From Trash to Treasure: The Art of Sugarcane Trash Composting

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ABSTRACT

Composting sugarcane trash offers a sustainable solution to manage agricultural waste effectively. This process involves transforming leftover plant material from sugarcane fields into nutrient-rich compost through controlled decomposition. Sugarcane trash, comprising leaves and tops, is rich in carbon and nutrients, enhancing soil fertility and structure when composted. Pressmud and sugarcane molasses can also be used as a potential source of compost after proper decomposition and nutrient enrichment. Successful composting mitigates environmental impacts by reducing waste disposal, improving soil health, and promoting sustainable agricultural practices.

INTRODUCTION

Since 2021-22, India has taken a pivotal role in the global sugar market, becoming the leading producer ahead of Brazil. Furthermore, it holds the position as the second-largest sugar exporter worldwide (www.drishtiias.com). The growth of the ethanol biofuel segment in recent years has not only bolstered the sugar industry but also enhanced the financial viability of sugar mills. Sugarcane typically yields between 10 to 12 tonnes of dry leaves per hectare per crop. The main sugarcane-growing states, particularly Uttar Pradesh and Maharashtra, collectively account for about 65% of India's total sugarcane cultivation area. These states, along with Karnataka, Tamil Nadu, and Bihar, are pivotal in India's sugarcane production, contributing significantly to the country's overall output. Detrashing is typically conducted in the 5th and 7th months of its growth cycle. This trash contains approximately 28.6% organic carbon, 0.35%

to 0.42% nitrogen, 0.04% to 0.15% phosphorus, and 0.50% to 0.42% potassium. Incorporating sugarcane trash into the soil affects its physical, chemical, and biological properties. It reduces soil electrical conductivity (EC) and enhances water holding capacity, soil aggregation, and porosity. Incorporating sugarcane trash also lowers soil bulk density, increases infiltration rate, and reduces soil penetration resistance. Directly integrating chopped trash into the soil enhances nutrient availability, thereby promoting soil fertility. Sugarcane trash is easily composted with fungi such as *Trichurus*, *Aspergillus*, *Penicillium*, and *Trichoderma*. Adding rock phosphate and gypsum accelerates decomposition processes. There is a growing scarcity of farm yard manure (FYM) on agricultural lands due to two primary reasons. Firstly, the number of cattle is declining as more farmers opt for mechanization in farming operations. Secondly, cattle dung is increasingly used for making fuel cakes due to the diminishing availability of firewood. Consequently, farmers either apply minimal amounts of FYM or entirely forego its application. Sustainable improvements in soil physical and chemical properties can only be achieved through adequate application of organic manures.

Sugarcane produces a substantial amount of foliage, accounting for about 40% of its total biomass. For every tonne of sugarcane trash, nutrients available are approximately 3.5 kg of nitrogen, 1.3 kg of P_2O_5, and 10 kg of K_2O. From one hectare of sugarcane, trash alone can provide around 50 kg of nitrogen, 20 kg of P_2O_5, and 100 kg of K_2O.Traditionally, sugarcane farmers dispose of trash by burning it in the fields. This practice is driven by the high labour requirements for trash removal and a lack of awareness about its value as a source of organic carbon and nutrients. Burning trash releases smoke, carbon dioxide, and carbon monoxide into the environment, causing pollution. Additionally, some nutrients are lost in gaseous form, and the organic matter is burnt and lost. Moreover, burning trash generates intense heat ranging from 600 to 800ºC, which destroys beneficial soil microorganisms and earthworms, thereby disrupting favourable soil biological activity. The heat also kills sugarcane buds in the stubbles, leading to gaps in the field and ultimately reducing stalk population and crop yield. These detrimental effects on soil health, environmental pollution, nutrient loss, and reduced crop yield can be mitigated by recycling trash through composting.

Composting steps

1. **Trash collection:** After detrashing, the collected material should be gathered and transported to the composting site. If there is no designated compost yard available, farmers can utilize any corner of the sugarcane field itself for composting. It is not necessary to dig a pit for composting; composting can be done directly on the soil surface.

