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Green Manuring

A Sustainable Approach to Improve Soil Health

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Introduction

A sustainable farming method called "green manuring" requires growing certain plant species, referred to as "green manure crops," mainly to be added to the soil while still green or shortly after flowering. Green manuring can be defined as a practice of ploughing or turning into the soil, undecomposed fresh green plant tissue for the purpose of improving fertility status of soil, physical as well as biological properties of the soil. Green manures are crops grown specifically to build and maintain soil fertility and structure, although they may have other functions as well. They are usually incorporated back into the soil either directly. The process of producing green plants, then plowing them into the soil or mixing them into the soil is known as "green manuring." Legumes like vetch, alfalfa, clover, and dhaincha, as well as non-legumes like mustard and rye grass, are examples of common green manure crops. The capacity of legumes to fix atmospheric nitrogen through a symbiotic connection with rhizobium bacteria in their root nodules makes them especially valuable. The green manure crops are typically grown in crop rotations, between crops, or during fallow seasons. When they reach maturity, they are added to the soil, where they break down and add nutrients and organic matter. One good thing about green manuring is that it enriches soil nutrients. Soil fertility is improved by the addition of nutrients, particularly nitrogen, by green manures. The nitrogen in the air can be fixed and converted into a form that plants can absorb by using leguminous green manures. They are useful to succeeding crops because, when they break down, they release minerals like potassium and phosphorus.

Benefits of green manuring

- Enhancement of Soil Mechanical Properties- Decomposed green manure's organic content increases soil porosity and aggregation, which in turn improves soil structure. This improves water infiltration, root penetration, and aeration—three factors critical to plant health.
- Increasing the Activity of Microbes in Soil- Soil microbiota thrives when fertilized with green manure. Improved nutrient cycling and suppression of soil-borne diseases are two outcomes of organic matter decomposition, which provides food for beneficial bacteria and earthworms.
- Managing Erosion- Green manure crops lessen the effects of wind and water erosion on soil by covering the soil. When it rains or is really windy, their root systems will hold the soil in place and keep the topsoil from washing away.
- Controlling Pests and Weeds- Some kinds of green manure have allelopathic effects,

meaning they release biochemical that inhibit the germination and growth of weeds. Furthermore, by using green manure crops in rotation, you can break the cycles of pests and diseases and keep weeds at bay thanks to their dense cover.

- The Abstraction of Carbon- Green manures are a great tool in the fight against climate change because they add organic matter to the soil, which helps with carbon sequestration.
- **Guidelines for Efficient Green Manuring**
- **Crop Selection:** Consider your soil's and cropping system's unique requirements while selecting green manure species. Soils low in nitrogen are perfect for legumes, and fast-growing grasses are great for producing biomass rapidly. You can get the most out of the green manure in terms of nutritional content and how easily it breaks down if you apply it at the correct time, which is typically shortly before flowering.
- **Coordinating with Soil Rotations:** Incorporating green manuring into a well-thought-out crop rotation programme can help you interrupt pest cycles, control nutrients, and improve soil fertility. For the best results in terms of decomposition and nutrient release, it is important to incorporate the material into the soil in a timely and complete manner.
- **Diverse Agricultural Systems and Green Manuring:** Green manuring can be easily incorporated into several agricultural systems, such as: One, Farming Without Chemicals as a key component of organic farming practices, green manuring helps keep soil fertility high and weeds and pests under control without the use of synthetic fertilizers or pesticides. Organic systems rely on closed-loop nutrient cycling, to which it makes a substantial contribution.
- **Subsistence and Small-Scale Farming:** Green manuring is an affordable and effective way for small-scale farmers, particularly in developing areas, to improve soil quality without using costly inputs. To make the most of limited space, it makes use of seeds and other resources that are already in the area, and it is frequently intercropped with primary food crops.
- **Traditional Farming Methods:** Reduce your use of chemical fertilizers and tackle problems like soil erosion and degradation using green manuring, even in conventional systems. Conservation tillage and cover crops are two methods that it can supplement.

