION

Waste is any substance, which constitutes scrap materials or any effluent or other unwanted surplus substances arising from the application of a process, or any substance or article, which requires to be disposed off as being broken, worn out, contaminated or otherwise spoiled (Rana, Ganguly and Gupta, 2015). Indian waste collection system has not yet been regularized and organized. Without an appropriate collection system, municipal bodies find themselves spending inordinate amounts of money on street sweeping, cleaning drains or on common/municipal land littered with waste. Proximately, 30-40% of what waste thrown is organic matter, which if composted, can produce rich top soil for the plants (The Hindu, 2013). Solid waste management includes the entire process starting from the collection from the primary source to ultimately disposing hygienically, so that it may not be a nuisance or create any harmful effect on near-by community (Pandit and Kumar, 2013).

Biodegradable waste is defined as waste that is capable of being broken down (decomposed) rapidly by the action of microorganisms.**Biodegradable plastic bags** usually contain some plant based/“bio” plastics or additives mixed with real plastics and are not compostable or recyclable. These are made up of polyhydroxybutrate(PHB) and other traditional plastics.**Composting** is defined as nature's way of recycling i.e. a biological process that breaks the organic waste into an extremely useful humus like substance by various micro-organisms in the presence of oxygen.

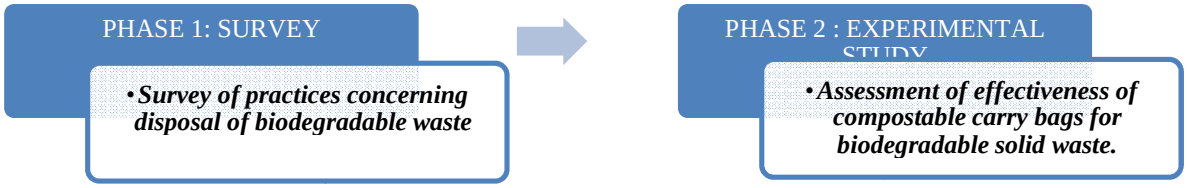
Compostable bags or items certified by BIS, IS/ ISO17088:2012 compliant are “capable of undergoing biological decomposition in a compost site”. They biodegrade, disintegrate and have no eco-toxicity. They are derived from blending processed starch from a number of plant based products such as corn, with other bio-basedplastics or polyhydroxyalkanoates or PHA.

Compostable carry bags are now being introduced as an alternative of conventional (petro-based) carry bags for the disposal of waste. Systematically, compostable carry bags can produce organic compost and enrich the top soil of plants.

The urban Indian citizen generates nearly 700 grams of solid waste per person per day which is nearly 250 kg in a year. Due to poor source segregation, Municipalities in India are currently able to compost only 0.21 % of the wet waste generated (The Hindu, 2013). Municipal Solid Waste (MSW) generation has increased in India from 100 g/day/person to 450 g/day/ person after Independence (The Times of India, 2015). The total MSW generation in India is around 48 million tons per annum and this would increase to 300 million tons by the **year 2047**. The quantity of waste produced is lesser than that in developed countries and is normally observed to vary between 0.2-0.6 kg/capita/day. Value upto 0.6 kg/capita/day are observed in metropolitan cities. The total waste generation in urban areas in the country is estimated to be around 38 million tonnes per annum (The Government of India, 2015).

II. PHASES

2.1. Research was conducted in two phases.



III. RESEARCH PREMISE

The study focused on practices adopted by residents for disposal of biodegradable waste, different kinds of biodegradable waste generated daily in the households, effectiveness of the selected bags in terms of their degradability and composting,time taken by the compostable and paper bags to decompose or make compost, and impact of disposal of these bags on soil quality used for composting biodegradable waste.

IV. OBJECTIVES

- To explore the practices with regard to disposal of biodegradable household solid waste.
- To compare the disposal of organic waste in paper bag (240 GSM) and compostable carry bags of two thicknesses i.e. 10 microns and 20 microns with respect to their effectiveness for composting.
- To analyze both controlled and experimental soil samples of location where biodegradable waste is disposed in the selected bin liner bags in the land pits or pots.

