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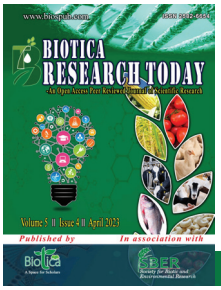

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Management of Crop Residues

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Abstract

After the harvest and threshing of crops the plant parts which are left behind are called as crop residues. It includes straw, stubbles, roots, stalks, and stem. The growing population has resulted in a significant upsurge in food production, which in turn has led to an increase in the amount of crop residues generated, such as those from rice, wheat, and sugarcane. However, due to a lack of awareness regarding the utilization of crop residues, most of the crop residues are burnt in the fields after harvesting. These crop residues are considered as "*Potential Black Gold*" are they are rich in organic matter and can be utilised in manufacturing of bio-char, pellets, various packaging materials, paper industry, bio-gas production, mushroom cultivation and mainly used as surface mulch and composting which enhances soil fertility and productivity.

Keywords: Crop residues, Livestock feed, Mushroom cultivation, Surface mulch

Introduction

Due to increased food consumption in developing countries there is a massive increase in global food production. In India, fibre crop production has increased to 37.38 million bales, oilseeds production to 38.50 Mt, sugarcane production to 430.50 Mt and food grain production to 314.51 Mt. Out of which Rice contributes to 129.66 Mt, Wheat - 106.41 Mt, Maize - 33.18 Mt and Pulses - 27.75 Mt. Farmers prefer these crops as they provide huge economic returns to the farmers.

As per MNRE, the yearly production of crop residues in India amounts to an average of 500 million tonnes (Mt) (Bhuvaneshwari *et al*., 2019). Crop residues possess a nutrient potential of approximately 36.89 million tonnes. But, instead of using crop residues as a potential source of plant nutrients, a significant amount is burnt every year in the field mainly to get rid of straw and stubble in the field which is left over after the harvest of the previous crop. There is still a surplus of 140 million tonnes, of which 92 million tonnes are burned annually. Hence it is essential to adopt methods to manage this valuable resource.

Crop Residues

After the harvest and threshing of crops the plant parts which are left behind are called as Crop Residues. It includes Straw, leaves, roots, stalk, stubbles and stem. Crop Residues are considered as "*Potential Black Gold*" as they are a rich source of organic matter. Recycling of crop residues provides an advantage by transforming surplus farm residue into a valuable resource that can fulfill the nutrient requirements of crops. Furthermore, this practice helps to preserve the soil's physical and chemical properties and improves the ecological equilibrium of crop cultivation. Hence different management strategies can be done with these crop residues as they improve soil fertility, restore nutrients to the soil.

Crop Residues Management Options for Rice and Wheat

The predominant cropping system in North-western India is rice-wheat, which produces a vast quantity of crop residues, and the most common method of harvesting is through combine harvesters, leaving behind a significant amount of residue in the field. Cereal crop residues are primarily utilized as livestock feed. Due to the narrow timeframe between rice harvesting and wheat sowing and absence of suitable recycling technologies, effectively managing rice straw poses a significant challenge. Farmers have various management choices at their disposal, such as utilizing crop residues as animal feed, cultivating mushrooms, incorporating, retaining on the soil surface, mulching, and preparing biochar as mentioned in the figure 1. Additionally, it can also be used for thatching, manufacturing mats, sacks, ropes and baskets (Bhattacharyya *et al*., 2021).

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Livestock Feed from Crop Residues

In India, crop residues have been historically used as feed for animals. For every kg of harvested rice grain, it is anticipated that just 0.6 kg of rice straw and chaff is given to the cattle. Crop residues cannot be the sole source of nutrition for cattle due to their unpalatable and poor digestion.

Livestock feed accounts for about 75% of wheat straw usage. Rice straw has a lower silica concentration in the stem, which makes it more digestible than the leaves. If the straw is meant for animal feed, it is advisable to harvest the rice crop as close to the ground as possible.

Figure 1: Residue management of rice and wheat straw

Preparation of Compost from Crop Residues

The pits are dung and crop residues are heaped in it for the preparation of compost. In animal sheds, every kg of straw can absorb roughly 2-3 kg of urine, enriching it with nitrogen. Composting the residues from one hectare of rice crops generates roughly 3 tons of nutrient-rich FYM. By utilizing an autochthonous source of low-grade rock phosphate, P can be added to the rice straw compost to produce a value-added (Singh and Brar, 2021).