   Sugarcane trash is typically long and handling and piling it can be quite cumbersome. It is advisable to shred the trash into smaller pieces. Shredding reduces the volume of the material and increases its surface area. With a greater surface area, microorganisms can more effectively work on the material, speeding up its decomposition. A shredder is the preferred equipment for shredding sugarcane trash, although a chop cutter machine can also serve this purpose. In the absence of machinery, manual shredding is recommended. Without shredding, the composting process will be prolonged (agritech.tnau.ac.in.).

2. **Inputs used for composting**

a. **Microbial consortium:** The TNAU biomineralizer comprises a consortium of

microorganisms specifically designed for composting various agricultural wastes. It is recommended to use two kilograms of this inoculum per ton of waste for optimal results. Without this microbial consortium, the composting process will proceed at a natural pace. An alternative source of microorganisms for composting is cow dung slurry. However, the microbial population required for composting in cow dung slurry is generally low, and these microbes must compete with other microorganisms present in the slurry for survival. In contrast, this biomineralizer contains only the necessary microorganisms essential for composting, ensuring a high population of these specific microbes. Therefore, opting for the TNAU biomineralizer is recommended for efficient composting.

b. Animal dung: Animal dung or fresh poultry litter serves as an excellent nitrogen source to lower the C N ratio during composting. It is recommended to use 50 kilograms of fresh dung per ton of sugarcane trash. The dung can be mixed with 100 liters of water and thoroughly blended with the sugarcane trash. Additionally, adding 5 kilograms of rock phosphate per ton of waste enhances the phosphorus content of the compost. This combination ensures optimal nutrient balance and facilitates effective composting of sugarcane trash.

3. **Heap formation:** Once all the inputs are thoroughly mixed with sugarcane trash, it is essential to form a heap with a minimum height of 4 feet. This height is necessary to promote higher heat generation during the composting process, and it helps in retaining the generated heat within the material for an extended period.

4. **Effectively turning the compost material:** The compost material should be turned regularly, ideally once every 15 days, to enhance aeration within the material. During the turning process, the bottom layer is brought to the top and the top layer to the bottom, ensuring uniform composting throughout.

5. **Control of Moisture:** Maintaining 60% moisture throughout the composting period is crucial. If the composting material dries out, it will lead to the death of beneficial microorganisms and halt the composting process. Thus, maintaining adequate moisture is essential for successful composting

6. **Compost maturity:** Volume reduction, the presence of an earthy aroma, a dark brown to black appearance, and a decrease in particle size are essential criteria for assessing compost maturity. Once the compost has fully matured, it should be aerated by turning the heap and spreading out the material for curing. After allowing it to cure for 24 hours, the compost can be sieved through a 4 mm mesh to achieve a uniform texture. Any remaining residues from the sieving process should be reintegrated into the next batch of compost for further decomposition.

7. **Application in the field:** The nutrient-rich compost can be spread at a rate of 5 tons per hectare as a foundational treatment for the field. Regardless of its origin from sugarcane trash, this compost can be incorporated back into sugarcane fields to enhance soil fertility.

Table. 1: Composition of cane trash compost

SL. No.	Nutrient	Per cent contribution
1.	Nitrogen (N)	1.60
2.	Phosphorus (P)	1.10
3.	Potassium (K)	0.50
4.	Calcium (Ca)	1.00
5.	Magnesium (Mg)	0.60
6.	Sulphur (S)	0.48
7.	Iron	2710 ppm
8.	Manganese	450ppm
9.	Zinc	370ppm
10.	Copper	80 ppm
11.	C:N ratio	22:1

(Source: **https://www.ikisan.com/tn-sugarcane-compost.html**)

Sugarcane molasses

Sugarcane molasses waste is the concentrated liquid remaining after sugar crystallization, typically discharged from factories as a residual product. Due to its substantial volume, high acidity, and complex composition, direct discharge without treatment poses a significant risk of water pollution. Despite these characteristics, it is non-toxic and biodegradable, rich in organic matter and various trace elements. Recognized for its high utility value, it has emerged as a valuable raw material for fertilizer production through composting processes.