V. RATIONALE OF THE STUDY

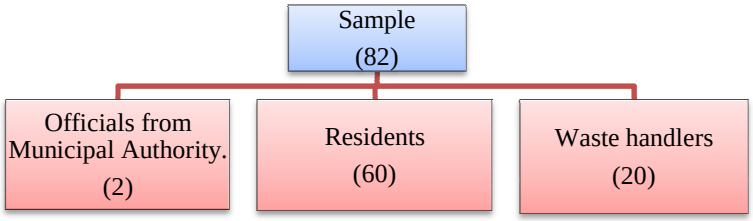
The purpose of the study was to find out the effectiveness of compostable carry bags as waste bin liners for disposing biodegradable waste by the households. Different types of waste bin liners are available and some companies have come up with compostable bags. An attempt was made to reduce the littering of conventional (petro-based) plastic carry bags used as bin liners for disposing waste and to introduce an alternate compostable (100% bio-based) carry bags to facilitate recycling of the waste.

The study was an attempt to investigate how effective are these compostable bags as waste bin liners. The research will bring forth the resultant soil quality when compostable bags are disposed in the ground and also the quality of compost created. Research will also explore the feasibility of using compostable bags for biodegradable household waste by those living in apartments, as available space is quite less. The findings pointed out how effectively the compostable bags decompose household biodegradable solid waste and provided an alternative solution for environment friendly and sustainable waste recycling options.

VI. METHODOLOGY

District Ghaziabad was selected for the study.

