

## Green manuring

The land's nitrogen and other nutrient status became depleted after years of cropping cereals and vegetables with no addition of adequate quantity of manures. In addition, with the cost of N fertilizer increasing every year, and the quality of our soils deteriorating under monoculture cropping, green manuring might just be the best method of saving our good farmland. Soil productivity is an important concern for farmers. Green manuring is gaining popularity as a method that successfully improves soil productivity.

Green manuring is the plowing under or soil incorporation of any green manure crops while they are green or soon after they start flowering. Green manures are forage or leguminous crops that are grown for their leafy materials needed for soil nutrient conservation.

**“The value of Green Manuring lies in the fact that organic matter is incorporated into the soil”.** The organic matter in the soil is recognized as being one of its most valuable constituents for real soil fertility. The soil nitrogen is associated with the organic matter and the decay of this organic matter influences the availability of the soil nutrients. For these reasons, it has seemed advisable to discuss the amount of organic matter in soils, its source, and the influences, which operate for the increase of organic matter, as well as the part it plays in the soil. Such a discussion is a necessary preliminary to understand the need of green manuring.

Agronomists have argued that green manuring will increase either the humus content or the supply of available nitrogen in the soil, but rarely both at the same time. The humus content is only increased appreciably if the material is fairly resistant to decomposition is added to the soil (high Carbon:Nitrogen ratio), and this type of plant material is typically low in nitrogen (less than 1.5 per cent on a dry-weight basis). The available nitrogen supply is only increased if readily decomposable material high in nitrogen, such as immature green plants, is incorporated into the soil. The amount of organic matter that may accumulate will vary with the soil, climatic conditions, and the age and type of crop.

**How to practise?**

While introducing this practise among farmers, the main question that will be raised is “How and from where it is possible to bring the required huge quantity of biomass as green manure?” if we turn back the pages of history there are evidences to show how it was practised in the past. Now-a-days the farmers with intensive farming areas are not prepared to allot a two month for this purpose and they are very greedy to grow more. Actually this period will be a good investment for the next two seasons of crops. In olden days the biomass was generated as ‘off-farm’ and ‘on-farm’.

**Off-farm green manure:** As an off-farm, the foliages of the shrub and herb type of weeds that are grow along the roadside, riverside and lake bunds were harvested and brought-in. in this there will be more variety of species. The commonly used weeds are as follows:-

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

**On-farm green manure:-**

**A, Tree green manure:-** Biomass from the farm can be generate from the legume or non-legume trees that were grown along the boundaries of the farm and along the main bunds of the fields at 15 –20 feet intervals. While preparing the main fields for the next crop the foliage from these trees will be lopped and chopped in to small pieces and then incorporated by hoeing in the garden lands and by puddling in the wet lands. The trees that can be grown for this purpose are as follows:-

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

**B, Life fence and hedge rows:-** Some shrub species can be grown along the fence as life fence or as hedge rows along the path ways and waste patches. These life fences and the hedge rows can be trimmed off whenever needed and used. The suitable shrubs are as follows:-

1. *Vitex negundo*,
2. *Nerium thevetifolia*,
3. *Adathoda vasica*,
4. *Datura stramonium*,
5. *Artemesia nilagirica*

The non-legume supplies a large amount of energy (carbohydrate) material readily, but the bacteria responsible for the decay of this material must have access to N. If the N carried in the green manure crop isn't sufficient (that is, a C:N greater than 30:1, or less than 1.5 per cent), the bacteria will draw on the available soil N. during this time the newly grown crop will show a nitrogen deficiency symptom for sometime.

### **C, Legume Green Manuring**

Legume green manuring is a management tool worth considering. The role of nitrogen-fixing plants in cropping systems diminished in the 1940s, when relatively inexpensive and abundant nitrogen fertilizers became available. The addition of organic material improves soil tilth. At the same time, the nutrients used in the plant growth are conserved and returned to the soil to enhance its fertility.

Almost any crop can be used for green manuring, but legumes are preferred because of their ability to fix nitrogen from the air. Green manuring with legumes (peas, clovers, lentils, etc.) is called legume green manuring.

Growing a legume crop to be worked into the soil is an old agricultural practice that is increasing in popularity again. It is a viable alternative to conventional summer fallowing and can reduce the amount of nitrogen fertilizer required.

This crop has to be turned under the soil before the plants set seed. Growing legumes as green manures or as forage crops became an important practice for maintaining soil productivity. Stated legume green manuring could be profitably used on lands where it was not possible to add animal manures.

## Nitrogen fixation

The main benefit of using a legume as a green manure is that legumes fix nitrogen from the atmosphere and convert it into a form that is available to other plants. Legumes form a symbiotic association with soil bacteria called rhizobium. These bacteria colonize the root hairs of the legumes and multiply causing swellings, which become nodules. The bacteria benefit from the relationship by obtaining carbohydrates (plant sugars) from the legume. The growing legume benefits from the nitrogen that is captured from the air and converted into ammonium within the nodules.

The incorporated legume residues are a biological source of nitrogen that reduces the amount of nitrogen required for the following crop. The amount of nitrogen fixed by a legume depends on the legume variety, the effectiveness of the legume-bacteria association in root nodules, soil fertility and climatic conditions.

