

# Plant and Animal Based Fertilizers and Pesticides



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## **Introduction**

Agriculture sector plays an important role in food security of the growing population globally as well as improving the economic growth of developing countries. But there is a major concern to cater the needs of estimated 9 billion world population during 2050. Presently, agricultural production is facing masses of challenges like water scarcity, climate change and volatility, raising the risk of production shortfalls. The future vision of the world is to adopt new strategies to increase agricultural production in a sustainable manner. Subsequently, agriculture has a bigger responsibility for food security, environmental sustainability and economic opportunity worldwide.

The Green Revolution (GR) technology adoption from 1960 to 2000 has increased wide varieties of agricultural crop yield per hectare. GR exploitation of chemical pesticides and fertilizers to improve the agricultural productivity has caused injurious impact on environment by affecting soil fertility, water hardness and development of insect resistance, increase the toxic residue through food chains and animal feeds.

The existing trends in food habits among people in developed and developing countries are focused towards organic agricultural products. Therefore, it has become crucial to yoke the best of scientific knowledge and a technological innovation which are essential to meet today's complex challenges. Bio fertilizers and bio pesticides are important areas to fulfill the challenges in a sustainable way.

## **Novel Trends of Fertilizers and Pesticides Applications**

At present some of the countries around the globe are restricting import of fruit, vegetable that contain chemicals and also, they are restricting import of animals that contain chemicals. Due to these restrictions and the people are getting wiser

about the deadly harm to the health by consuming food that contain chemicals are fast moving to consuming food that contains less chemicals or no chemicals. To avoid harmful chemicals in the agricultural produce is to use microbial or bio-fertilizers, bio-pesticides and bio-fungicides. So, it is required to use plant based or biologically produced fertilizers and pesticides to enhance the crop productivity and its quality while minimizing the damage to the environment.

### **Fertilizer - Definitions**

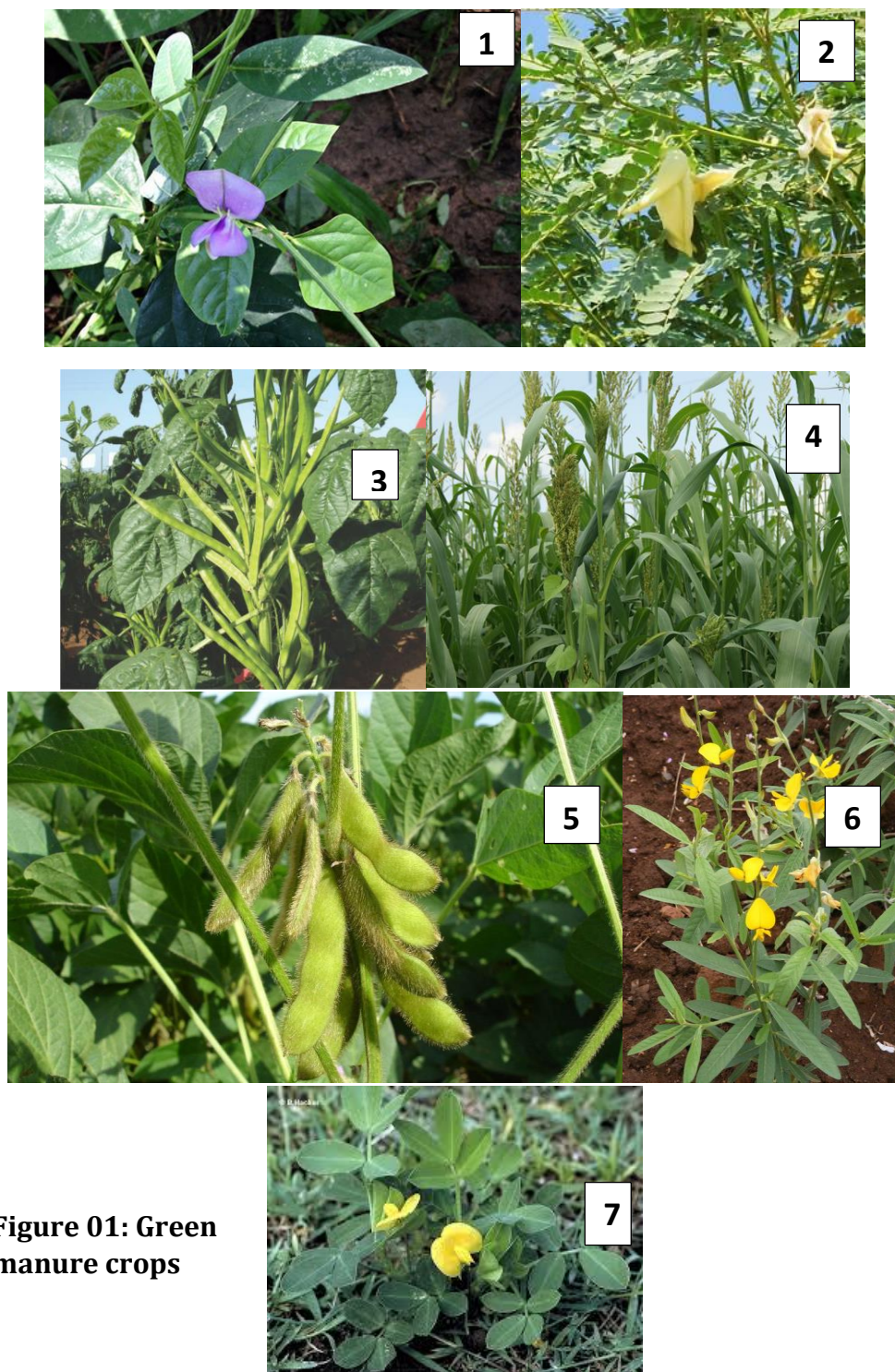
A fertilizer is a natural or synthetic, chemical-based substance that is used to enhance plant growth and fertility. It also called as any material of natural or synthetic origin (other than liming materials) that is applied to soils or to plant tissues to supply one or more plant nutrients essential to the growth of plants. Many sources of fertilizers both natural and industrially produced are existing. Fertilizers may also enhance water retention and filter any excess liquid, hence enhancing soil effectiveness. Fertilizers typically offer the three major macro-nutrients; potassium, phosphorus, and nitrogen. Fertilizers may also add secondary nutrients such as sulfur, magnesium, and calcium to the soil or growing media.