6.1. Sample size

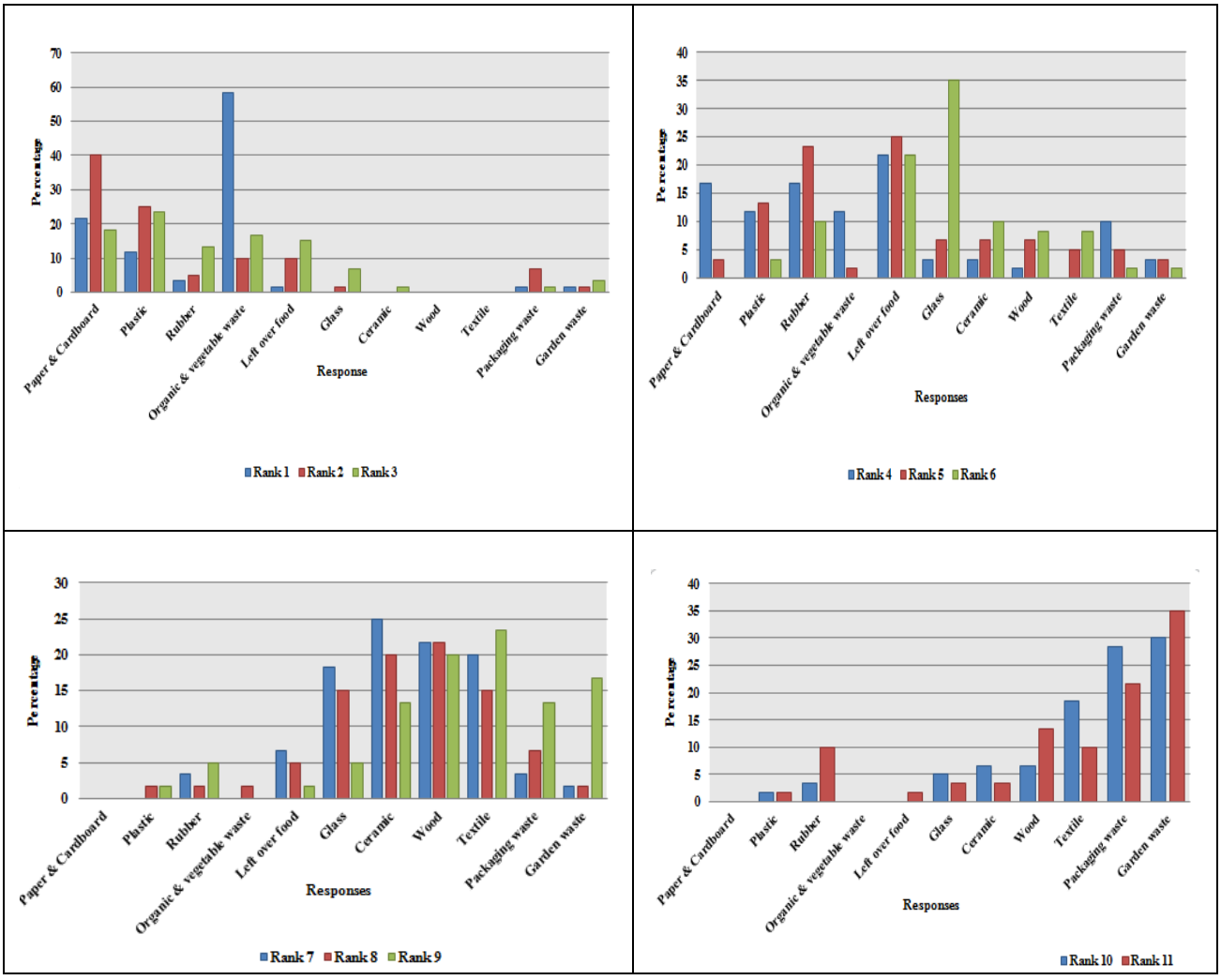


6.2. Sampling technique

Simple random sampling technique was used for selecting the households for survey whereas for waste handlers, purposive sampling technique will be used.

