



ROLE OF BROWN MANURING IN SUSTAINABLE AGRICULTURE

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Introduction

Brown manure is a sustainable agricultural practice that involves the incorporation of cover crops into the soil to enhance soil fertility, improve structure, and suppress weeds. Unlike traditional green manuring, where cover crops are plowed into the soil while still green, brown manuring allows the cover crop to grow until a specific stage (usually just before flowering), after which it is terminated (killed) and left on the soil surface to decompose naturally. The dead plant material acts as mulch, providing organic matter and nutrients as it breaks down, contributing to healthier and more productive soils. This practice is beneficial for enhancing soil organic matter, reducing the need for synthetic fertilizers, conserving water, and promoting weed control in an environmentally friendly manner. Brown manuring is often used in conservation agriculture and regenerative farming systems, where the focus is on maintaining soil health and reducing chemical inputs, ultimately leading to more sustainable and resilient farming operations.

How is Brown Manuring Done?

Selection of Cover Crop: Choose a cover crop that suits the soil type, climate, and the main crop. Leguminous crops (like vetch, peas, or clover) are preferred due to their nitrogen-fixing abilities, but non-legumes like

mustard or sorghum can also be used for biomass production.

Timing of Sowing

The cover crop is usually sown either before or at the same time as the main crop. It grows alongside the main crop, providing weed suppression and soil cover until it reaches the desired growth stage.

Termination of Cover Crop

The cover crop is terminated before it matures fully, usually at the flowering stage. This can be done through mechanical methods (rolling or mowing) or by applying a non-selective herbicide. The crop is left on the surface to decompose.

Decomposition and Nutrient Release

As the cover crop breaks down, it releases nutrients into the soil and contributes to organic matter buildup, enhancing soil fertility and structure over time.

Key Benefits of Brown Manuring

Improving Soil Structure

When cover crops used for brown manuring decompose, they add organic matter to the soil. This organic matter enriches the soil, promoting the growth of beneficial microorganisms that break down organic material, releasing essential nutrients like nitrogen, phosphorus, and potassium. These nutrients become available for subsequent

crops, improving overall soil fertility. The addition of organic matter from brown manure enhances soil structure by promoting the formation of stable soil aggregates. These aggregates improve soil porosity, water retention, and aeration, allowing for better root penetration and microbial activity. Healthy soil structure also helps prevent erosion and compaction, which are key factors in maintaining fertile soils.

Nitrogen Fixation & Nutrient Recycling

Leguminous cover crops (such as clover, peas, and vetch) are commonly used in brown manuring because of their ability to fix atmospheric nitrogen. These plants have symbiotic relationships with nitrogen-fixing bacteria (*Rhizobium* species) in their root nodules, converting atmospheric nitrogen into a form that plants can use. Once the cover crop is terminated and decomposed, this nitrogen becomes available for the next crop, enriching the soil and reducing the need for synthetic nitrogen fertilizers. Brown manure recycles nutrients that might otherwise be lost from the soil through leaching or erosion. As the cover crop grows, it takes up nutrients from deeper soil layers, stores them in its biomass, and then releases them back into the soil upon decomposition. This cycle helps maintain a balanced supply of nutrients, ensuring they are available to the following crops.

Reduction of Nutrient Losses & Increased Humus Content

Brown manure can help reduce the loss of nutrients through erosion or leaching by stabilizing the soil and improving its capacity to retain water and nutrients. Cover crops act as a protective barrier against erosion and help trap nutrients in the root zone, preventing them from being washed

away during heavy rains. As the organic matter from brown manure decomposes, it contributes to the formation of humus, a stable organic compound that plays a critical role in maintaining soil fertility. Humus improves soil texture, enhances its water-holding capacity, and binds nutrients, making them available to plants over longer periods.

Physical Mulch Barrier

The cover crops used in brown manuring grow rapidly, forming a dense canopy over the soil. This canopy shades the ground, reducing the amount of sunlight that reaches weed seeds, which inhibits their germination and growth. By outcompeting weeds for light, space, and nutrients, brown manure reduces weed pressure in the early stages of crop development. After the cover crop is terminated and left on the soil surface, its dead biomass forms a physical mulch layer. This mulch acts as a barrier that prevents weed seeds from accessing light, which is necessary for germination. The mulch layer also physically blocks emerging weeds from breaking through the soil, further suppressing weed growth.

Allelopathic Effects

Some cover crops used in brown manuring, such as rye, sorghum, and certain legumes, have allelopathic properties. This means they release natural chemicals into the soil that inhibit the germination and growth of weed seeds. These allelopathic compounds can provide a natural form of weed control without the need for synthetic herbicides.

Prevention of Herbicide Resistance

By reducing the reliance on chemical herbicides for weed control, brown manure helps prevent the development of herbicide-resistant weed populations. Continuous

herbicide use can lead to resistance in certain weed species, making them harder to control. Brown manuring offers a natural alternative that reduces the risk of resistance development.

Challenges and Considerations

Timely Termination

Proper timing of cover crop termination is critical to prevent it from competing with the main crop for resources like light, water, and nutrients.

Residue Management

Managing the cover crop residue can be a challenge, particularly if large amounts of biomass are produced, which could hinder planting or seeding of the subsequent crop.

Herbicide Use

If herbicides are used to terminate the cover crop, it can raise concerns about chemical inputs, especially in organic farming systems.

Applications in Different Farming Systems

Conservation Agriculture

Brown manuring is an integral part of conservation agriculture, which emphasizes minimal soil disturbance, continuous ground cover, and crop rotations.

Organic Farming

Organic systems often rely on brown manuring for nutrient management and weed control, as synthetic inputs are restricted.

Conclusion

Brown manure is a valuable agricultural practice that enhances soil health, improves fertility, and promotes sustainable farming. By incorporating cover crops that are terminated and left to decompose on the soil surface, brown manure contributes to weed

suppression, reduces reliance on chemical fertilizers and herbicides, and enriches the soil with organic matter and nutrients. This practice improves soil structure, enhances water retention, fosters biodiversity, and supports carbon sequestration, all of which are essential for long-term soil productivity and environmental sustainability. As part of conservation and regenerative farming systems, brown manure plays a critical role in creating resilient agricultural systems that can adapt to changing climate conditions while reducing the environmental footprint of farming. Through its multiple benefits, brown manure offers a sustainable solution for enhancing crop yields, reducing input costs, and improving overall farm management, making it an essential practice for the future of agriculture.

Reference

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