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"Soil and environmental quality enhancement through Green manuring"

Rahul Verma[1*], Dr. Dinesh Sah[2], Dr. G.S.Panwar[2], Devrani Gupta[1], Rinku Kumar[1], Abhishek Raj Ranjan[1]

Introduction:

The decline in soil quality is a major environmental issue globally. Balancing the production of high-quality food in adequate quantities for the growing population, while preserving soil quality and fertility, presents a significant challenge. The extensive use of agrochemicals to increase soil productivity has led to soil degradation, negatively impacting human health and the environment. Conversely, green manure usage in crop production is seen as an economically feasible and environmentally sustainable alternative to agrochemicals. Green manures, which are crops grown specifically to be incorporated into the soil, enhance the soil with organic matter and nutrients through symbiotic nitrogen fixation. They play a vital role in restoring and improving soil quality, preparing it for future crops. These green manures can include legumes, cover crops, and other plant species selected for their ability to improve soil properties. Around the world, various green manure plants contribute to the improvement of the biological, physical, and chemical properties of the soil. Beyond enhancing soil quality, green manures assist in managing agricultural diseases, pests and weeds, providing a comprehensive approach to sustainable agriculture. Green manure crop may be taken as sole crop or intercrop.

Types of green manuring:

1. **Green manuring (*in-situ*):** Green manuring in-situ involves cultivating green manure crops directly in the field, either as standalone crops or intercropped with the primary crop, and then incorporating them into the soil on-site. Examples of such crops include Sannhemp, Dhaincha,

Rahul Verma[1], Dr. Dinesh Sah[2], Dr. G.S.Panwar[2], Devrani Gupta[1], Rinku Kumar[1], Abhishek Raj Ranjan[1]*
Research Scholar[1], Professor[2], Department of Agronomy, Banda University of Agriculture and Technology, Banda – 210001

Biomass production and N accumulation of Green manure crops			
Crop Age (Days)	**Age (Day)**	**Dry matter (t/ha)**	**N accumulation (Kg/ha)**
Sesbania aculeata (Dhaincha)	50-60	23.2	133
Sunnhemp	50-60	30.6	134
Cow pea	50-60	23.2	74
Pillipesara	50- 60	25.0	102
Cluster bean	50-55	3.2	91
Sesbania rostrata	50-55	5.0	96

These crops can be sown as the main crop, inter-row sown crops, or on bare fallow land, depending on the soil and climatic conditions of the area.

2. **Green leaf manuring (*ex- situ*):** This practice involves incorporating tender green branches and leaves from shrubs and trees grown on bunds, wastelands, and in nearby forests into the soil. Examples of such plants include Neem, Subabul, Pongamia, Parthenium, Glyricidia, wild Dhaicha, and Karanj. Some weeds before seed setting may be utilized as green leaf manuring.

Nutrient content of Green Leaf manure				
Plant	**Scientific name**	**Nutrient content (%) on air dry basis**		
		N	**P_2O_5**	**K**
Neem	*Azadirachta indica*	**2.8**	**0.3**	**0.4**
Subabul	*Leucaena leucocephala*	**3.5**	**0.5**	**0.8**
Pongamia	*Pongamia glabra*	**3.3**	**0.4**	**2.4**
Parthenium	*Parthenium hysterophorus*	**2.7**	**0.7**	**1.5**
Water hyacinth	*Eichhornia crassipes*	**3.0**	**0.9**	**0.2**
Gliricidia	*Gliricidia sepium*	**2.8**	**0.3**	**4.6**

- **Quality enhancement of Soil and environment through Green manuring:**

Enhancing soil and environmental quality through green manure involves the strategic use of specific plant species to boost soil health, fertility, and resilience, while also promoting environmental conservation and sustainable agricultural practices. The main goal is to utilize natural and ecologically sound methods to increase the productivity and long-term sustainability of agricultural ecosystems, while minimizing adverse environmental impacts. At its core, the concept of green manure aims to address multiple interconnected objectives:

Soil Fertility Enhancement: By incorporating nitrogen-fixing cover crops, such as legumes, into crop rotations or fallow periods, green manure enriches the soil with essential nutrients, particularly nitrogen. This reduces the reliance on synthetic fertilizers, mitigating nutrient runoff and associated environmental pollution.

