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Paddy Straw Management for Intensive Cropping Practice

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ABSTRACT

Majority of the farming community is burning away the straw as they feel it to be quick and easy. Burning of straw not only pollutes the air, but also results in the loss of valuable organic matter. This articles highlights various useful ways by which paddy straw can be managed. Straw can be managed in many ways depending on the cropping pattern like incorporating into the soil by tillage, chopping and spreading in the field as mulch, collection and value addition. Recent advances in machineries viz., straw baler, mulcher cum spreader and happy seeder are also allowing the farmers to carryout intensive cropping practice.

Keywords Mulching, Tillage, Straw chopper, Happy seeder, Briquetting.

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INTRODUCTION

Rice (*Oryza sativa* L.) is India's most important crop, accounting for 23.3% of the country's gross planted area. In 2017-18, rice production and productivity in India were around 122.27 million metric tons and 2585 kg ha^{-1}, respectively, covering an area of 35.23 lakh ha (Anonymous 2021). Rice accounts for 43 % of overall cereal production and 46 % of total food grain production.

In India, managing paddy straw left in combine harvested fields is a serious issue. Farmers typically use a stubble shaver to shave paddy straw after harvesting it with a combine harvester and then burn it. Despite several uses such as cattle feed, bedding and shelter for cattle, briquetting and thermal power generation - major part goes as waste or burnt in fields. This problem is mostly encountered in Paddy-wheat crop rotation as farmers assume this practise of burning to be quick and easy for disposing paddy straw which enables them to plant the next wheat crop well in time. This is also because combine harvested paddy straw is loosely scattered on the fields and require machinery like straw baler, rake and choppers to manage it.

Every year, the total yield of rice straw in combine harvested fields in Punjab is completely burned. States viz., West Bengal (4.30 Mt), Uttar Pradesh (3.57 Mt), Punjab (3.25 Mt) and Andhra Pradesh (3.38 Mt) stands highest in the straw burning records (Pathak *et al.* 2010). The burning of straw not only pollutes the air, but it also results in the loss of valu-

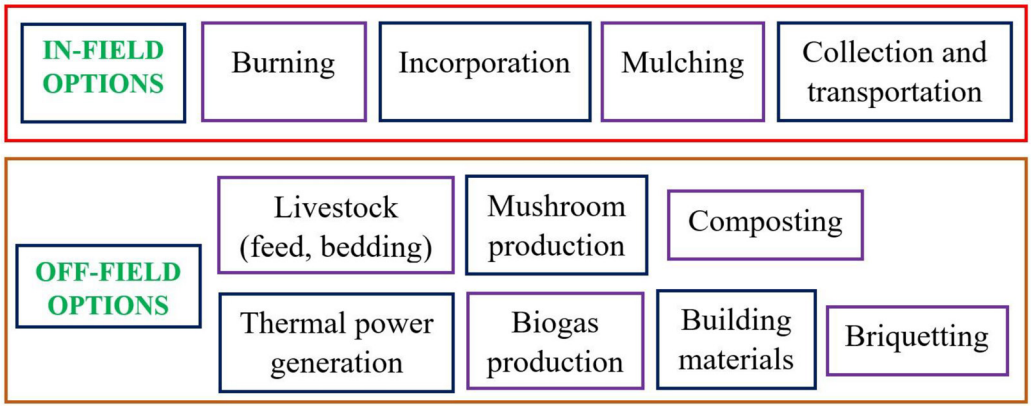

Fig. 1. In-field and of-field options for paddy straw management.

able organic matter (Thakur 2007). And emission of smoke, which, when combined with other gases in the atmosphere such as methane, nitrogen oxide, and ammonia, can result in severe pollution (Kumar *et al.* 2015). Hence farmers must be supported and trained regarding various straw collecting machinery and management practices.