Perennial, biennial and annual legumes have all been successfully used as green manures. The choice of legume depends on soil type and climate, especially levels of precipitation. In dry areas the legumes like Moth bean (*Phaseolus aconitifolia*), horse gram (*Dolichos biflorus*) can grow better, whereas in the wet land areas legumes like sesbania rostratum, *Crotalaria juncea* (sun hemp), cowpea, Daincha, cluster beans, etc will be of great use. In regions with adequate precipitation, underseeding of a perennial legume to be green manured in the second or even third year is a common practice. In drier regions, annual legumes grown for six to seven weeks are incorporated before full bloom and do not excessively deplete soil moisture reserves for the subsequent crop.

## Green manure crops :-

Green manure crops	Seeding rate (kg/ha)	Green biomass (t/ha)	Dry biomass (t/ha)	Nitrogen content (%)	Nitrogen (kg/ha)	When to incorporate in the soil? (DAP)
Azolla	50-90	8-10	1.8-3		52	35
Cowpea	40	9-10	3-4	1.4-1.5	140-150	40-60
Lablab	7-18		5-7		220	45-60

Mustard	5-12			3.5		21-37
Pigeon pea	45-60	9-10	5-7			45-60
Sesbania	20-30		1.5-4	4.3	250-360	45-50
Soybean	30-56		5-7.4		310	45-60
Sun hemp	35-40	5-19	5.5-6	1.7	108	50-60
Sweet clover	30-40	12	6	2		40-50

### At orchards:-

At orchard conditions even the weeds that are grown in the interspaces can be used as green manure. The weeds has to be allowed to grow for a particular period of time till it reaches the stage of flowering and then it can be ploughed into the soil using disc harrow. Using of rotovalor has to be avoided. By this practise the useless weeds are effectively used as green manure and also saves the weeding cost. Here we are inducing the organic recycling of nutrients in the soil and conversion of the mineral state of the nutrients into an organic realm. With proper planning green manuring can be practised at any agricultural lands.

Here in orchards we can also introduce any legume green manure crop in the interspaces and it can be incorporated latter on. By this the weeds can be suppressed and the weeding cost can be reduced. If it is not possible to grow the legume green manure crop in the interspaces due to the dry climatic condition, then it can be grown in the basin of the trees and incorporated. Sow the seeds during the onset of the monsoon and plough it in the offset of the monsoon.

### Criteria for the selection of green manure crops

- a. Fast growing,
- b. Produces abundant and succulent shoots (foliages),
- c. Well adapted to the local condition,
- d. Have a high rate of nitrogen fixation
- e. Have high water-use efficiency when used in drier regions. The legume should use as little water as possible while still producing substantial quantities of top-growth,

### **Essential precautions**

- a. Broadcast or sow the seeds after the harvest of main crop, preferably in the water sign/ zodiac of the ascending period of the month,
- b. Slash the green manure crops shoots and incorporate them into the soil,
- c. Slashing and incorporation of green manure crop should be done while the soil has adequate moisture. If there is no moisture an irrigation is essential. Without moisture incorporation is difficult and if done, it will not be effective. Meanwhile moisture is a critical factor for the microbes to act over the incorporate material.
- d. Sow or transplant the next crops 1 – 2 weeks after the incorporation of the green manure, since in the initial stage of decomposition there will be a release heat of decomposition that is very Unfavourable for germination and the growth of young plants
- e. Use disc harrow to incorporate the green manure crop. Discs harrow have become the implement of choice for incorporating all the heaviest perennial stands. Disc harrow implements adequately mix the legume residues into the soil, promoting even decomposition and nutrient release near to the soil surface.

### **Advantages of green manuring**

- a. Improves the soil fertility by the increasing the humus content of the soil,
- b. Adds nutrients and organic matters,
- c. Improves the soil structure,
- d. Improves soil aeration,
- e. Increases the water holding capacity of the soil,
- f. Increases the nutrient holding capacity of the soil
- g. Helps control the soil born insects/ mite (neem, Vitex, etc), nematodes (marigold) and diseases (crucifers),
- h. Used as a soil binder in the sloppy areas,,
- i. Conserves and recycles plant nutrients,
- j. Protects the soil from erosion.
- k. Promotes habitat for natural enemies,
- l. Serves as a good food for the earthworms,
- f. Increases soil's biodiversity of beneficial microbes by stimulating their growth.

**References :-**

- a. Green Manuring: Principles and Practice/Adrian J. Pieters. Reprint. Jodhpur, Agrobios, 2004, v, 356 p., figs., tables, ISBN 81-7754-188-9.
- b. Boller, E.; Hani, F.; Poehling. Editors. (2004): *Ecological infrastructures.: Ideabook on functional biodiversity at the farm level*. IOBC, OILB, Mattenbach AG. Winterthur, Switzerland.
- c. Jayashankar, M.; Subramanian, K.; Arumugasamy, S.; Saraswathy, H.; Vijayalakshmi, K. (2002): *Soil conservation in organic farming*. CIKS. Chennai, India.
- d. Wagner, Georg. (2004): *Vegetables' pests*. Personal Communication. Schopperplatz 14, 4082 Aschach / Donau.
- e. The Basics of Green Manuring by Professor P. Warman, Soil and Land Resources, Department of Renewable Resources