Mushroom Cultivation from Crop Residues

By using crop residues in the cultivation of mushrooms, the inedible crop waste can be transformed into a nutritious food. *Agaricus bisporus* and *Volvariella volvacea* can be effectively grown using wheat and rice straws as their substrates. The paddy straw mushroom has only 15-days production cycle (Birla *et al.*, 2020).

Biochar from Crop Residues

Biochar can be described as a fine-grained charcoal that is rich in carbon, which is produced through slow pyrolysis and involves heating under anaerobic conditions. A certain kind of carbon found in biochar is very prone to microbial deterioration, making it an effective carbon sequestration tool when added to soil. As a result, it has a significant impact on long-term carbon storage in the soil, reduces greenhouse gas emissions from agricultural land, and enhances water quality by acting as a purifying agent (Birla *et al.*, 2020).

Surface Mulching with Crop Residues

The conservation of soil and reduction of water loss through evaporation can be achieved through the retention of residues on the soil surface. This method effectively inhibits the germination of weeds and promotes the development of microorganisms in the soil, ultimately resulting in an increase in soil organic carbon levels - a crucial indicator of soil health. When compared to no mulch, the rice straw mulch boosts grain yield in the subsequent wheat crop.

Industrial Uses of Rice Straw

Biogas from Rice Straw

To generate biogas from rice straw, a cement and brick dome-shaped structure measuring 2.5 meters in width and 4 meters in height is built, equipped with a water inlet and gas outlet. The crops like sugarcane and sorghum are best suitable for biofuel production owing to their high carbohydrate content.

Rice Straw Pellets

To produce compact biomass fuel pellets used for heating or energy production, the first step is to crush the raw material. The crushed biomass is then compressed to increase its density, resulting in small-sized pellets. This type of fuel offers better efficiency, ease of storage and can help to mitigate environmental pollution concerns. It is typically utilised in industrial furnaces, biomass power plants, life stoves, and hot water boilers.

Rice Straw for Handmade Paper

Agricultural residues, with their high fibrous lignocellulose and hollo cellulose content, are valuable raw materials for the paper industry. One method of utilizing them involves acetic acid pulping with H_2SO_4 acting as a catalyst, under specific conditions. The excellent mechanical properties of the produced pulp make it suitable for crafting handmade paper and manufacturing carry bags.

Manufacturing of Packaging Materials

Because of its high durability and compact resistance, rice straw can be used in the production of packing materials. This replaces costly petroleum-based products.

Residue Management of Cotton Stalks

Residues from the cotton crop include stalks, boll locules, leaves, and roots. Farmers typically employ a variety of residue management techniques as mentioned in the figure 2.

- Farmers allow livestock to graze on the cotton residues, thereby destroying the pink bollworm (*Pectinophora gossypiella*) larvae and pupae.
- Seeds of cotton are used as cattle feed as they are rich in protein and B-complex vitamins. Dysentery and sporadic fevers are both treated with cotton seed decoction.
- Cotton seed oil can be used to make lubricants, sulfonated oil, protective coatings and soap. Additionally, it is used as a substitute for olive oil in pharmaceutical industry (Sharma *et al.*, 2018).

Figure 2: Residue management of cotton

Residue Management of Sugarcane Trash

For every 10 kg of raw cane collected, it is expected that just one kg of sugarcane residues (stripped leaves and bagasse) is provided to animals. This takes into account the fact that the sugar mills consume around 60% of the bagasse as fuel.

• Bagasse is primarily utilized as fuel, in the production of paper (Sharma *et al.*, 2018).

• Molasses is employed in the manufacturing of candies.

• From 1 ha of sugarcane 5-8 tons of trash is obtained. Trash mulching improves soil health and increases the water holding capacity of soil from 45% to 49% and increases organic carbon.

Conclusion

Crop residue is typically viewed as a problem, but when it is managed, it enhances the dynamics of the soil's organic matter and nutrient cycles, which benefits plant growth. Utilizing agricultural residues in Indian agriculture has enormous potential. When agricultural residues are incorporated, the soil's fertility, productivity and organic matter are all greatly enhanced. Recycling of crop residues also helps farmers financially. Crop residues have great economic value in conservation agriculture.

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