

Mitigation of Stubble Burning with Pusa Decomposer

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Introduction

PUSA decomposer is a new technology for paddy stubble management. It is an innovative solution developed by scientists at ICAR- IARI Pusa, New Delhi, to solve the problem of stubble burning and pollution in India. It is a bio-decomposing approach, especially 'Pusa decomposers,' to convert agricultural stubble into compost. It is a microbial-capsules can degrade the stubbles within 15-20 days.

The Pusa bio decomposer is a type of capsule made by extracting fungal strains that assist paddy straw break down and decompose faster than usual. This fungus produces numerous important enzymes that contribute in the overall breakdown process. The Pusa Bio Decomposer is made from a combination of six fungal and two bacterial spp. The enzymatic activity of decomposers leads to degradation of pectin, cellulose, lignin and increase in humic and fulvic acid. Psychotropics and mesophilic species helpful for the degradation of paddy stubbles.

Action of stubble burning in climate change:

When crop residues are burned, they release various greenhouse gases (GHGs) into the atmosphere, primarily carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O). These gases trap heat in the Earth's atmosphere, leading to global warming and climate change.



Carbon dioxide is the primary greenhouse gas emitted during stubble burning, as the carbon stored in the plant material is released during combustion. Methane and nitrous oxide, while emitted in smaller quantities, have a much higher global warming potential than carbon dioxide over a 100-year time frame.

Preparation for use of Pusa decomposers

Firstly, 150 g jaggery was boiled in 5 litres of water to make culture, once culture cooled the jaggery solution was combined with 50 g of chickpea flour and 4 capsules of Pusa decomposers are added to solution and kept in a container for 8-10 days for fermentation. The solution of 25 litres of Pusa decomposer is added to 475 litres of water. The 500 litres are sufficient for spraying one hectare of land.

Benefits of Pusa decomposers

- ✓ The bio decomposer improves and enhances soil fertility levels. This, in turn, immediately serves to boost the fertility of the soil, resulting in a higher yield for farmers.
- ✓ Farmers can utilize the leftover stubble for manure and compost for their crops. As a result, they can reduce their applied fertilizers with good harvest of the crop. This will result in direct savings for the farmers.
- ✓ Pusa bio-decomposer enhances the rate of decomposition of various agricultural wastes. It can turn stubbles into organic manure within 15-20 days.
- ✓ Replenishes organic content in the soil.

The decomposition process of rice stubble:

- 1. Inoculation and colonization:** After the application of the PUSA decomposer on the moistened rice stubbles, the microbial consortium starts to colonize the stubble surface.
- 2. Enzymatic breakdown:** The microorganisms in the PUSA decomposer produce a range of enzymes, including cellulases, hemi cellulases, lignin-modifying enzymes, and other hydrolytic enzymes. These enzymes break down the complex organic compounds present in the rice stubble, such as cellulose, hemicellulose, and lignin.
- 3. Depolymerization:** The enzymatic action leads to the depolymerization of the complex polymers in the rice stubble, breakdown into smaller molecules, such as simple sugars, amino acids, and other organic compounds.

4. **Microbial metabolism:** The fungi and bacteria in the PUSA decomposer utilize the depolymerized compounds as sources of carbon and energy for their growth and metabolism. Through various metabolic pathways, they convert these compounds into carbon dioxide, water, and other byproducts.
5. **Humus formation:** During the decomposition process, a portion of the organic matter is transformed into humus, a stable and complex organic compound.
6. **Nutrient release:** As the microorganisms break down the organic matter, they release essential nutrients, such as nitrogen, phosphorus, potassium, and micronutrients, into the soil.

Cost for application

4 capsules of Pusa bio decomposers are required to convert one hectare of farm waste into useful compost, each capsule cost Rs 5, or Rs 20. The net cost per acre is around ₹300, which includes the cost of preparing the mixture with jaggery and gram, combining the capsules in large water containers, and spraying labour cost. It is so affordable and effective at disintegrating stubble that it can be used by any farmer without regard for expense or depriving the soil of nutrients by burning it.

How Can Farmers be Benefited by This Technology?

The burning of stubbles in the field results losses of valuable nutrients of up to 100% C, 90% N, 60% S, and 25% P, K and not only effects the environment but also effect the soil health. Based on this consideration IARI announced the development of “PUSA DECOMPOSER” on September 2020, a microbial capsule to decompose paddy stubble residue. Another benefit of the capsule containing crop-friendly fungi is that there are no negative effects. Usha Rai found that 90 percent of paddy stubbles was decomposed after 15 days of Pusa decomposer application. Pusa decomposer used farmers achieved 0.30 q ha⁻¹ increase yield, which indicates economic benefit in addition to benefits for the ecosystem and soil health.

Conclusion

Toxic chemicals released by burning of paddy stubbles are major thread in present days. Using a bio decomposer is an efficient, effective, and less expensive way to eliminate the harmful practice of stubble burning. It is very environmentally friendly and ecologically safe technology that can help to eliminate the problem of air pollution.

Reference

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