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Brown farming: A tool for Integrated Weed Management

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Abstract

In India, Agricultural practices have been updated and more emphasis is being placed on enhancing resource management strategy. There are several choices existing among them "Brown farming/manuring" is a technique which involves co-cultivation of rice beside with green manure crop like *Sesbania*. Thereafter, it is knocked down by application of 2, 4-D ester at 20-25 DAS.Itis an unconventional and eco-friendly approach of weed management that not only suppresses weeds but also improves soil health, conserves soil moisture and leads to higher crop productivity and more economic benefits to the farmers. As the technology is cost effective and easy to adopt, it is also suited for resource-poor marginal farmers and need to be popularized among farming community.

Introduction

Weeds are one of the most important biotic constraints to global agricultural production. Weeds decrease both the quantity and quality of agricultural production while raising the overall cost of cultivation. They compete with crops for resources like sunshine, water, nutrients, and space as well as harbor insects and viruses. Weeds, along with pathogens, pose the highest potential yield loss to crops, and it is estimated that weeds cost Indian agricultural production over USD 11 billion each year (Gharde *et al.*, 2018). Crop yield losses caused by weeds vary depending on the type of weeds and crops weed density, weed emergence time, critical period of competition etc. and can even result in 100% yield loss if left uncontrolled.

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Hand weeding is the most common and effective tool for weed management in Agriculture. Nowadays due to timely unavailability of the skilled labour, growing agricultural wage expenses and migration of rural labour to cities, herbicides have become unquestionably significant agents for weed management. However, weed resistance to herbicides, weed population shift and a lack of new molecules and broad spectrum activities of herbicides have raised concerns now a days. The Herbicide-resistant weeds have evolved as a result of unscientific practice of over-reliance on herbicides with similar modes of action. Currently, over 500 unique cases of herbicide-resistant weeds have been reported around the world (Heap, 2019). These issues and concerns have necessitated and encouraged agronomists to develop new eco-friendly weed management strategies such as brown farming/manuring, and to consider the potential for integrating them with herbicide use.

Brown Farming or Manuring

Brown farming was first introduced in North-South Wales, Australia's Lock hart district in 1996. Goodens was the first person to adopt the practice of brown manuring. In Australia for winter crops they employed this strategy against the herbicide-resistant ryegrass population. They planted a cover crop with the intent to incorporate it in to soil before weed seed setting. This practice has helped to rotate the chemical classes, preserve ground cover, prevent weed seed setting and added useful nitrogen from pulse nitrogen fixation, as well as provided the farm's cropping system with agronomic advantages of improved soil quality and water holding capacity.

In India, Agricultural practices have been updated and more emphasis is being placed on enhancing resource management strategy. There are several choices existing among them "brown manuring" (BM) is becoming a current trend for rice eco-system and more prominent method in modern agriculture. Conventionally green manure crops are typically grown earlier to rice cultivation and incorporated by puddling before transplanting of rice seedlings and this necessitates a greater number of tillage practices, which results in a loss of soil moisture content, as well as extra irrigation water and fuel costs. Sometimes farmers unable to take full advantage of green manuring during rice production due to water shortage during peak summer. As a consequence, BM is a substitute to green manuring. It is a method of growing green manuring crops such as Dhaincha, *Sesbania*, Sunnhemp, and other green manuring crops as an intercrop or mixed crop and destroying them with a pre-emergence herbicide for

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manuring. Because of the loss of chlorophyll content in green crops after spraying, the practice is known as Brown manuring (Tanwar, 2010).

Benefits of Brown Manuring Over Green Manuring

Farmers typically cultivate green manure crops before the crop cultivation and introduce them by incorporating into soil.This process of green manuring involves a larger number of green manure tillage operations leading to soil moisture depletion and increased labour cost, irrigation water and fuel costs for cultivation since there are no cultural operations during brown manuring, it saves the cost. Farmers can grow the manure crop in the standing main crops hence, brown manuringis the alternative to green manuring.

Green manuring	Brown manuring
It is the incorporation of a manure crop by tillage before seed set usually around flowering	It is a no-till version of green manuring, where herbicides are used to kill the manure crop and weeds
Risk of soil surface erosion	The plants are left standing so it protects lighter soil from risk of soil erosion
Moisture is necessary for incorporation and decomposition.	Moisture is conserved during the practice
The microbial population is necessary for decomposition	Chemical desiccation will take place
It acts as a live mulch	It act as both live and dead mulch
Main objective is enhancement of organic matter in soil/ nutrient management	Main objective is weed management

