

### Green Manure

The compost which is prepared from freshly collected green materials of shrubs, herbs, and trees is called as green manure. The plants are uprooted and ploughed back in the fields at the time of flowering. Green manuring helps to increase the nitrogen content of the soil. Green manuring is specially useful in flooded rice ecosystem. The flooded rice soil provide a congenial microhabitat for a variety of nitrogen fixing micro-organisms. In such system rice can grow year after year with minimum but constant yield, without additional chemical fertilizers. The rice crop use only 20-40% of added nitrogen. As like blue green algae, Azolla, micro-organisms, "legume green manure" is also an important source of biologically fixing of nitrogen.

The fresh green matter of legumes can be collected from plant species grown specially for this purpose and from naturally grown plants. The leaves of shrubs, herbs and trees of legumes are collected, transported and applied to rice fields prior to seedling transportation.

The genera *Astragalus*, *Aeschynomene*, *Crotalaria*, *Indigofera*, *Lathyrus*, *Pongamia*, *Tephrosia*, *Trifolium*, and *Sesbania* are mainly used as green manure crops in wetland rice farming (Allen & Allen, 1981).

*Arachis*, *Cajanus*, *Calopogonium*, *Atylosia*, *Canavalia*, *Cassia*, *Cullen*, *Cochlianthus*, *Derris*, *Dipogon*, *Lablab*, *Dolichos*, *Dumbaria*, *Mimosa*, *Mucuna*, *Eruthrina*, *Flemingia*, *Gliricidia*, *Kummerowia*, *Lespedeza*, *Leuceana*, *Lupinus*, *Mastersia*, *Melilotus*, *Pisum*, *Ormocarpum*, *Pachyrhizus*, *Parkia*, *Phaseolus*, *Pteroloma*, *Psophocarpus*, *Peneraria*, *Shuteria*, *Stylosanthes*, *Tetragonolobus*, *Trigonella*, *Uraria*, *Vigna*, *Vicia*, etc. are important genera for green manuring to plantation crops and *Aeschynomene*, *Neptunia* and *Sesbania* are important genera among the legumes which are known to bear nodules on stems. The genus *Aeschynomene* contains 150-250 species of herbs to small and medium sized trees. In India, *A. indica* and *A. aspera* species are more familiar.

The genus *Sesbania* contain 170 species. *S. rostrata* is cosmopolitan species and useful in rice agroecosystem. Indian green manuring is well known to the world. Specially, South Indian farmers practised the green manuring since long back. Sunhemp (*Crotalaria juncea*) Dhaincha (*Sesbania aculeata bispinosa*), Pillipesara (*Phaseolus trilobus*), Mung (*Vigna mungo*), Cow pea (*V. unguiculata*) Gaur (*Cyamopsis tetragonoloba*), Sengi (*Melilotus alba*) Berseem (*Trifolium alexandrinum*) and Khesari (*Lathyrus sativus*) are practised in rice field in India.

In Southern India, leaves of *Cassia auriculata*, *Calotropis gigantea*, *Jatropha gossypifolia*, *J. glandulifera*, *Tephrosia purpuria*, *T. candida*, *Cassia tora*, *Ipomea carnea*, *Melia azadirachta*, etc. are used as leaf green manure. In northern part of India *S. aculeata* is preferred in rice field. It is sown after wheat in April, the biomass turned into soil in standing water after 8 weeks of growth followed by transplantation of seedlings of rice. The application of green manure of sunhemp, cow pea and Dhaincha increases the yield of rice crop and also nitrogen content of the soil.

### Organic Matter and Composting

The primary sources of organic matter in soil are dead and decaying parts of plants and animals. The organic matter, further consists of soluble sugars, amino acids and organic acids and insolubles like celluloses and legnin. Fats, oils, waxes, resins, pigments, minerals, proteins, etc. are also other components of organic matter. The above mentioned matter is given out by micro-organisms in soil. As a rule, micro-organisms feed readily on soluble resources and slowly on insoluble matter.

Through assimilation, the carbon content of the protoplasm of micro-organisms is derived mainly from organic substrates. From organic matter entire carbon is not assimilated into the microbial protoplasm. However, the assimilation of carbon depends upon the nature of micro-flora and the oxygen status of the soil. Immobilization process is also a very prominent process in organic matter-composting, under which nutrients such as

N, P, K and S are taken up by the microbial cells at the time of carbon assimilation. Mineralization is the conservation of organic complexes of an element to its inorganic state. It is also related with organic matter and composting.

Fungi releases less CO<sub>2</sub> and incorporate more carbon in their tissues. But, in some aerobic bacteria it is reverse process. From organic matter, methane (CH<sub>4</sub>) and hydrogen (H<sub>2</sub>) are evolved under anaerobic condition in incomplete degrading organic matter. While, several intermediate organic acids, CH<sub>4</sub>, H<sub>2</sub> and CO<sub>2</sub> are generated in waterlogged situations. From organic acids mainly acetic acid, formic, butyric and lactic acids are released. In addition, lactic and succinic acids are also released but in lesser quantities. O<sub>2</sub> uptake, loss of weight, magnitude of CO<sub>2</sub> formation, etc. are important parameters for measuring organic matter decomposition.