Pressmud

Pressmud, also known as filter cake or press cake, is a residual byproduct from the sugar industry that has gained recognition for its potential in green energy production. Indian sugar mills can significantly boost their revenue by utilizing pressmud as a feedstock for biogas production through anaerobic digestion and subsequent purification into compressed biogas (CBG). Typically, pressmud constitutes about 3-4% of the weight of sugarcane processed at a unit. Using pressmud for CBG production offers several advantages. Firstly, it simplifies the feedstock supply chain compared to agricultural residue, which requires specialized biomass harvesting equipment for collection and aggregation. Secondly, pressmud is sourced from a limited number of sugar mills or producers, unlike agricultural residue that involves multiple farmers over a short harvest window each year. Thirdly, pressmud's consistent quality eliminates concerns often associated with municipal solid waste, such as inorganic content that can disrupt anaerobic digesters and reduce gas output (www.downtoearth.org.in).

Fourthly, pressmud requires no pretreatment costs due to the absence of lignin, an organic polymer found in agriresidue. Lastly, in terms of conversion efficiency, approximately 25 tonnes of pressmud are necessary to produce a tonne of CBG, compared to 50 tonnes of cattle dung for the same output. Moreover, with costs ranging between Rs 0.4-0.6 per kilogram, pressmud proves more economical than other feedstocks like agricultural residue (Rs 1.5-2/kg) and cattle dung (Rs 1-2/kg).

Sugarcane press mud is the residue left after the filtration process of sugarcane juice. During clarification, the sugarcane juice is separated into a clear juice used for processing, and a sediment known as press mud settles at the bottom. This mud undergoes further filtration to remove suspended materials such as insoluble salts and fine bagasse. Typically, press mud accounts for approximately 4 percent of the cane crushed in a sugar mill. It contains significant amounts of both major and minor nutrients.

The application of press mud enhances the availability of nutrients such as iron, zinc, calcium, magnesium, and manganese in the soil. In calcareous soils, it contributes to a

reduction in soil pH, electrical conductivity (EC), and exchangeable sodium percentage (ESP), while simultaneously increasing the soil's nutrient availability.

Enrichment of Pressmud by composting

Direct application of pressmud is not recommended due to its high carbon to nitrogen ratio and the potential for generating excessive heat during decomposition. To enhance its suitability for field application, press mud can be effectively composted using microorganisms. For composting one tonne of press mud, a pit measuring 2m x 1m x 1m is excavated. The press mud is divided into three equal portions, with one portion spread evenly at the bottom of the pit. Following this, 2 bags (500 g) of *Trichoderma viride* or 2 bottles of *Pleurotus* species culture are added. Additionally, 5 kg of urea and 50 kg of cow dung or well-decomposed farmyard manure (FYM) are layered over the press mud. This layering process is repeated twice more, and the heap is covered at the top. The composting process continues for 45 days, maintaining adequate moisture levels by periodically sprinkling water over the heap (www.ikisan.com.).

Table. 2: Nutrients content of enriched press mud

Enriched pressmud	Total N (%)	Available N (ppm)	Total P (%)
Pressmud enriched by *Trichoderma viridae*	1.19	856	2.90
Pressmud enriched by *Pleurotus* sp.	1.26	988	3.13
Pressmud-non enriched	1.03	775	2.76

(Source: https://www.ikisan.com/tn-sugarcane-compost.html**)**

CONCLUSION

In conclusion, the processes of composting sugarcane trash and utilizing press mud represent sustainable practices with multiple benefits for agriculture and the environment. Composting sugarcane trash not only reduces environmental pollution from burning but also enriches soil fertility through the release of nutrients like nitrogen, phosphorus, and potassium. This method contributes to improved soil structure, water retention, and overall crop yield. Similarly, press mud, a byproduct of sugar production, can be effectively utilized to generate biogas, contributing to renewable energy production and reducing greenhouse gas emissions. Its application as a feedstock for compressed biogas offers economic advantages over other feedstocks, such as agricultural residue and cattle dung. Together, these practices underscore the importance of integrating waste management with sustainable agricultural practices to enhance productivity while mitigating environmental impact.

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