Fertilizers have played an important role in increased crop production because science-based agriculture is required to feed the expanding world population. Fertilizer replenish the nutrient removed from soils by harvested crops, encourage adoption of high-yielding varieties, and increase biomass in the nutrient-poor soils of the tropics.

## 1. Plant Based Fertilizer Preparations

Plant based fertilizer preparations mean, fertilizers made with the use of plant materials. Those fertilizer are used to ensure the quality and high yield of organic crop production and to secure the sustainability of the system while safeguarding the food security. Plant based fertilizers are used as an alternative to synthetic fertilizers to provide the nutrient requirement to the plants.

### 1.1. Green Manure



**Figure 01: Green manure crops**

### **Examples of green manure crops (Figure 01):**

Green manuring is the growing certain crops that usually belonging to leguminous family and incorporating them into the soil after sufficient growth. The plants that are grown for green manures are known as green manure crops. After becoming to the right maturity, most probably before flowering, these green manure crops are uprooted or sown into the field. They serve as mulch and soil amendments.

Cover crops in many crop fields are also grown primarily for this purpose. Leguminous green manures contain nitrogen-fixing symbiotic bacteria in root nodules that fix atmospheric nitrogen in a form that plants can use. This performs a vital function on adding fertilizers to the crops.

1. Cowpea - *Vigna unguiculata*
2. Sesbania - *Sesbania grandiflora*
3. Cluster bean - *Cyamopsis tetragonoloba*
4. Sorghum
5. Soy bean - *Glycine max*
6. Sun hemp - *Crotalaria juncea*
7. Groundnut - *Arachis hypogaea*

#### **1.1.1. How to Grow Green Manure Crops?**

Just after harvesting the major crop, broadcasting the seeds of the green manure crop (ex: Sun hemp) is done. Once plants are still young, before they produce any seed and often before they flower, those manure crops are dug into the soil. Green manure crops also can be grown together with crops or alone. Once they are grown with crops, the plant parts are added to the soil as mulches or green manure time to time.

### 1.1.2. Importance of Green Manures

- ✓ Increase and recycle plant nutrients and organic matter
- ✓ Improve soil fertility
- ✓ Improve soil structure
- ✓ Improve the ability of the soil to hold water
- ✓ Control soil erosion
- ✓ Prevent weed growth
- ✓ Stop nutrients being washed out of the soil, when the ground is not used between main crops

### 1.2 Leafmould

Leafmould is a substance consisting of decayed leaves which is used as a source of fertilizer to improve the soil fertility. It can be used as a moist growing medium for young plants. It protects the ground from drying out during periods of low rainfall.



**Figure 02: Leafmould**



### **1.2.1 How to Prepare Leafmould**

- Make a square or round frame from chicken wire mesh or similar, supported at the corners or at intervals around the circle with stakes or bamboo canes.
- Preferably this should be in a sheltered part of the garden to ensure that the leaves are not blown away.
- Make your leaf heap as large as possible to accelerate the decaying process,
- Moisten it periodically to avoid drying.
- Most of the time leaves take about around two years of period to break down.
- After the process is completed it can be applied to the field as a source of nutrient supplier moisture retainer.

### **1.2.2 Importance of Leafmould**

1. Good quality, well-decayed leafmould (more than two years old) can be used as seed-sowing compost.
2. Mixed equally with sharp sand, garden compost and good quality soil for use as potting compost.
3. Poor quality leafmould, which is less than two years old can be used as mulch, soil improver, or as a covering for bare soil.