Soil Structure Improvement: The extensive root systems of green manure crops help to improve soil structure by increasing soil aggregation and stability. This enhances water infiltration, reduces soil erosion, and promotes better aeration and nutrient exchange, ultimately supporting healthier plant growth and crop yields.

Carbon Sequestration and Climate Mitigation: Green manure crops contribute to carbon sequestration by converting atmospheric carbon dioxide into organic matter through photosynthesis. By enhancing soil organic carbon levels, green manure helps mitigate climate change by storing carbon in the soil, thereby reducing greenhouse gas emissions and enhancing climate resilience in agricultural systems.

Biodiversity Promotion: The cultivation of diverse cover crop species as green manure fosters biodiversity in agricultural landscapes. This provides habitat and food sources for beneficial insects, birds, and other wildlife, promoting natural pest control, pollination, and ecosystem resilience.

Long-Term Sustainability: Ultimately, the overarching objective of enhancing soil and environmental quality through green manure is to foster long-term sustainability in agriculture. By adopting regenerative practices that improve soil health, conserve natural resources, and enhance ecosystem functions, farmers can build resilient agricultural systems capable of meeting the needs of current and future generations while safeguarding the health of the planet.

Reduction of Synthetic Inputs: By integrating green manure into crop rotations or agro ecosystems, farmers can reduce reliance on synthetic inputs such as chemical fertilizers and pesticides. This not only minimizes the environmental footprint of agricultural production but also enhances farm profitability and resilience by reducing input costs and dependency on external inputs.

- **The Impact of synthetic Fertilizers on the Environment (In fig.): Inorganic vs. green manure:**

Advantages of Green manuring:

- Increases water holding capacity.
- Growing of green manure crops in the off season reduces weed proliferation and weed growth.
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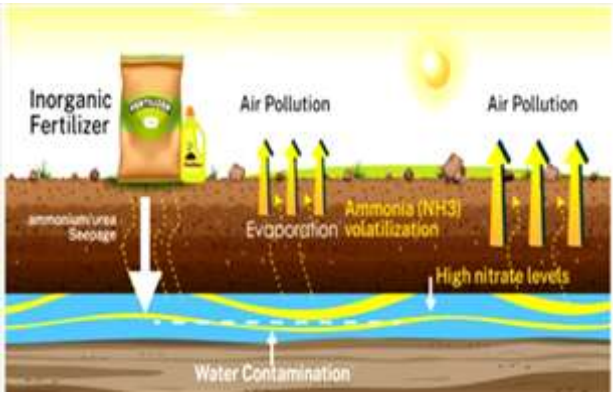

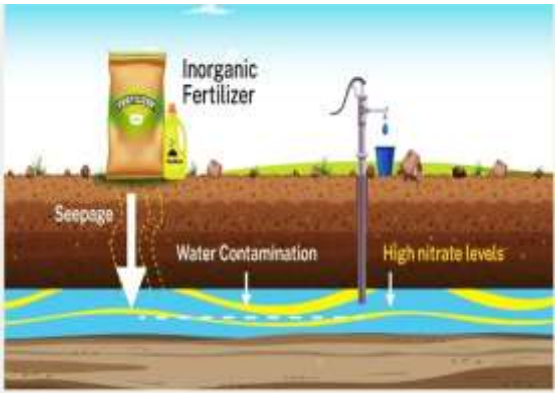

- Green manuring helps in reclamation of alkaline soils.
- Reducing pest and disease problems, and adding organic matter to the soil.
- Increasing biological activity, And increasing the supply of nutrients available to plants, Reducing leaching losses and No adverse impact on soil and environment, hence environment friendly and help in maintaining the fertility of the soil in long term.

Conclusion

Green manuring offers a sustainable approach to enhancing soil and environmental quality. By enriching the soil with organic matter and nutrients, improving soil structure, and providing various ecological benefits, green manures represent a valuable tool in sustainable agriculture. Their adoption can lead to healthier soils, reduced reliance on chemical inputs, and improved agricultural productivity, contributing to long-term food security and environmental health.