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Green Manuring: An approach to Improve Soil Fertility and Crop Production



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Abstract

The importance of green manuring in crop production has been known since ancient time. In recent years its importance is also increasing continuously because of high cost of chemical fertilizers, increased risk of environmental pollution, and need of sustainable cropping systems. Green manure crop absorbs the nutrient from lower layer and leave them in surface when ploughed. However, green manuring can improve soil fertility and consequently crop yields. Green manuring is low cost-effective technology in minimizing cost of fertilizers and safe guarding productivity.

Keywords: Green manuring; Legume; Soil fertility; Crop production; Environmental pollution

Introduction

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 minimising cost of fertilizers and safe guarding productivity. Green manure crop absorb the nutrient from lower layer and leave them in surface when ploughed [1].

Green manuring

Green manuring 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, alfalfa, peas, beans, soybeans.

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.

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 sun hemp (*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 a green-manures or as forage crops has become, an important practice for maintaining soil fertility and productivity.

Green leaf manuring: In this practice the foliage of the shrub and herb type of weeds that are 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:

- a. *Pungamia pinnata*
- b. *Cassia auriculata*
- c. *Calatropis gigantea*
- d. *Ipomoea sps*
- e. *Eichornea*

The commonly used tree species are as follows:

- a. *Azadiracta indica*
- b. *Pungamia pinnata*
- c. *Glyricidia sps*
- d. *Thespesia populina*
- e. *Cassia seamia*
- f. *Cassia auriculata*

Characteristics of legume green manure crops [2]

- a. Short duration, fast growing, and high nutrient accumulation ability.
- b. High N accumulation rates.
- c. Highly efficient in use of water.
- d. Wide ecological adaptability.
- e. Tolerance to shade; flood, drought and adverse temperatures.
- f. Early onset of biological nitrogen fixation in soil.

- g. Produce abundant and succulent tops.
- h. Photoperiod insensitivity.
- i. High seed production.
- j. High seed viability.
- k. Ease in incorporation.
- l. Pest and disease resistant.
- m. They should have high biomass production.

Objectives of green manuring

To add N to the crop and add or sustain organic content of the soil.

Subsidiary objective

- a. Legumes are inter-sown in standing crop before or after harvest, to utilize nitrates or the left over moisture.
- b. Sown in young orchards with the objective of shading the soil surface and, preventing the rise of temperature.
- c. Green manure crops are grown with the objective of covering the soil surface with a vegetative material, especially in hilly slopes during the rainy period to reduce soil erosion and run-off of water.
- d. Legume are grown for taking cutting of green fodder for cattle in early stages and later as green manure. Pillipesara seeds can be broadcasted in the standing rice crop.

Advantages of green manuring

- a. Improves the soil fertility.
- b. Provision of nutrients and organic carbon of soil.
- c. Prevention of erosion.
- d. Improves the soil structure.
- e. Improves soil aeration.
- f. Reducing pest and disease problems.
- g. Promotes habitat for natural enemies.
- h. Suppressing weeds.
- i. Lower fertilizer N requirements for succeeding crops.
- j. Providing supplementary animal forage.
- k. Increase the yield of crop 10-15%.

A number of disadvantages can also be identified

- a. Direct costs of seed and extra cultivations.
- b. Extra work at busy times of the year.
- c. Lost opportunities for cash cropping.

How green manuring improve the fertility of soil [3]

- a. Green manure crop absorb the nutrient from lower layer and leave them in surface when ploughed.
- b. Prevent leaching of nutrient to lower layers.
- c. Harbour N fixing bacteria, rhizobium in root nodules and fix atmospheric nitrogen.

d. Increase solubility of lime phosphate, trace element etc., through the activity of soil micro-organism and by producing organic acids during decomposition.

Management of green manures: Management of green manures will depend on the type of green manure, the duration of the crop spp., and the nature of the farming system in which green manure crop used. The key management practices for some common species of green manure are summarized in (Table 1-3).

Table 1: Management of green manures.

S. No.	Crop	Seed Rate (kg/ha)	Sowing Time	Green Biomass (tonne/ha.)	N Content (%)	Available N kg/ha.)
Green manure crops						
1	Sun hemp	April-July	40-45	20-30	0.43	84.0-129
2	<i>Sesbania</i> Spp.	April-July	35-40	23.2	0.42	77.1-105
3	Cluster bean (Guar)	June-July	40-45	18-30	0.43	61.0-85
4	Lobia	April-July	45-50	15-18	0.49	74-88
5	Green gram (Moong bean)	March-April	20-25	10-Aug	0.53	38.6
6	Black gram	June-July	20-25	12-Oct	0.41	42.5
7	Berseem	Oct.-Dec.	18-20	16-18	0.43	60
8	Senji	Oct.-Dec.	20&25	26-29	0.51	134.4

Table 2: Available nutrient content (%) in green manure and green leaf manure crop.

S. No.	Crop	Botanical Name	Nutrient Content (%) on Dry Weight Basis		
			N	P ₂ O ₅	K ₂ O
Green Manure Crop					
1	Sun hemp	<i>Crotalaria juncea</i>	2.3	0.5	1.8
2	Dhaincha	<i>Sesbania aculeata</i>	3.5	0.6	1.2
3	Sesbania	<i>Sesbania speciosa</i>	2.71	0.53	2.21
4	Jangli neel	<i>Tephrosia purpurea</i>	2.4	0.3	0.8
Green Leaf Manure Crop					
1	Neem	<i>Azadiracta indica</i>	2.83	0.28	0.35
2	Karanj	<i>Pungamia pinnata</i>	3.31	0.44	2.39
3	Glyricidia	<i>Glyricidia sps</i>	2.76	0.28	2.8

Table 3: Green manure crops suitable for different type of soil.

S. No.	Type of Soil	Green manure crops
1	Light sandy loam soil of dry region	Lobia, Guar, Green gram and Black gram
2	Saline and Alkaline soil	Sun hemp and Dhaincha
3	Loamy sand soil	Dhaincha, Guar, Sun hemp and Green gram

Preparation of seed bed

A seedbed for green manure crop should be prepared using standard techniques by loosening the soil with a fork to break up any clods to a reasonable depth. The earlier development of effective root systems is play a vital role for overall performance of the green manure crop. This is particularly important for the shorter-term green manures. The broken of compaction of soil depend on the size of seed and it is particularly important that

small seeds such as clover is sown into a fine, well-firmed seedbed. Although it may seem obvious there should be adequate moisture in the seedbed prior to sowing.

Sowing techniques: Green manure crops are sown by broadcasting and drilling. In practice the choice is often determined by what machinery is available. Even distribution of seed and uniform sowing depth are the prime requirements for successful establishment in conjunction with a fine firm seedbed.

Mowing: Most of short-duration green manure crops are grown to generate bulk and this is turned in soil after flowering time or before the crop has set seed. Longer duration green manures need proper management if they are grown to generate the required benefits.

Incorporation of green manure crop: Effective incorporation of the green manure crop is as important as the growing of the crop. Green material of incorporated crop should breakdown quickly and this will depend on good mixing of the green manure crop and proper aeration of the soil. It is also important that the green manure has not become too mature and woody at the time of incorporation. Before incorporation, the top growth should

ideally be wilted. If there is a lot of bulk a topper should be used to chop the growth, which is then wilted for up to 7 days before incorporation. To chop the green material into the soil surface, an alternative approach is uses disc harrows or a shallow rotavator.

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