### **1.3 Green Leaf Manure (GLM)**

Green Leaf Manures (GLMs) are organic manures made from leaves collected from all available sources and used to supply essential plant nutrients to the soil to increase soil fertility in a healthy manner. Green Leaf Manuring is application of green leaves and twigs of trees, shrubs and herbs collected from elsewhere or manuring the field by adding the lopping from legume trees and ploughing them

into the field. Forest tree leaves are the primary source for green leaf manure. Plants growing in wastelands, field bunds etc., are another source of green leaf manure. GLMs can easily replace chemical fertilizers along with providing health and protection to the plant and the soil.

- Ex: 1. Karanda – *Pongamia globra*  
2. Gliricidia- *Gliricidia sepium*  
3. Neem - *Azadiracta indica*  
4. Ehela- *Cassa pistula*  
5. Ipil ipil- *Leucaena leucocephala* (Figure 03)



**Figure 03: Green leaf manure species**

### **1.3.1 Preparation of Green Leaf Manure**

- This is very easy and cheap method. Different green manuring trees and plants can be grown as live fences around the field or on barren lands near the field. When they are well grown, their leaves are simply cut and brought to the crop fields in bundles. Leaves of some green manuring crop are needed to wither for two days before incorporating them into the soil to enhance the process of decaying.

### **1.3.2 Application of Green Leaf Manure**

Application of green leaf manures to a soil is dependent on the moisture content of the soil. Enough moisture content is necessary to apply this manure. It is required to check the moisture content of the field to accelerate the process.

### **1.3.3 Advantages of Using GLMs**

- ✓ Add a huge quantity of N to the soil.
- ✓ Ensure balanced nutrition for plants and improve soil fertility to a great extent.
- ✓ GLM trees are perennial and supply leaves 2-3 times in a year for manuring; so, they need not to replant.
- ✓ They are releasing fertilizers and act as plant nutrient source for a long time after their application.
- ✓ Soil structure is improved to a great extent due to the application of GLM.
- ✓ Encourage the development of earthworms by acting as food material to them.
- ✓ Produce very high quality and safe food materials.
- ✓ No threat to water and air quality.

- ✓ Stimulate the growth of various beneficial microorganisms in soil and thus improve the soil biodiversity.
- ✓ Very useful in reclaiming salinity affected soils
- ✓ The woody branches of GLM trees are used as fuel.
- ✓ They are cheap and easily affordable.
- ✓ Readily available and very easy to use.

## 2. Animal Based Preparations

Animals, fish, and birds all provide organic fertilizers that can help plants to grow healthy. Most of the animal-based fertilizers contain nitrogen, phosphorous, and potassium. Animal -based fertilizers are added to the field crops as a nutrient supplement when soil is deficient or when growing vegetables, fruits or other nutrient demanding crops. Using fresh manure as a fertilizer to the fields can burn plants, so it is advised to add partially decayed manure (Figure 04) when direct applying to the crops.



**Figure 04: Partially decayed manure**

Examples:

- Manure
- Blood meal
- Bone meal
- Fish products
- *Panchagavya*
- Shellfish fertilizer

## 2.1 Manure

Manure is organic matter, mostly derived from animal feces. They can be used as organic fertilizer as well. Manures contribute to the fertility of the soil by adding organic matter to the field. Common forms of animal manure include farmyard manure (FYM) or farm slurry (liquid manure). Manure for the crops comes majorly from cow, goat and poultry (Figure 05).



**Figure 05: Fresh cow dung**

## 2.2 Blood Meal

It is dried, powdered blood specially collected from cattle slaughterhouses (Figure 6). It is considered as a rich source of nitrogen. Farmers have to be careful not to over-apply.

Since then burning of roots of their plants could happen due to blood meal. Applying of [blood meal](#) just before planting to stimulate green leafy growth is recommended.



**Figure 06: Blood meal**

### **2.3 Bone Meal**

A popular source of phosphorous (11 percent) and calcium (22 percent). Bone meal is derived from animal or fish bones (Figure 07). It is commonly used in powdered form on root crops and bulbs. It also contains 2 percent nitrogen and many micronutrients. Over application may cause to attract rodents.



**Figure 07: Bone meal**

## 2.4 Fish Products

Fish by-products make excellent fertilizers, and they are available in several forms:

### 2.4.1 Fish Emulsion

It is derived from the fermented remains of fish. This liquid product can have a fishy smell (even the deodorized version). It is considered as a great complete fertilizer and adds trace elements to the soil. When mixed with water, it is effective for stimulating the growth of young seedlings.



### 2.4.2 Hydrolyzed Fish Powder

It has higher nitrogen content (12 percent) than fish emulsion; it's mixed with water and sprayed on plants.



### 2.4.3 Fish Meal

Fish meal is a fertilizer which is high in nitrogen and phosphorus, is applied to the soil.