When fresh plant residues reach soil, immobilization become slow. However, mineralization gradually increases depending upon temperature, water content, oxygen supply, hydrogen ion concentration, inorganic nutrients, the nature of micro-flora, nitrogen content of residues, and C/N ratio of the organic matter.

Leguminous plant residues encourage the growth of micro-organism by supplying ready available nitrogen and accelerate decomposition. In nitrogen-deficient cereals, straw residues, additional ammonia or nitrate accelerate decomposition and microbial activity.

The branches of older trees contain lignin and residues of younger plants contain soluble nutrients. Hence, younger plant residues are metabolized more easily than residues of older trees. In acidic soil, filamentous fungi degrades cellulose. Likely, in neutral and alkaline pH levels, many micro-organisms act on cellulose. *Chaetomium* and *Trichoderma* are good examples of fungi and *Cellulomonas* and *Clostridium* of bacteria.

Humus contains aminoacids, purines, pyrimidines, aminosugars, methylsugar, pentoses, hexoses, sugar alcohols,

aliphatic acids, uric acids, and aromatic substances. The age of humus can be identified by radio-carbon dating techniques. According to Williams (1971) certain fungi like *Aspergillus* and *Penicillium* and some actinomycetes produce dark humus which contain aminoacids, peptides and polyphenols.

According to the reports of ICAR addition of farm yard manure increases the number of root nodules of leguminous plants and also the number of *Azotobacter* cells in soil. In pea (*Pisum sativum*), Dhaincha (*Sesbania aculeata*) and berseem (*Trifolium alexandrinum*) the number of nodules, nodule weight and yield have been increased due to application of specific calcium and sodium humate. Likely, in soyabean, nodule number and dry weight yield increases due to use of pelleted seeds with calcium humate when grown in a saline and alkaline soil.

In India, Fowler (1930), Howard (1935), Acharya (1939, 1949), etc. contributed on composting. They described advantages and disadvantages of composting practices in India specially in rural areas. It is noted that rural method or native method of composting is crude and unscientific.

The scientific methods designed in India includes,

1. Indore method (aerobic) and
2. Bangalore method

#### 1. Indore Method

Digout a pit of 3 feet deep and 6-8 feet wide near a cattle shed. The place must be free from water-logging. A cattle bed is prepared with the plant residues cut into shrubs and used for cattle in shed. After use, the bed with wet excreta is removed and heaped in a layer of 3-5 metres in the pit. A sufficient quantity of cattle dung is spread over this layer. Later, water is sprinkled to maintain moisture. Above mentioned sequential layering is followed till the residues reach one feet above the ground level. The excess rains may be avoided by erecting shed over the pit.

The residues are turned every two weeks thus, within 16 weeks the compost will be ready for use.

## 2. Bangalore method

In Bangalore method, pits are similar to Indore method. The preparation of heaps is also similar to Indore method except that each heap in a pit is sealed with plaster of mud. This increases the temperature inside the pit by an anorobic fermentation and thus nitrogen-rich compost is formed. For the complete process of composting it take 32 weeks. This method was proposed by ICAR in 1964. The use of additional micro-organisms accelerates composting process. The cellulolytic micro-organisms used in the process are - *Trichoderma viride*, *Aspergillus niger*, *A. terreus*, *Chaetomium abuanse*, *Myrothecium roridum* and *Cellulomonas*, etc.

## CHAPTER 3

# PRODUCTION TECHNIQUES FOR BIOCONTROL AGENTS

### What is biocontrol ?

Biocontrol of pests is an introduction of *biocontrol agents* (living) against target pests for suppression of their population below the level of economic damage by keeping the environment harmonized.

### Why biological pest control ?

Since last 50 years, there is an enormous increase in the use of chemical pesticides for controlling pest species. The pesticides kill the pests, and thus, certainly increase the yield of crops but, many pesticides losing their efficiency due to the development of resistance in pests. Secondly, pesticides create many serious problems like

1. Air, water and soil pollution due to repeated application of chemicals.
2. Health hazards.
3. Physical and physiological changes in the soil.
4. Deleterious effects on beneficial insects like parasitoids, predators, honey bees, pollinator, etc.
5. Destruction of natural balance and ecological cycle.
6. Pest resurgence.
7. Secondary pest out-break.
8. Pest resistance.
9. Stimulation of reproductive rate in certain pests, etc.

Dear students these notes are for last unit of Biofertilizers. On 7th March I had discussed in details about green manure, vermicompost (notes already given in class on 7TH March). Here are a few additional information. All are required to read and revise the syllabus and consult me via mail. Please keep your assignments for biofertilizer ready. You have to submit the assignments plus field trip report immediately after the college reopens.