Different paddy straw management practices

Straw management practices are mainly two types i.e., in-field and on-field as depicted in Fig.1. Straw can be managed in many ways depending on the cropping pattern like incorporating into the soil by tillage, chopping and spreading in the field as mulch, collection and value addition. If rice is followed by rice i.e., flooded crop, straw management will be strongly effected by flooded soil and soil anaerobic conditions. If rice is followed by any non-flooded crop, options like no till sowing and mulching are feasible.

Fig. 2. Paddy straw incorporation through tillage.

Fig. 3. Happy seeder.

Incorporation

Rice straw incorporation into soil is a common management option, but adequate time must be allowed for its decomposition to ensure effectiveness and production efficiency. Farmers typically perform several harrowing operations, cultivator operations and planking operations, totalling 8-11 tractor operations to incorporate and thoroughly mix paddy straw into soil as shown in Fig. 2. Although straw incorporation improves soil fertility, excessive tillage consumes energy, time, and money and has negative consequences on various soil physical, chemical and biological aspects (Shukla *et al.* 1996). Rice straw has a slow decomposition rate due to which farmers find it difficult to practice intensive cropping system.

Rice and wheat productivity in a 7-year study was not adversely affected when rice residues were incorporated at least 10 days and preferably 20 days before the establishment of the succeeding crop (Singh *et al.* 2007). Also to speed up the decomposition rate, different fungal inocula spraying's have been tested (Goyal and Sindhy 2011). Study concluded that by using consortium of three fungi as inoculum, stable and mature compost is produced without any phytotoxic effects.

Prior to incorporation, paddy straw can be held in place by using a rake followed by baler. Baler helps in compressing and binding the collected straw into compact bales that are easy to handle, transport, and store. Baler leaves the field with stubbles alone which can be further incorporated into soil using a happy seeder as shown in Fig. 3. In recent times, innovative happy seeder is popularly used to sow wheat seeds directly in the combine harvested paddy field without any prior seedbed preparation and without getting jammed.

Mulching

Rice straw as a mulching (soil cover) increases the soil nutrients, maintains the optimum soil temperature, restrict the rate of evaporation from the soil surface, restrict weed growth and prevent soil erosion. It increases soil water content by 3-9 %, decreased soil penetration resistance by 28-77 % and crack volume by 84-91 % (Paul *et al.* 2021). Erosion can be greatly reduced by maintaining a crop residue cover on the soil surface of at least 30% after all tillage and planting operations. In certain cases, rice straw can

Fig. 4. Tractor operated mulcher cum spreader.

be temporarily removed from the field and then returned for mulching after planting the crop. Not much farmers are interested in this practice as it results in no saving of labor due to handling of straw mulch.

Many straw choppers cum spreaders have been developed to cut the standing stubbles and loose straw left after combine harvesting with simultaneous spreading over the field (Verma *et al*. 2016) (Bhavya *et al*. 2020) (Singh *et al.* 2011) (Fig. 4). This practise helps in achieving conservation tillage, which is the most effective means of cropland erosion control (Kenneth *et al*. 2005).

Value addition

Rice straw is a potential source of bioenergy with a high calorific value (15.60 MJ kg^{-1}) and low ash content (13.32%) (Rhofita *et al.* 2018). One of the effective ways to use rice straw for energy production is by briquetting. Briquetting technology converts low density agricultural residues to high density solid biofuel, which is easy to use and has higher burning efficiency. Different types of briquetting machines help in this densification process by compressing the feed into a higher density briquette of about 15 times and enhancing its volumetric calorific value.

CONCLUSION

Rice-wheat crop rotation is a common intensive cropping practice seen in India. Combine harvested paddy field is left with scattered straw and stubbles which makes it difficult to manage on and off the field. This articles highlights various useful ways by which paddy straw can be managed. Despite several uses like incorporation, mulching and briquetting, major part goes as waste or burnt in fields as farmers find it easy to plan next crop. Farmers must be supported and trained regarding various straw collecting machinery and management practices. NGO's must come forward by setting up briquetting units which further assist in thermal power generation.

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