### 2.4.4. Shellfish Fertilizer

It is made from crushed bones or shells from crab or other shellfish (Figure 08). A great source of calcium in addition to phosphorus and many trace minerals. It contains chitin which encourages the growth of organisms that inhibit harmful pest nematodes.





Figure 08: Shellfish fertilizer

## 2.5 Panchagavya

It is made from the blend of five cow-derived products. It is the only organic products which can be made at home. The five ingredients are cow urine, fresh cow dung, cow milk, cow curd and cow ghee.

### 2.5.1 How to Prepare?

Cow milk- 2 liters

Cow curd- 2 liters

Cow urine- 3 liters

Cow ghee- ½ kg

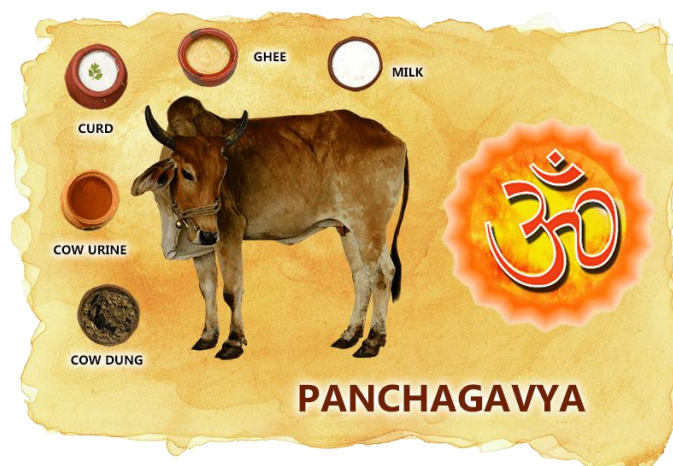
Fresh cow dung- 5kg

Sugarcane juice – 3kg

Tender coconut water- 3 liters

Ripen Banana - 12 numbers

Toddy and grape juice- 2 liters



Fresh cow dung and ghee in the container are mixed. Those should, be mixed twice a day for 3 days. On the fourth day, remaining ingredients are added to the

container. Then the mixture is stirred twice a day for the next 15 days. On the 19<sup>th</sup> day the *panchagavya* mixture will be ready for use.

### **2.5.2 Uses and Benefits of *Panchagavya***

- ✓ It increases the yield (in most cases, yield increased by 20 to 30%) and quality of produce.
- ✓ It acts as an organic growth-promoter and immunity booster of plants.
- ✓ This also cures already infested plants and other living organisms.
- ✓ It enhances the shelf life of vegetables, fruits and other agriculture produce.
- ✓ It produces larger leaves and denser canopy.
- ✓ It increases aroma and sugar content in fruits.
- ✓ Makes crops to mature early
- ✓ It reduces the water requirement by 20 to 30% thus sustain drought conditions
- ✓ This can reduce cultivation costs when made by you own when compared to chemical fertilizers.

## **2.6 Vermi-Fertilizers**

### **2.6.1 Vermicompost**

Vermicomposting is a type of composting in which certain species of earthworms (Figure 09) are used to enhance the process of organic waste conversion and produce a better end-product which can be used as a source of fertilizer to enhance the crop production and soil quality. Vermicomposting uses earthworms to turn organic wastes into very high-quality compost. Earthworms feeds the organic waste materials and passes it through their digestive system and gives out in a granular form (cocoon) which is known as vermicompost. This is probably the best way of composting kitchen wastes. It recycles organic nutrients from dead tissues back to living organisms. Vermicomposting is done on small and large scales.



**Figure 09: Earth worms for vermicompost procreations**

### **2.6.2 Materials for Preparation of Vermicompost**

Any types of biodegradable waste can be used.

1. Crop residues
2. Weed biomass
3. Vegetable waste
4. Leaf litter
5. Hotel refuse
6. Waste from agro-industries
7. Biodegradable portion of urban and rural wastes

### **2.6.3 Procedure of Preparation of Vermicompost**

- **Collection** of wastes, shredding, mechanical separation of the metal, glass and ceramics and storage of organic wastes.
- **Pre-digestion** of organic waste for twenty days by heaping the material along with cattle dung slurry. This process partially digests the material and fit for earthworm consumption. Cattle dung and biogas slurry may be used after drying. Wet dung should not be used for vermicompost production.

- **Preparation of earthworm bed.** A concrete base is required to put the waste for vermicompost preparation. Loose soil will allow the worms to go into soil and also while watering, all the dissolvable nutrients go into the soil along with water.
- **Collection of earthworms** after vermicompost collection. Sieving the composted material to separate fully composted material.
- The partially composted material will be again put into vermicompost bed.
- Storing the vermicompost in proper place to maintain moisture and allow the beneficial microorganisms to grow.