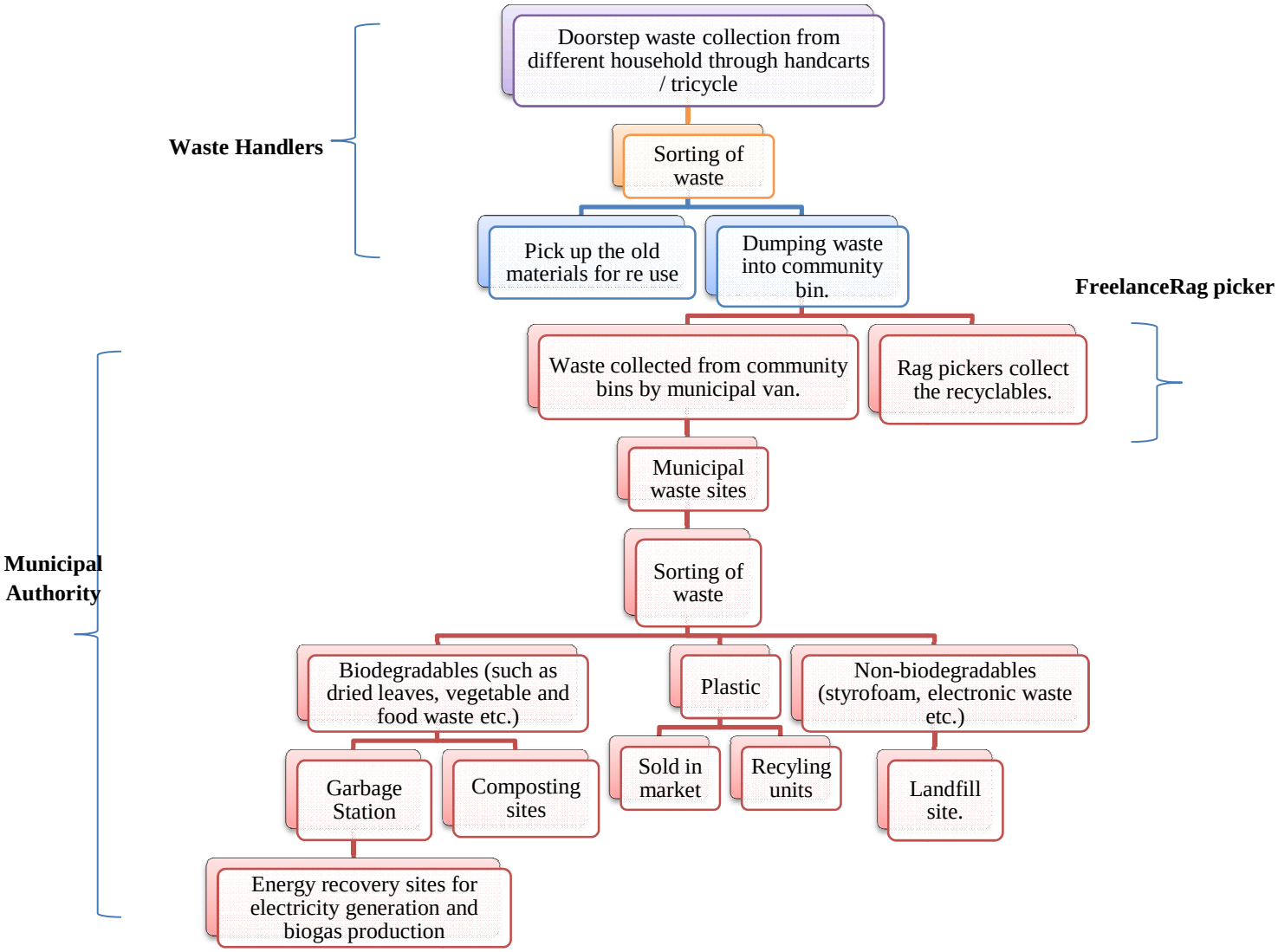
VII. RESULTS AND DISCUSSION

In residential areas, generally the waste generated could be categorized into organic and inorganic waste. It was found that organic/ vegetable waste was generated in maximum amount and the garden waste was least generated in the households.



Waste disposed by the respondents in the dustbin, was lined by plastic bag which is easily available. They changed it every day and the wastes were sorted by lot of residents. Some of them were engaged in gardening at their households.Therefore they needed compost for their plants to grow well.

Collection of solid waste by the waste handlers organized by the municipal authority

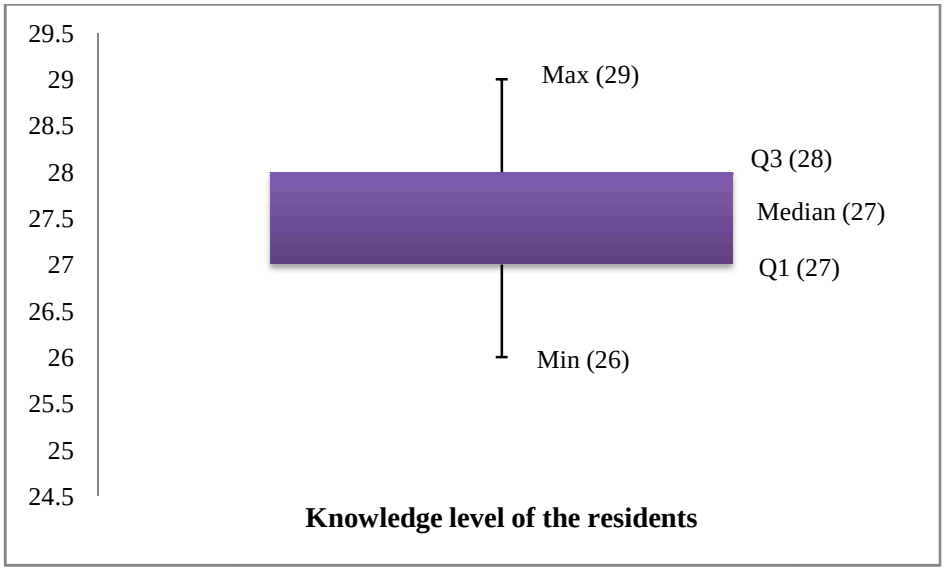


The waste generated in majority of the households was taken to the community bin by the waste handlers and some residents dumped the waste directly in the community bin. The waste was finally dumpedinto the waste dump near Sai UpvanNalah, authorized site for segregating the waste, by municipal authority, by workers appointed by municipal authority. Some waste was picked up by rag pickers from the community bin.