Important Factors to Think About Green Manuring

Even though there are numerous benefits involved with green manuring, there are also some challenges that come along with it. By gaining an awareness of and finding solutions to these issues, it is possible to improve its successful adoption. However, you should be prepared to put in more time and work in order to cultivate and incorporate green manure crops. In the event that the incorporation is not planned out appropriately, it has the potential to cause difficulties to the main crop planting schedule. When water is limited one of the major problems that can arise is the usage of water for crops that are not harvested until later. On the other hand, the benefits of increased soil water retention potentially have the potential to more than compensate for this in the long run. The Competition for Land Use: In regions where there is a scarcity of arable land, it may appear to be a waste of money to cultivate green manure crops on land that could be utilized for food crops. Because of this, it is extremely important to make use of green manures throughout the times of the year when there are no growing seasons or in the intervals between harvests.

Some Popular Green Manure Crops and Their Benefits

Crops	Types	Benefits/ Role
Sunhemp (*Crotalaria juncea*)	Legumes	Fix significant amounts of nitrogen
Dhaincha (*Sesbania aculeata*)	Legumes	More nitrogen-fixing capabilities
Cluster Bean (*Cymopsis tetragonoloba*)	Legumes	The drought-resistant crop that also has the ability to fix nitrogen
Clover (Trifolium species)	Legume	Excellent nitrogen fixer, good ground cover
Alfalfa/Lucerne (*Medicago sativa*)	Legume	Deep-rooted, improves subsoil structure
Khesari (*Lathyrus sativus*)	Legume	Can fix nitrogen and is also used for forage.
Vetch (*Vicia sativa*)	Legume	Cold-tolerant, builds biomass and nitrogen
Green Gram (*Vigna radiata*)	Legume	It also fix nitrogen
Other Legumes: Many other legume species, such as soybean, cowpea, and lablab bean, are also used as green manure crops.		
Some non-legumes: Mustard Quick-growing, biofumigant properties (pest suppression)		

There are long-term and short-term impacts of green manuring on the environment.

The use of green manure is not only advantageous for individual farms, it also contributes to greater ecological and climate advantages, including the following:

1. Carbon Storage in the Soil: As the organic matter in green manure breaks down, it transforms into humus, which is a form of carbon that is stable and may be found in the soil for extended periods of time. By lowering the amount of carbon dioxide in the atmosphere, this contributes to the mitigation of climate change.
2. Activities to Promote Biodiversity: Creating a more resilient agroecosystem can be accomplished by cultivating a wide variety of green manure crops. These crops can attract beneficial insects, enhance habitats for pollinators, and increase the biodiversity of the soil.
3. The Elimination of Pollution Caused by Agriculture: Green manuring helps to prevent problems like as eutrophication and water contamination by reducing the number of synthetic fertilizers and herbicides that are required. This, in turn, minimizes the danger of nutrient runoff into water bodies.

Prospects for the Future and New Developments

Green manuring is anticipated to receive greater attention as the interest in regenerative agriculture and sustainable food systems continues to rise. For the purpose of developing superior kinds of green manure that have more biomass, faster decomposition rates, and improved resistance to pests, research is currently being conducted. It is also possible that the efficiency and accessibility of green manuring could be improved by combining it with contemporary agricultural technologies such as no-till farming, precision agriculture, and agroforestry.

The following are some of the ways in which governments and agricultural extension agencies can further promote green manuring:

- Providing training and demonstration projects
- Offering incentives or subsidies for green manure seed
- Including green manuring in national soil health programmes

Conclusion

Green manuring is a practice that has been around for a long time, is kind to the environment, and considerably improves the health of the soil. Through the addition of organic matter and nutrients to the soil, the enhancement of the soil's structure, the

enhancement of the microbial life, and the provision of natural weed and insect control, green manuring contributes to the maintenance of sustainable agriculture and the long-term productivity of land. It is a sustainable and regenerative approach that can be helpful to farmers who are wanting to reduce the amount of chemical inputs they use while still maintaining a high level of soil fertility. It is also one of the most effective methods for establishing a connection between soil health, crop productivity, and environmental. It does this by organically nurturing the soil, which has the effect of promoting not only healthier crops but also healthier ecosystems. Whether you are a conventional producer, an organic grower, or a smallholder farmer who is wanting to lower the costs of inputs, green manuring provides a solution that is both diverse and effective. You are making an investment in the future when you invest in the soil, and green manuring is a straightforward yet significant method to get started.

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