#### **2.6.4 Advantages of Vermicomposting**

- ✓ Vermicompost is rich in all essential plant nutrients.
- ✓ Provides excellent effect on overall plant growth
- ✓ Encourages the growth of new shoots / leaves and improves the quality and shelf life of the produce.
- ✓ Vermicompost is free flowing, easy to apply, handle and store and does not have bad odour.
- ✓ It improves soil structure, texture, aeration, and water holding capacity and prevents soil erosion.
- ✓ Vermicompost is rich in beneficial micro flora such as a fixers, P-solubilizers, cellulose decomposing micro-flora etc in addition to improve soil environment.
- ✓ Vermicompost contains earthworm cocoons and increases the population and activity of earthworm in the soil.
- ✓ It neutralizes the soil protection.
- ✓ It prevents nutrient losses and increases the use efficiency of chemical fertilizers.
- ✓ Vermicompost is free from pathogens, toxic elements, weed seeds etc.
- ✓ Vermicompost minimizes the incidence of pest and diseases.
- ✓ It enhances the decomposition of organic matter in soil.

- ✓ It contains valuable vitamins, enzymes and hormones like auxins, gibberellins etc.

## 2.7 Vermiwash

Vermiwash is a liquid fertilizer can used as a foliar spray collected by passing water in an irregular way through a column of active live local earthworms being cultured in a container, being fed with cattle dung and straw. It is a collection of excretory products and mucus secretion of earthworms along with micronutrients from the soil organic molecules. It contains growth hormones (auxins and cytokinin), N, P, K and other micronutrients which are essential to the plant growth. Vermiwash is an ecofriendly natural fertilizer prepared from biodegradable organic wastes and is free from chemical inputs (Figure 10).

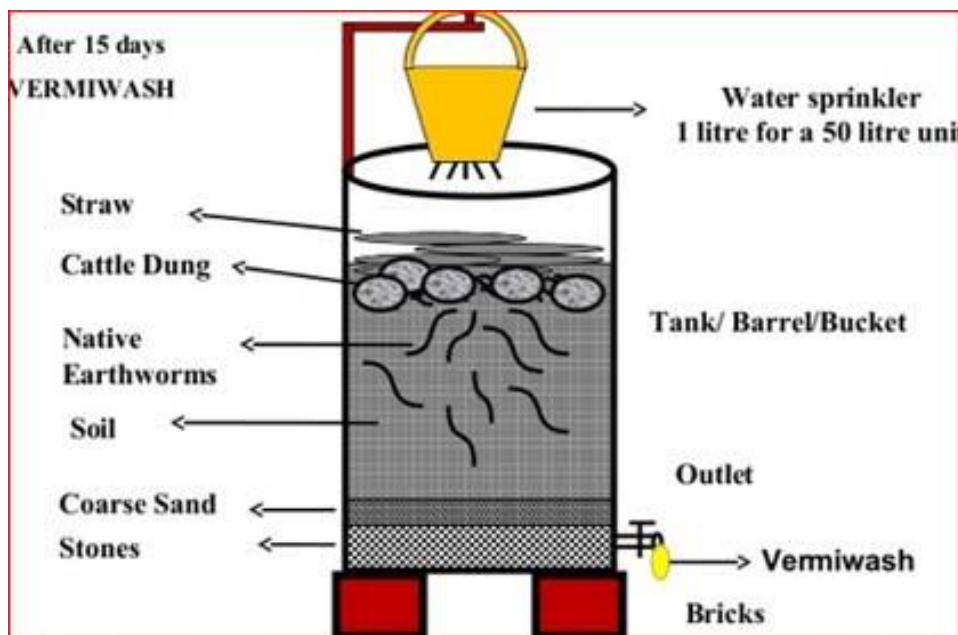


Figure 10: Vermiwash preparation structure

### **2.7.1 Benefits of using Vermiwash**

- ✓ Vermiwash helps to develop resistance against various disease and pests in plants
- ✓ It helps in initiating flowering and produce good yield in some vegetable plants
- ✓ Act as a bio pesticide when diluted with 10% cow urine or neem extract or garlic extract
- ✓ Does not have any adverse effect on soil, plant and environment
- ✓ Improves soil aeration, texture and tilt thereby reducing soil compaction
- ✓ Improve water retention capacity of the soil due to high organic matter content
- ✓ Improve the nutrient status of the soil
- ✓ Promotes better root growth and nutrient absorption

### **2.8 Bio Fertilizers**

Bio fertilizer contains living cells or strains of microorganisms which, when applied to soil, colonizes the rhizosphere or the inside of the plant and promotes growth by increasing the availability of primary nutrients to the host plant. Most of the bio fertilizers are eco-friendly and cause no danger to the environment. These can also be called as "Live Fertilizer" and most commonly used in Organic Farming/Agriculture. Bio fertilizers help to increasing the nutrient availability to plants as a result of their biological activities of the microorganisms. They help to enrich the soil nutrient content. Bio-fertilizers can fix atmospheric nitrogen either freely or in the form of various symbiotic associations with plants.

