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# Green Manuring: A Sustainable Path To Soil Health

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**ABSTRACT**

Green manuring is a sustainable agricultural practice that involves the cultivation and incorporation of green plants into the soil to enhance soil fertility, improve structure, and increase organic matter. This article explores the concept, benefits, types and challenges of green manuring, as well as its role in sustainable agriculture. Additionally, the selection of appropriate green manure crops, the biochemical processes involved, and its long-term effects on soil health and crop productivity have also been discussed.

***Key Words:*** Green manuring, soil fertility, environmental conservation and leguminous crops

## INTRODUCTION

Soil fertility is an important aspect of agricultural productivity. Over the time, continuous dominant rice-wheat cropping system and injudicious use of chemical fertilizers disturbs the soil nutrient balance, leading to yield stagnation and other environmental concerns. Green manuring offers a viable solution to maintain soil health naturally by incorporating fresh plant biomass into the soil. Moreover, this practice can enhance nutrient cycling, suppress weeds, and improve soil microbial activity and ultimately leads to sustainable agriculture.

**Concept of Green Manuring**: Green manuring is an age-old agricultural practice followed by farmers which involves growing leguminous or non-leguminous crops (preferably leguminuous) and incorporating them into the soil while they are still green or near flowering. The plant material decompose, releases essential plant nutrients and adds organic matter into the soil, which enhances soil fertility and improves the soil structure. Green manuring also enhances microbial diversity, enhances soil porosity, and improves the water retention properties of the soil.

**Types of Green Manuring:**

1. **In-situ Green Manuring:** This method involves growing green manure crops such as sunhemp (*Crotalaria juncea*), dhaincha (*Sesbania bispinosa*) and cowpea (*Vigna unguiculata*) within the same field where they will be ploughed back into the soil before maturity, ensuring maximum biomass contribution and nitrogen fixation.

2. **Ex-situ Green Manuring:** This implicates collecting organic materials such as green leaves, crop residues, and biomass from plants like neem (*Azadirachta indica*) and glyricidia (*Gliricidia sepium*) from different locations and incorporating them into the soil. This method is particularly useful in areas where dedicated green manure crops cannot be grown due to space constraints.

**Selection of Green Manure Crops** The selection of green manure crops depends on multiple factors, including soil type, climate, cropping pattern, and expected benefits. Leguminous crops are generally used for green manuring due to their ability to fix atmospheric nitrogen through symbiotic relationships with rhizobium bacteria. Non-leguminous plants such as mustard, buckwheat, and rye can also be used for their ability to improve soil structure and suppress weeds.

**Stage of green manure crop at burying:** Green manure crop may be turned into the soil when the crop approaches flowering stage. Therefore, bury 6 to 8 weeks old dhaincha/cowpea/sunnhemp one day before transplanting of paddy and 10-15 days prior to maize sowing by using disc harrow or rotavator.

**Benefits of Green Manuring**

- **Nutrient Enrichment:** Leguminous green manure crops fix atmospheric nitrogen through biological nitrogen fixation (BNF) and helps in improving the soil nitrogen status significantly.
- **Soil Structure Improvement:** Addition of organic matter through burial green crops improves soil aeration, increases water-holding capacity, reduces compaction and enhances soil aggregation.
- **Weed and Pest Suppression:** Some green manure crops act as cover crops, reduces weed growth by outcompeting unwanted species and producing allelopathic compounds that prevents weed germination.
- **Erosion Control:** Green manure crops protect the soil from wind and water erosion by providing ground cover and stabilizing soil particles.
- **Microbial Activity Enhancement:** The decomposition of green manure buried plant material increases soil microbial biomass and diversity, hence promoting beneficial microorganisms that aid in nutrient cycling.
- **Reduction in Chemical Inputs:** By increasing natural soil fertility, green manuring minimizes the need for synthetic fertilizers and pesticides, leads to decrease the cost of cultivation as well as environmental pollution.

**Challenges of Green Manuring**: Despite its numerous benefits, green manuring has certain limitations:

- **Land Use Constraints:** Green manure crops require land, which may otherwise be used for cash crops, reducing immediate economic returns for farmers.
- **Time Consumption:** Growing and incorporating green manure takes time, which may delay the planting of primary crops in intensive farming systems.

- **Moisture Dependency:** Decomposition and nutrient release depend on adequate soil moisture, making green manuring less effective in drought-prone areas and areas affected by the shortage of electric supply for irrigation purpose.
- **Limited Immediate Impact:** Green manure takes time to break down and release nutrients, making its effects less immediate compared to chemical fertilizers.

**Role of Green Manuring in Modern Agriculture** With increasing emphasis on sustainable farming practices, green manuring is gaining importance in organic farming, conservation agriculture, and integrated nutrient management systems. It plays a crucial role in climate-resilient agriculture by enhancing soil organic carbon sequestration, improving water-use efficiency and dropping greenhouse gas emissions associated with chemical fertilizers. Governments and agricultural extension services are promoting green manuring through incentive programs, awareness campaigns and field demonstrations to encourage farmers to adopt this practice for long-term sustainability.

**CONCLUSION**

Green manuring is an effective, eco-friendly strategy for enhancing soil health and agricultural sustainability. While it offers certain challenges, its benefits in terms of nutrient enrichment, erosion control, enhanced microbial activity, and reduced chemical dependency make it a valuable and beneficial practice. Future agricultural policies should integrate green manuring into comprehensive soil fertility management approaches, ensuring its extensive adoption to support environmental conservation and sustainable crop production.