Sorting of waste was done by the municipal workers employed by the East Delhi Municipal Corporation at Ghazipur landfill site. Sorting of waste was done at three categories- **biodegradables** which included vegetable and food waste, **plastics** and **non-biodegradables**, also including e-wastes etc. Even though the objective of municipal authority to employ municipal workers was to ensure all non-biodegradable waste and plastic waste is picked up but the present scenario is quite different. It is so because field workers are able to collect only those plastic and non-biodegradable wastes which is perceived with some utility / economic value. Therefore, despite of collection of plastic and non-biodegradable wastes, still some are left behind rendering landfill site jeopardized.

Awareness of waste handlers and residents about safe and intelligent disposal of solidwaste

It was found that majority of the residents were not having much knowledge towards solid waste management



Municipal authorities revealed that they were not very clear about the rules and regulations of solid waste management that they were trying to comply with the solid waste management handling rules, 2015 but there were several lacunae in the study. Though draft rules were available, yet municipal officials continued to follow solid waste management rules of 2013. Extensive patrolling to monitor the rules was not happening. Therefore, if penalty should be fined, municipal officials were dependent on their heads. They were not able to take decision at their own.

Waste handlers as well as residents were not aware of the solid waste management rules and were not adequately complying them. Residents were not even segregating the waste at their own level. Waste handlers took bribe from the residents and picked waste from outside the house where people had thrown on open spaces outside the house. Majority of the waste handlers were privately operators and therefore were not able to monitor the rules.

Effectiveness of compostable bag for bio-degradable solid waste

7.1. Collection of solid waste

The experiment was conducted to test the soil samples of the paper bag and compostable carry bags to check the effectiveness of the compostable bags which indicated clearly that compostable bags had increased the nutrients' level in soil.

Residents were instructed to put only biodegradable waste in all designated bags till it got filled in 2-3 days. A list of bio-degradable waste was given to the residents so that they were careful to include only the relevant waste in the bags provided to them. It was repeated for three days.

7.2.Soil testing

Soil testing of paper bag, 10 micron and 20 microns bags for selected parameters.

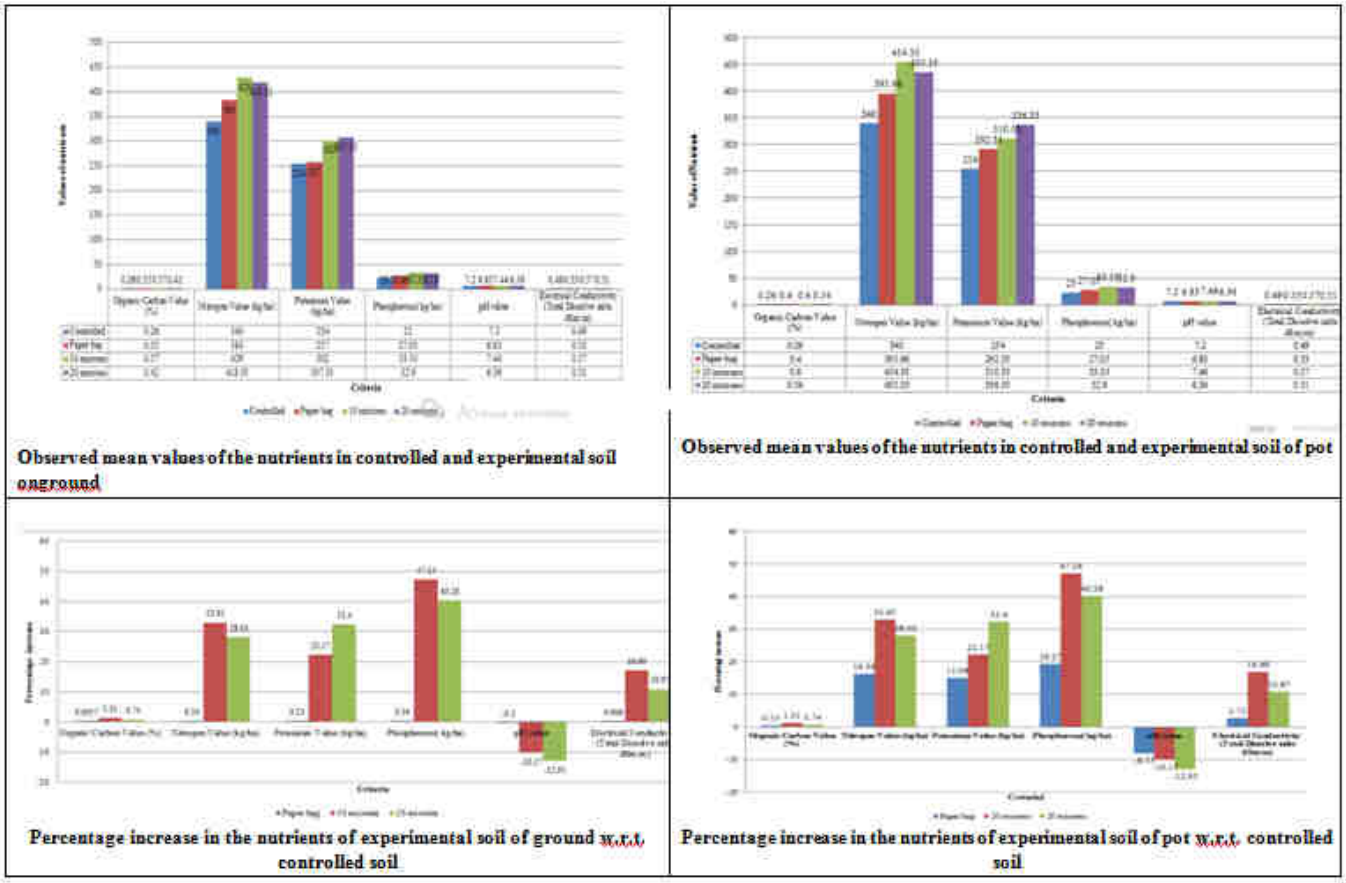
Each bag was tied with the cotton thread which was kept visible from the top and buried in ground soil as well as pot soil.