### 2.8.1 Different Types of Biofertilizers

- *Rhizobium*
- *Azotobacter*
- *Azospirillum*
- Cyanobacteria
- *Azolla*
- Phosphate solubilizing microorganisms (PSM)
- Arbuscular Mycorrhiza (AM) Fungi
- Silicate solubilizing bacteria (SSB)
- Plant growth promoting Rhizobacteria
- Liquid biofertilizer



### 2.8.2 Microbial Biofertilizers

Microbial biofertilizers are biologically active one or more types of beneficial microorganisms such as bacteria, Fungi or algae which are either in living or temporarily inert form.

A numeral type of microbial biofertilizers are being used in agriculture all over the world in order to have an enhanced crop production. The microbial biofertilizers come up with different groups. Mainly there are three types of microbial biofertilizers.

- 1) Plant Growth Promoting Rhizobacteria (PGPR)
- 2) Arbuscular Mycorrhizal Fungi (AMF)
- 3) Rhizobial Biofertilizers

**Plant Growth Promoting Rhizobacterial Biofertilizers:** A group of root colonizing rhizobacteria that exercise a beneficial effect on host plant is referred

as PGPR. There can be find numeral benefits of PGPP as N<sub>2</sub>-fixation, increasing the availability of phosphorous and other nutrients etc.

**Arbuscular Mycorrhizal Fungal Biofertilizers:** Fungal biofertilizers are being used in agriculture to achieve higher crop production in an environmentally friendly manner. The fungal biofertilizers can be identified as, (1) plant growth stimulating fungi like Trichoderma, mycorrhizal fungi, (2) P solubilising fungi, and (3) K solubilising fungi.

**Rhizobial Biofertilizers:** This is the most commonly used microbial biofertilizer since N is one of the mostly limited nutrients for plants growth, bacteria that are capable of fixing atmospheric N<sub>2</sub> have a great potential as microbial inoculants. Inoculation of N<sub>2</sub> fixing rhizobia has long been practiced.

### **2.8.3 Application of Biofertilizers**

There are several ways to add biofertilizers in agriculture to field, seeds and seedlings:

1. Seed treatment or seed inoculation
2. Seedling root dip
3. Main field application

#### **❖ Seed treatment**

In this treatment Nitrogen and Phosphorous fertilizers are mixed together in the water. The seeds are dipped in this mixture. After application of the mixture, seeds are dried. After the drying out, they have to be sown as soon as possible before they get damaged by harmful microorganisms.



### ❖ **Seedling root dip**

This way is majorly applied for rice crop. A bed of water has spread on the land where the crop has to grow. Then seedlings are ready for planting are dipped in water dissolved with biofertilizers (Eg: *Pseudomonas fluorescens*) and kept for 8-10 hrs



### ❖ **Main field application**

All biofertilizers along with the compost fertilizer are mixed together. They are kept for one night. Next day this mixture spread on the soil where seeds have to be sown

## **2.8.4 Advantages of Using Biofertilizers**

- ✓ It is a cost-effective & eco-friendly solution
- ✓ Careful selection of microorganisms in BFBF enables plants to continuously source Nitrogen from the soil
- ✓ Increases yield
- ✓ Enhances plant growth rate
- ✓ Increases organic matter in the soil
- ✓ Boosts new life into the soil
- ✓ Increase in capability to retain water makes plants more drought resistance

## **2.9 Traditional Fertilizers**

In Sri Lanka farmers had used various kinds of traditional fertilizers which add nutrients to the soil to promote the plant growth and enhance the soil fertility for a longer period of time. Nowadays there can be found a trend of going toward

those traditional practices to retard the usage of synthetic fertilizers which are hazardous to human beings in different ways.

### **2.9.1 Natural Liquid Fertilizer**

It was prepared using fresh cow dung and *Gliricidia* leaves. Those two components are put in to a barrel and mix well together and kept it for 15 days while mixing it well daily to aerate the mixture to accelerate the process. It is good to apply this fertilizer to the nutrient deficient plants twice a week.

### **2.9.2 Paddy Husk Fertilizer**

Farmers used to prepare paddy husk fertilizer using a *Kunthanaya* (an equipment made with a barrel to burn paddy husk). First the *Kunthanaya* was heated using fire woods and then dried paddy husk is applied to cover the *Kunthanaya* as a heap and let it to burn completely. Then remove the *Kunthanaya* and apply water to stopover burning. This is kept for days to cool. This can be used as a fertilizer to the field. It provides K and Si nutrients to the plant and retard the damage from snails. It improves the plants' ability to withstand as well.