Crops Used For Brown Manuring

- **Non-leguminous crops:** The non-leguminous crops which provide only organic matter to the soil are used to a limited extent. Example: Niger, Wild indigo *etc.*
- **Leguminous crops:** Crops provide organic matter along with nitrogen to the soils. The legumes are preferably used, and they can fix atmospheric nitrogen with the help of its nodule bacteria. Example: Sun hemp, Dhaincha, Mung, Cowpea, Lentil *etc.*

Qualities of an Ideal Brown Manure Crops

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Crop species that are most suited to brown manuring enable growers to maximize weed control and nitrogen fixation while minimizing cost and risk. The main criteria to be considered in selection of brown manuring crops includes:

- Seeds of the plants should be easily availability and cost effective
- It should be easy to cultivate and have vigorous growth
- High dry matter production in less span of the crop
- It should have competitiveness with target weeds
- The crops should have high ground cover to reduce wind erosion and conserve moisture
- It should not compete with the main crop
- It should not be an alternative host for the disease and pest organisms.

Benefits of Brown Manuring

- Brown manuring increases the soil organic carbon content and reduces the requirement of nitrogen through biological nitrogen fixation (BNF). Thus, a part of nitrogenous fertilizer (upto 25%) can be replaced by brown manuring
- It increases the yield of the crops thereby improving the economic benefit of the farmers
- It improves the soil health parameters like organic carbon content and earthworm population of the soil
- Brown manuring reduces the weed population in the early stage due to its high canopy cover, rapid growth rate and competitive ability with the weeds.
- Brown manuring has a positive impact on soil physico-chemical properties viz., soil structure, organic carbon, bulk density and pH of the soil.
- Integration of herbicide/herbicides with brown manuring markedly improves protein content in grain and protein yield than other management practices

Brown Manuring As Weed Management

Generally, brown manuring in rice is the practice of growing *Sesbania spp*. and rice together, and when these dhaincha plants overtake the rice plants in height at about 25 days of co-culture, a weedicide 2, 4-D is applied to kill these Sesbania plants. After 4-5 days of spraying, Sesbania plants will appear brown and then start dying; leaves will fall on the ground and form mulch and help in smothering of weeds. As it is a selective herbicide, it kills

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only Sesbania plants and not the rice plants. This is called the down knocking effect. Sesbania is a live cover that offers interference (at pre-killing period) with weed and later as a dead residue mulch offers stimulation by addition of organic matter (at post-killing period). As brown manure crops are grown between the lines of the major crop, so planting density in the field is high, due to which there would be no free space available for weed for its spread resulting in a minimum weed population. In brown manuring, knocking down of Sesbania by 2,4 D application fasten the decomposition and release of nutrient present in Sesbania as compared to in-situ incorporation. Sesbania could add C and N into the soil, which facilitates favourable microbial action (Behera and Das, 2019). Also, during the decomposition of Sesbania, certain organic acids, allelochemicals are released, which might offer some depressive effect on the weed seed bank. Enhanced soil fertility as well as lesser weed competition under brown manuring treatment, leads to higher productivity of crops.

The research review has shown that brown manuring suppressed the broad-leaved weeds density (76-80%) and grassy weed density (20-33%), total weed biomass by 37 to 80% in rice and also increases the physico-chemical condition of soil. The correct time for sowing *Sesbania* to get maximum weed suppression is on the day of rice sowing (Singh *etal*., 2007).

Pre emergence (PE) application of Pendimethalin@ 2.0 kg a.i. ha-1 + brown manuring of sesbania + hand hoeing at 90 DAP could also lower weed density and weed dry weight and increase weed control efficiency, yield parameters and cane yield of sugarcane (Anitta and Ragavan., 2020)

Ramachandran *et al.*, (2012) reported that the weed management practice of PE Alachlor 1.0 kg/ha + brown manuring proved to be effective in registering the lowest weed density of grasses, sedges, broad-leaved weeds and total weeds at 20, 40 and 60 days after sowing (DAS) and was at par with PE Alachclor 1.0 kg/ha + daincha as intercrop with in-situ incorporation on 35 DAS except at 20 and 40 DAS and resulted in higher weed control efficiency (84.41, 92.15 and 89.65% at 20, 40 and 60 DAS, respectively).

Conclusion

In recent years, more attention has been given to the possibilities of exploiting brown farming/manuring to aid in weed management to suppress the weeds without affecting the soil physico-chemical properties and its associated microbes. It can be achieved through raising green manure crops such as Sesbania (Daincha), Sunhemp *etc.* as inter crop and

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killing the same by application of post-emergence herbicides. The killed manure is allowed to remain in the field along with main crop without incorporation / in-situ ploughing until its residue decomposes itself in the soil aiming to add organic manure beside weed suppression by its shade effect. A lower broad-leaved weed density and dry weight were observed with Sesbania and other brown manuring species than the surface mulch. It should thus be widely advocated by the extension agencies to realize its benefits for the farming community of the Nation.

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