



## Green Manuring: An Approach to Improve Soil Fertility

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Presently, India has achieved food sufficiency level by increased fertilizer use with subsidized prices. Inorganic fertilizers are becoming more expensive, therefore sustainability of soil productivity has become a question. Hence, alternate sources to supplement inorganic fertilizers are thought. Green manures crops grown for the benefit of the soil. The use of green manure crops in traditional agriculture for thousands of years are more common but conventional farming systems largely rejected them. Importance of this soil ameliorating practice is increasing in recent years because of high cost of chemical fertilizers, increased risk of environmental pollution, and need of sustainable cropping systems. Healthy soils lead to healthy plants. Maintaining such soils and increase crop production is a huge task for farmers. Green manures are a gift from nature, being a suitable alternative to increase the organic matter content of the soil and fulfilled the task of farmers to improve soil productivity and crop production. Green manuring is an effective technology in minimizing cost of fertilizers and safe guarding productivity. Green manure crop absorb the nutrient from lower layer and leave them in surface when ploughed.

### Green manuring

Green manuring (GM) is the practice of ploughing under or turning in to soil, any green manure crops; tender twigs or leaves while they are green or soon after they flower. Green manures are forage or leguminous crops that are grown for their leafy materials needed for soil nutrient conservation and to add organic matter in the soil. "The value of green manuring lies in the fact that they add the organic matter into the soil". The organic matter in the soil is recognized as being one of its most valuable constituents for real soil fertility.

In general, in green manuring two types of green manure crops used.

1. Legumes: Used for their ability to fix nitrogen from the air and add it to the soil; Examples: Sun hemp, sesbania, sweet clovers, guar, lupins, vetches, alfa, peas, beans, soybeans;
2. Non-legumes: Mainly serve as cover crops and enrich soils of organic matter; Examples: Berseem, buckwheat, chicory, mustard, turnips, ryegrass, oats, barley and rye.

### Practice of Green Manuring

Use of Green manure crops in cropping system is called 'Green Manuring'. There are two approaches of Green Manuring.

1. **In-situ Green Manuring:** In the in situ method, green manure crops are grown in a field prior to crop cultivation and then cut and buried when approximately 50 percent of all plants are flowering. For green manuring, legumes are preferred because of their ability to fix nitrogen from the air. The use of sunhemp (*Crotalaria juncea*) is popular and well practiced by most of the farmers. Because of its ability to grow fast and its efficient nitrogen fixing capacity, these plants are grown and sacrificed to improve the living condition of the main crop. Green manuring with legumes (*Sesbania*, cowpea, green gram, clovers, lentils, cluster bean etc.) is called legume green manuring. It is a viable alternative to conventional lean period fallowing and can reduce the amount of nitrogen fertilizer required. This crop has to be turned under the soil before the plants set seed. Legumes crops are used as green manures or as forage crops has become an important practice for maintaining soil fertility and productivity.



**Fig. 1 In-situ Green Manuring**

2. **Green leaf manuring:** In this practice the foliage of the shrub and herb type of weeds that grow along the roadside, riverside and lake bunds and leaves and twigs of trees that are grown along the boundaries of the farm and along the main bunds of the fields were collected and incorporated in the existing crop field. In this there will be more variety of species.

The commonly used weeds species as a green leaf manures are as follows:

1. *Pungamia pinnata*,
2. *Cassia auriculata*,
3. *Calatropis gigantea*,
4. *Ipomoea sps*,
5. *Eichornea*

The commonly used tree species are as follows:

1. *Azadiracta indica*,
2. *Pungamia pinnata*,
3. *Glyricidia sps*,
4. *Thespesia populina*,
5. *Cassia seamia*
6. *Cassia auriculata*

#### **An ideal green manure crop must have the following qualities**

1. Produce a significant amount of green material within a short period,
2. It should be resistant to heat, shade, and drought.
3. Grow quickly, particularly at first, to choke off weeds.
4. Have a quick breakdown by being succulent and growing more leaves than wood, so that its decomposition will be rapid,
5. Preferably is a legume, so that atm. 'N' will be fixed,
6. Have a deep and fibrous root system to better the soil's structure and to collect nutrients from the lower zone and add them to the surface sod.
7. Have the ability to thrive in subpar soils.

### Stage of green manuring

A crop for green manuring can be harvested during or shortly before blooming. The majority at the G.M. crops require 6 to 8 weeks after sowing at which there is maximum green matter production and most succulent.

**Table 1. Biomass production and N accumulation of green manure crops**

Crop	Age (Days)	Dry matter (t ha <sup>-1</sup> )	N accumulated
Sesbania aculeata	60	23.2	133
Sunnhemp	60	30.6	134
Cow pea	60	23.2	74
Pillipesara	60	25.0	102
Cluster bean	50	3.2	91
Sesbania rostrata	50	5.0	96

**Table 2. Nutrient content of green manure and green leaf manure crops**

Plant	Scientific Name	Nutrient content (%) on air dry basis		
		N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
<b>Green manure crop</b>				
Sunnhemp	<i>Crotalaria juncea</i>	2.30	0.50	1.80
Dhaincha	<i>Sesbania aculeata</i>	3.50	0.60	1.20
Sesbania	<i>Sesbania speciosa</i>	2.71	0.53	2.21
<b>Green leaf manure crop</b>				
Neem	<i>Azadiracta indica</i>	2.83	0.28	0.35
Karanj	<i>Pungamia pinnata</i>	3.31	0.44	2.39
Glyricidia	<i>Glyricidia sps</i>	2.76	0.28	2.8

### Advantages of green manuring

1. It enriches the soil with organic matter and mimics the activities of soil microorganisms.
2. It enhances soil structure, increasing the soil's capacity to retain water and reducing runoff and rain-related erosion.
3. The GM incorporates nutrients into the top layer of the soil by removing them from the soil's lower layers.
4. It is a leguminous crop that contributes to the soil and fixes 'N' from the atmosphere for use by following crops. Typically, the atmosphere provides approximately 2/3 of the nitrogen, while the remaining 1/3 comes from the soil.
5. It makes several plant nutrients, such as P<sub>2</sub>O<sub>5</sub>, Ca, Mg, and Fe, more readily available.
6. In the off-season, green manure crops are grown to control weed development and proliferation.
7. Alkaline soils can be recovered with the use of green manuring.
8. Green manuring can be used to control root knot nematodes.

### Constraints in green manuring

Although the advantages of green manure in terms of their impact on soil fertility and crop yield are well established, farmers do not frequently utilize this method due to the following limitations:

1. In a high-intensity cropping system, the farmers might not be compelled to set aside 6 to 7 weeks exclusively for the cultivation of green manure in the absence of financial reward. Only the fallow season (summer) will be left without any crops, therefore farmers were unable to consider cultivating any green manures during this time.

2. Because organic and inorganic sources are complimentary or synergistic in the farmer's eyes, the advantages of adding green manure were not as obvious as those of mineral fertilizer N.
3. Due to differences in soil types, types of green manure, environmental factors, etc., the advantages of green manuring may not necessarily be consistent across all crops.
4. In rain-fed conditions, the subsequent crop's germination and growth may be hampered by a lack of moisture for G.M. growth and decomposition.
5. G.M. crop inclusive of decomposition period occupies the field least 75-80 days which means a loss of one crop