### **3. Pesticides**

To fulfill the demand for increased agriculture productivity with the increase of population, the traditional sustainable agriculture gradually turned into commercial agriculture with the use of agrochemicals. At present farmers use huge amount of pesticides for their cultivations. Due to the increasing use of synthetic fertilizers, it raised lots of problems such as environmental pollution, health hazards to human and development of resistance to chemical fungicides by many soil borne pathogens. In this context, bio-pesticides are coming up as an ecologically conscious, sustainable alternative strategy for pest and disease management in agriculture. Locally produced botanical extracts are used to control pest and diseases in the organic farms in small scale throughout the country where synthetic pesticide usage is low.

#### **3.1. Introduction to Pesticides**

##### **Definitions**

- Chemical or biological substances designed to kill or retard the growth of pests that damage or interfere with the growth of crops, shrubs, trees timber and other vegetation desired by humans.
- Practically all chemical pesticides, however, are poisonous and pose long-term danger to the environment and humans through their persistence in nature and body issues.
- Most of the pesticide are non- specific, and may kill life forms that are harmless or useful.
- The term includes substances intended for use as a plant growth regulator, defoliant, desiccant, or agent for thinning fruit or preventing the premature fall of fruit. Also used as substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport.

- The term pesticide includes all of the following: herbicide, insecticides, nematocide, molluscicide, piscicide, avicide, rodenticide, bactericide, insect repellent, animal repellent, antimicrobial, fungicide, disinfectant (antimicrobial), and sanitizer.

Pesticides can be classified according to their chemical structure as organic, inorganic, synthetic, or biological (biopesticide).

### **3.2. Plant Based Pesticides Preparations**

#### **3.2.1 Neem Solution**

This is derived from the neem tree of arid tropical regions. It contains several insecticidal compounds. Main active ingredient is azadiractin. It helps to kill many species of caterpillars, thrips and whitefly. Both seeds and leaves can be used to prepare the solution. To prepare this solution, first crush both leaves and seeds well and then dilute it using water and apply directly to the crop. Neem solution loses its effectiveness within 8 hours after the preparation and when exposed to direct sunlight. It is recommended to apply neem oil in the evening. High neem concentrations can cause burning of plant leaves.



**Neem juice**

### **3.2.2 Neem Oil Spray**

First add half an ounce of high-quality organic neem oil and half a teaspoon liquid soap to two quarts of warm water. Stir slowly. Add to a spray bottle and use immediately to the crop.

### **3.2.3 Neem Seed Kernel Extract**

This is mostly used by cabbage farmers to repel diamondback moth. It is made with 30g neem kernels (seeds which the seed coat has removed) and mix in 1 liter of water. It is left overnight. Next day solution is filtered through a fine cloth and used immediately for spraying.

### **3.2.4 Pyrethrum**

It immediately paralysis most insects. Dosage does not kill but have knock down effect. Stronger does kill. Not poisonous for humans. This is extracted from dried pyrethrum flower. The flower heads are processed in to powder to make a dust and make a spray by diluting it in water.

### **3.2.5 Soap, Orange Citrus Oil, & Water**

To make this natural pesticide, simply mix three tablespoons of liquid Organic Castile soap with 1 ounce of Orange oil to one gallon of water. Shake well. This is an especially effective treatment against slugs and can be sprayed directly on ants and roaches.

### 3.2.6 Onion & Garlic Spray

Mince one clove of garlic and one medium-sized onion. Add to a quart of water. Wait one hour and then add one teaspoon of cayenne pepper and one tablespoon of liquid soap to the mix. This organic spray will hold its potency for one week if stored in the refrigerator.

Just as tobacco is hazardous to humans, tobacco spray was once a commonly used pesticide for killing pests, caterpillars, and aphids. Mix one cup of organic tobacco (preferably a brand that is organic and all-natural) into one gallon of water. Allow the mixture to set overnight. After 24-hours, the mix should have a light brown color. If it is very dark, add more water. This mix can be used on most plants, except those in the solanaceous family (tomatoes, peppers, eggplants, etc).

### 3.2.7 Cultivate Repellent Crops

Repellent crops (Merry gold, pyrethrum) are grown as a live fence around the cultivated land to repel the insects and pests from the field.



Merry gold



Pyrethrum

### 3.2.8 Other Preparations

Besides extraction of plants, there are some other natural pesticides which are allowed in organic farming.

