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BROWN MANURING: AN ECO-FRIENDLY APPROACH FOR SUSTAINABLE SOIL FERTILITY MANAGEMENT

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Sustainable agriculture focuses on maintaining soil fertility, reducing chemical inputs, and improving crop productivity while protecting environmental resources. One of the emerging eco-friendly techniques gaining importance in modern farming systems is brown manuring. Brown manuring is a method of incorporating partially decomposed green manure crops directly into the soil without uprooting them completely. Unlike conventional green manuring where the crop is ploughed into the soil before flowering, brown manuring involves killing the green manure crop using herbicides or mechanical methods and leaving the residues on the soil surface. This practice provides organic matter, suppresses weeds, and enhances soil fertility. In recent years, brown manuring has been widely promoted in rice-based cropping systems, particularly in regions where farmers face labor shortages and water scarcity. The technique is considered a practical alternative to traditional green manuring because it requires less labor and time while still providing many agronomic and ecological benefits.

Concept of Brown Manuring

Brown manuring is a soil fertility management practice in which a fast-growing leguminous crop is grown along with the main crop and then terminated at an early stage. The crop residues are left on the soil surface where they gradually decompose and release nutrients. The practice is commonly adopted in direct seeded rice (DSR) systems. In brown manuring, seeds of a green manure crop such as *Sesbania* species are broadcast in the field along with the main crop. After about 25–30 days, the green manure crop is killed using a selective herbicide such as 2,4-D. The killed plants dry and turn brown, forming a mulch layer on the soil surface, hence the name brown manuring. The decomposing biomass contributes organic matter and nutrients to the soil while also acting as a natural weed suppressant.

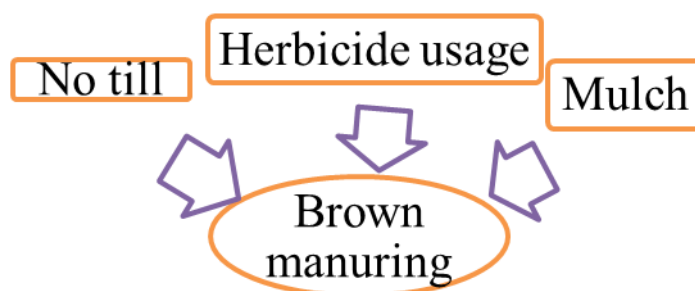


Fig. 1: Concepts of brown manuring

Crops Used for Brown Manuring

Several leguminous crops are suitable for brown manuring due to their rapid growth and nitrogen-fixing ability. Some commonly used crops include:

- *Sesbania aculeata* (Dhaincha)
- *Sesbania rostrata*
- *Crotalaria juncea* (Sunn hemp)
- Cowpea (*Vigna unguiculata*)
- Green gram (*Vigna radiata*)

Among these, *Sesbania aculeata* is widely preferred in rice fields because of its quick growth, high biomass production, and ability to fix atmospheric nitrogen.

Method of Brown Manuring

The process of brown manuring generally involves the following steps:

1. **Field preparation**
2. **Sowing of main crop and green manure crop**
3. **Growth stage** - during the initial stages and helps in suppressing weeds.
4. **Termination of green manure crop**
After about 25–30 days, the green manure crop is killed by spraying a herbicide such as 2,4-D or by mechanical flattening.
5. **Residue decomposition**

Advantages of Brown Manuring

- 1. Improvement in Soil Fertility:** Brown manuring adds organic matter to the soil through decomposing plant residues. Leguminous crops used in brown manuring fix atmospheric nitrogen, which becomes available to the main crop after decomposition.
- 2. Weed Suppression:** The mulch formed by dried plant residues acts as a natural barrier that suppresses weed growth. This reduces the need for additional herbicide applications.
- 3. Reduced Fertilizer Requirement:** The nitrogen fixed by leguminous crops helps in reducing the requirement for chemical nitrogen fertilizers. This can lower production costs and minimize environmental pollution.
- 4. Improved Soil Structure:** The addition of organic matter enhances soil structure, increases water infiltration, and improves soil aeration.
- 5. Moisture Conservation:** The mulch layer created by brown manuring reduces evaporation from the soil surface, helping conserve soil moisture during dry periods.
- 6. Cost-Effective and Labor Saving:** Compared to traditional green manuring, brown manuring requires less labor because the green manure crop is not ploughed into the soil.

Role of Brown Manuring in Rice-Based Cropping Systems

Brown manuring is particularly beneficial in direct seeded rice systems, where weed management is a major challenge. The early growth of *Sesbania* suppresses weeds and improves crop establishment. Research studies have shown that brown manuring can contribute approximately 25–40 kg nitrogen per hectare through biological nitrogen fixation and biomass decomposition. It also enhances soil microbial activity and nutrient cycling. In regions with labor shortages, brown manuring provides a practical solution because it eliminates the need for additional tillage operations required in traditional green manuring.

Environmental Benefits

Brown manuring contributes significantly to sustainable agriculture and environmental protection. By increasing soil organic matter and reducing dependence on chemical fertilizers, the practice helps lower greenhouse gas emissions associated with fertilizer production. Additionally, improved soil structure and organic matter content enhance soil carbon

sequestration. The practice also supports beneficial soil microorganisms that play a key role in nutrient cycling and soil health.

Challenges and Limitations

Despite its advantages, brown manuring has some limitations that may affect its adoption.

One of the main challenges is the need for proper timing of herbicide application to terminate the green manure crop. If the crop is not killed at the right stage, it may compete with the main crop for nutrients and water. In some cases, farmers may also lack awareness or access to suitable seeds for brown manuring crops. Furthermore, the effectiveness of brown manuring may vary depending on soil type, climate, and cropping system.

Future Prospects

With increasing emphasis on sustainable agriculture and resource conservation, brown manuring has strong potential to become an important component of integrated nutrient management. Advances in precision agriculture, improved seed varieties, and better weed management practices can further enhance the efficiency of brown manuring systems. Agricultural extension programs and farmer training initiatives are essential to promote awareness and adoption of this technique. Integrating brown manuring with other practices such as conservation tillage, crop rotation, and organic amendments can contribute to resilient and sustainable farming systems.

Conclusion

Brown manuring is an effective and environmentally friendly practice that improves soil fertility, suppresses weeds, and enhances crop productivity. By integrating leguminous green manure crops with main crops and allowing the biomass to decompose naturally, farmers can reduce dependence on chemical fertilizers and improve soil health. The practice is particularly suitable for direct seeded rice systems where weed management and nutrient availability are critical challenges. With proper management and increased awareness among farmers, brown manuring can play a significant role in promoting sustainable agriculture and improving long-term soil productivity.

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