Following steps were followed for the experiment –

- A 2' x 2' x 1' size of pits were dug up in a ground and .nine pots (12' x 9' x 11') were chosen where the compostable bags and paper bag were placed.
- Curing of soil was done with air drying and sieving technique after three months for soil testing.
- Soil was analyzed on the following parameters.
    - Soil reaction i.e. pH
    - Electrical Conductivity
    - Organic carbon
    - Nitrogen value
    - Phosphorous value
    - Potassium value

- Carbon-Nitrogen value

- Following were the observations that were drawn after analyzing the soil samples:-



Observed mean values of the nutrients in controlled and experimental soil onground

Observed mean values of the nutrients in controlled and experimental soil of pot

Percentage increase in the nutrients of experimental soil of ground w.r.t. controlled soil

Percentage increase in the nutrients of experimental soil of pot w.r.t. controlled soil

7.3. Major outcomes of the experiment

Experimental examination of biodegradable waste disposed in paper bag, 10 microns and 20 microns compostable bags was conducted. Soil samples (ground soil and pot soil) of these locations indicated that:

- All the three bags were completely degradable (in three months) along with the organic waste inside the bags, therefore, are environment friendly.
- Changes in soil composition had taken place in 90 days after composting the biodegradable waste.
- Nutrient level of the soil where the compostable bags were kept, had increased because these were made up of starch and vegetable oil which aided in increase in nutrients when degraded in comparison with organic waste disposed in paper bag.
- Compostable bags have come out to be more effective than paper in composting the organic household waste completely as it had enriched the soil nutrients in the form of organic contents. Following nutrients viz'.a.viz., organic carbon, potassium, phosphorous and nitrogen increased significantly in soil samples of compostable bags (10 and 20 microns) in comparison to paper bags.
- Experiment further revealed that 20 micron compostable bags resulted in higher increase in nutrients as compared to 10 micron bag, probably there were greater quantity of starches and vegetable oil which induced the degradation and conversion of waste into manure.

VIII. CONCLUSION

The present study revealed that the compostable bags were found to be quite effective in terms of composting the organic household waste completely as it had enriched the soil nutrients in the form of organic contents.

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