Soft soap solution: against aphids and other sucking insects

Light mineral oil: against various insects pests (Harm natural enemies)

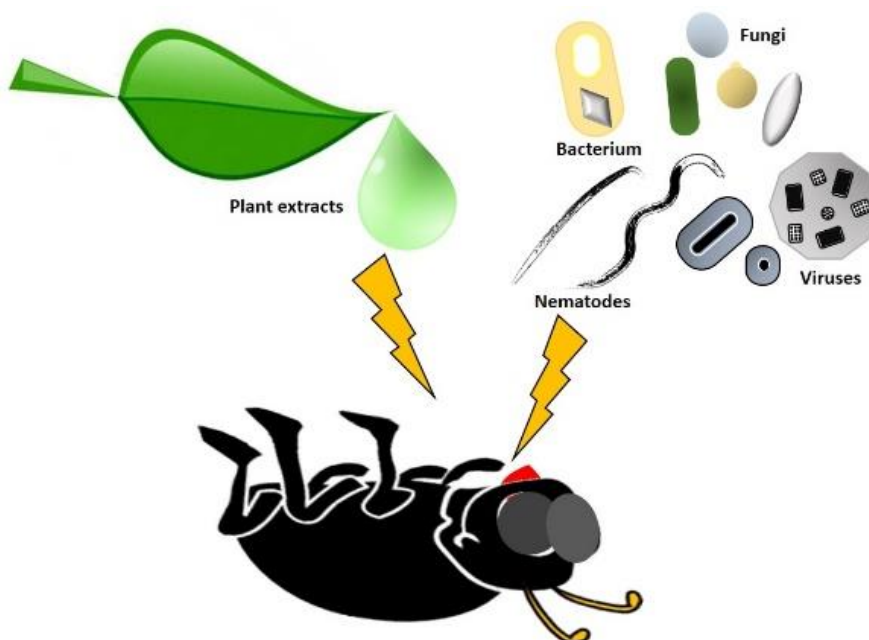
Sulphur: against spider mites

Plant ashes: against ants, leaf miners, stem borers

### 3.3 Biopesticides

Biopesticides are types of chemicals extracted from natural materials such as plants, animals, bacteria or certain minerals and these chemicals can be used for controlling pests. Biopesticides are usually inherently less toxic; generally affect only the target pest, effective in very small quantities, easily biodegradable, thereby resulting in lower exposures and largely avoiding the pollution problems. When used as a component of Integrated Pest Management programs, it can greatly control major pest menace while crop yields remain high.

#### 3.3.1. Types of Biopesticides



Biopesticides can be considered as dividing into three major classes

**1. Microbial pesticides consist of microorganism** (e.g. bacterium, fungus, virus or protozoan) as the active ingredient. It can control many different kinds of pests and each separate active ingredient is relatively specific for its target pest(s).

2. **Biochemical pesticides** are naturally occurring substances that control pests by non-toxic mechanisms. It includes substances, such as insect sex pheromones, which interfere with mating, as well as various scented plant extracts that attract insect pests to traps.

3. **Plant-Incorporated-Protectants (PIPs)** are pesticidal substances that plants produce from genetic material that has been added to the plant. For example, scientists can take the gene for the certain protein, and introduce the gene into the plant's own genetic material. Then the plant, instead of the, manufactures the substance that destroys the pest.

### **3.3.1.1 Advantages of Biopesticides**

- ✓ Difficult for insects to develop resistance to these pesticides
- ✓ Safe to natural enemies and higher organisms
- ✓ Biodegradable: Rapid degradation of the active ingredient make it more acceptable
- ✓ Cheaper, renewable, can be handled safely
- ✓ Often have other uses like household insect repellents or are plant with medicinal properties.
- ✓ Most are compatible with insecticides and microbial agents
- ✓ There is a great demand for residue free fruits, vegetables, and beverages, large scale utilization of botanical pesticides will certainly help us in meeting international standards of quality and safety in these products



- ✓ Inherently less harmful than conventional pesticides
- ✓ Generally, affect only the target pest and closely related organisms
- ✓ They often are very effective in very small quantities

### **3.3.1.2. Disadvantages of Biopesticides**

- ✓ Often slow speed of action (thus making them unsuitable if a pest outbreak is an immediate threat to a crop)
- ✓ High specificity: which may require an exact identification of the pest/pathogen and the use of multiple products to be used
- ✓ Often variable efficacy due to the influences of various biotic and abiotic factors (since some biopesticides are living organisms, which bring about pest/pathogen control by multiplying within or nearby the target pest/pathogen)
- ✓ Living organisms evolve and increase their resistance to biological, chemical, physical or any other form of control
- ✓ Unintended consequences: Studies have found broad spectrum biopesticides have lethal and nonlethal risks for non-target native pollinators

## **3.4 Traditional Methods of Controlling Pests**

To control the pest and insects in the field farmers have used to practice several methods which are inheritant from their older generations.

### **3.4.1 Lightning Neem Oil Traps**

A neem oil lamp is lightened through the plants will destroy the eggs of insects and pests.

### **3.4.2 Spread Crushed Merry gold Flowers and Leaves**

Leaves and flowers of merry gold plants are crushed and spread throughout the field without talking to anyone to protect the field from pests and insects.

### **3.4.3 Ashes**

Apply ashes (Figure 11) to the field early in the morning without talking to anyone to repel worms and nematodes like pests from the field



Figure 11: Wood burned ash

### **3.4.4 Burn Sulphur in the Field to Fumigation**

Burning of Sulphur under the trellising of the luffa, snake gourd and bitter gourd is done to repel insects.

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