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Green Manuring: A Sustainable Approach to Soil Fertility Management

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SUMMARY

Green manuring is a time-tested, sustainable agricultural practice that involves the cultivation and incorporation of specific green biomass crops—primarily legumes—into the soil to enhance its fertility and structure. In contrast to the overuse of synthetic fertilizers, which leads to long-term soil degradation, green manuring restores soil health by enriching organic matter, fixing atmospheric nitrogen, improving microbial activity, and recycling nutrients.

INTRODUCTION

The continuous degradation of soil fertility poses a significant challenge to global agricultural sustainability. This issue has been exacerbated by the widespread and long-term dependence on synthetic fertilizers and high-input, monoculture cropping systems. While chemical fertilizers provide immediate nutrient availability and have contributed to significant increases in crop yields—especially during the Green Revolution—their indiscriminate use has resulted in severe ecological consequences. These include depletion of soil organic matter, disruption of microbial biodiversity, contamination of water bodies, and increased greenhouse gas emissions. With rising concerns about soil health, environmental sustainability, and input costs, there is an urgent need to adopt alternative practices that restore the natural balance of agroecosystems. Green manuring emerges as a viable and eco-friendly solution. These crops are rich in biomass and nutrients and are particularly effective in biological nitrogen fixation due to their symbiotic association with *Rhizobium* bacteria. Green Manure refers to fresh plant biomass—mainly leguminous species—that is ploughed into the soil while green or soon after flowering to improve physical structure, nutrient content, and biological activity of the soil.

Types of Green Manuring

Green Manuring In-Situ

The green manure crops are grown and incorporated in the same field. Common crops:

- Sunnhemp (*Crotalaria juncea*)
- Dhaincha (*Sesbania aculeata*)
- Pillipesara (*Phaseolus trilobus*)
- Cluster bean (*Cyamopsis tetragonoloba*)
- Sesbania rostrata
- Cowpea, Mung, Urd, Berseem

Green Leaf Manuring

Leaves and twigs from shrubs or trees grown on bunds or wastelands are collected and added to the soil. Common sources include:

- Glyricidia (*Glyricidia maculata*)
- Pongamia (*Pongamia glabra*)
- Neem (*Azadirachta indica*)
- Calotropis gigantea
- Cassia auriculata, Ipomoea carnea, Leucaena leucocephala

Characteristics of Ideal Green Manure Crops

- Rapid growth and high biomass production in 6–8 weeks
- High nitrogen-fixing ability (preferably legumes)
- Succulent, leafy, and easily decomposable
- Deep and fibrous roots for nutrient recycling
- Adaptability to different soils and climates

Biomass Production and Nitrogen Accumulation

Crop	Age (Days)	Dry Matter (t/ha)	N Accumulated (kg/ha)
Sunnhemp	60	30.6	134
Sesbania aculeata	60	23.2	133
Cowpea	60	23.2	74
Pillipesara	60	25.0	102
Cluster bean	50	3.2	91
Sesbania rostrata	50	5.0	96

Nutrient Content of Common Green Manure Crops

Plant	Scientific Name	N (%)	P_2O_5 (%)	K (%)
Dhaincha	*Sesbania aculeata*	3.5	0.6	1.2
Sunnhemp	*Crotalaria juncea*	2.3	0.5	1.8
Sesbania	*Sesbania speciosa*	2.71	0.53	2.21
Tephrosia purpurea	*Tephrosia purpurea*	2.4	0.3	0.8
Pongamia	*Pongamia glabra*	3.2	0.3	1.3
Neem	*Azadirachta indica*	2.8	0.3	0.4

Advantages of Green Manuring

- Increases soil organic matter and microbial activity
- Enhances soil structure, aeration, and water retention
- Fixes atmospheric nitrogen and enriches soil nutrient content
- Suppresses weeds and controls erosion
- Reduces dependence on synthetic fertilizers
- Some plants (e.g., Neem, Pongamia) have pest-control properties
- Improves availability of secondary nutrients like Ca, Mg, Fe

Limitations and Constraints

- Requires 6–8 weeks fallow time, which may not be feasible in intensive cropping
- Green manure crops may compete for water or harbor pests
- Limited availability of quality seeds and water for growing G.M. crops
- Additional labor or cost for collection in case of green leaf manuring
- Not suitable for all soil types and climatic zones

CONCLUSION

Green manuring is an essential agroecological practice that enhances long-term soil health, supports sustainable agriculture, and fits well with organic and conservation farming systems. Though limitations exist, strategic use of green manure crops can significantly improve soil fertility, reduce input costs, and ensure environmental sustainability in both tropical and sub-tropical agro-ecosystems.

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